Nov. 23, 1943. J. C. ROSE ET AL 2,335,028

PINCH TYPE BENDING ROLL

Filed May 5, 1942 2 Sheets-Sheet 1

Fig. 1.

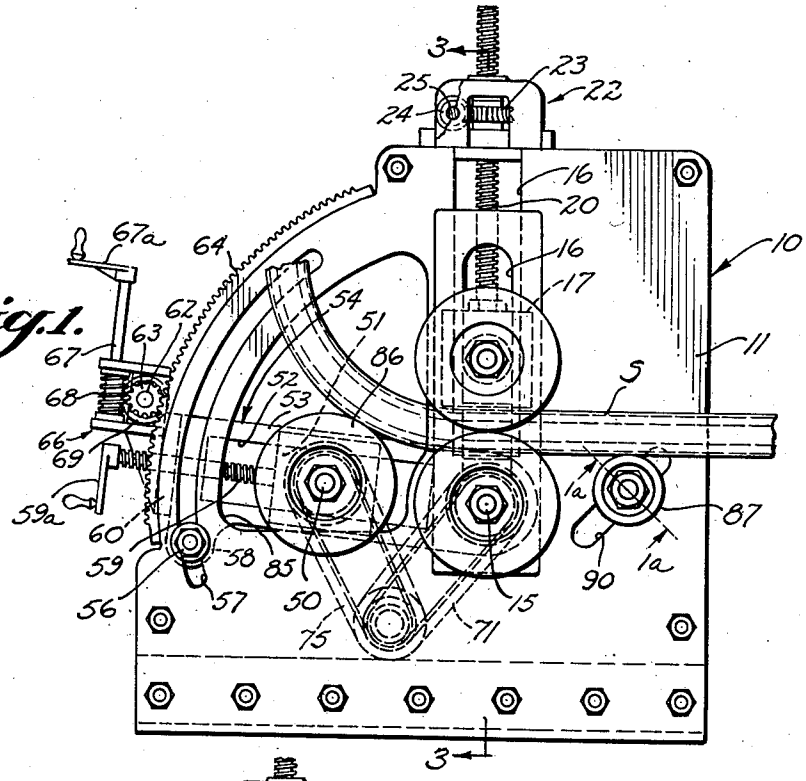
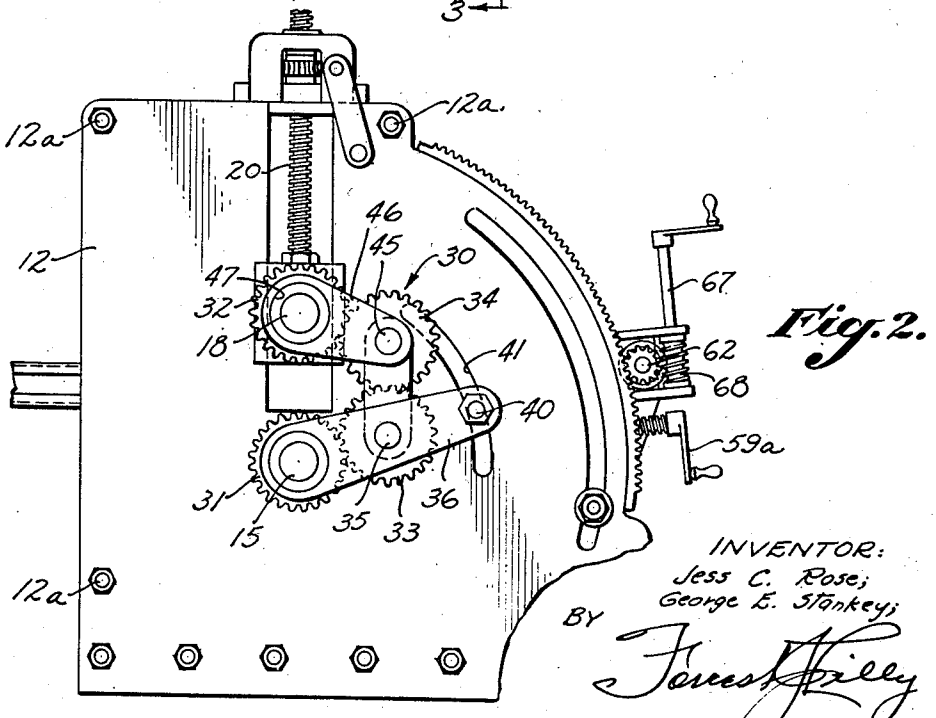


Fig. 2.



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Fig. 3a.

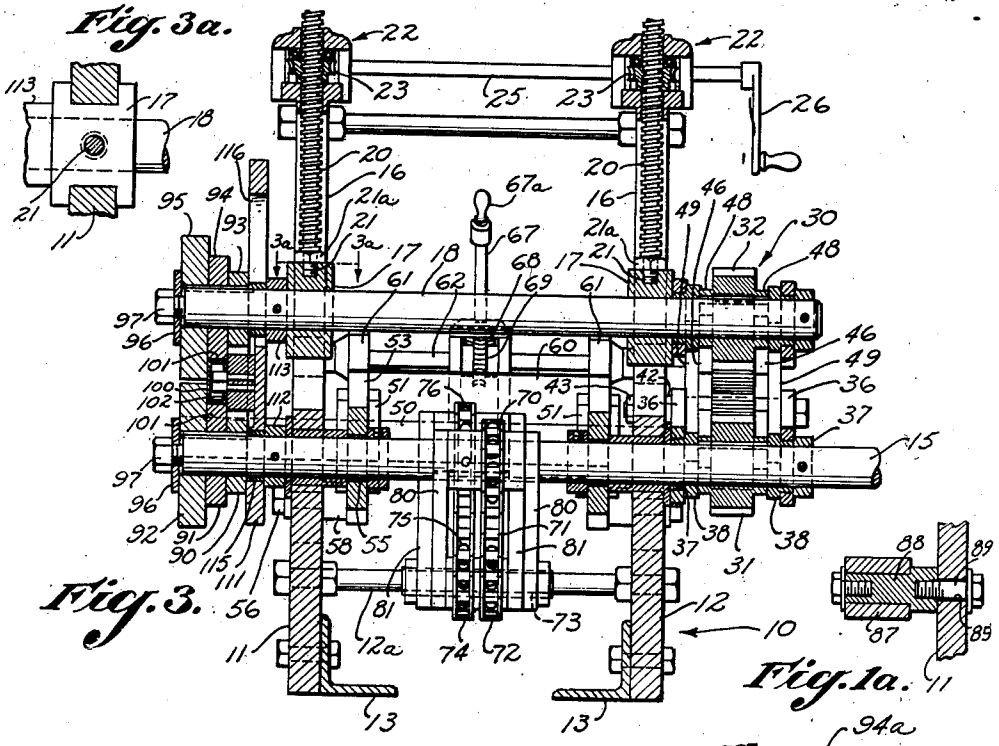


Fig. 3.

Fig. 1a.

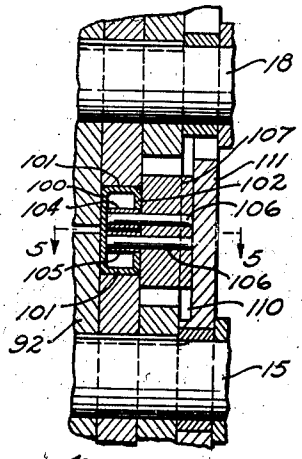


Fig. 4.

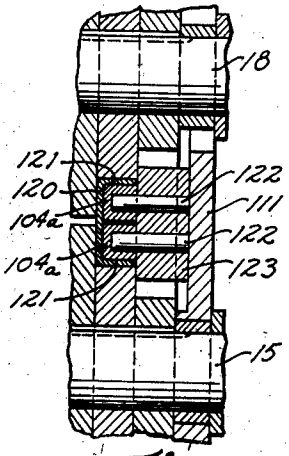


Fig. 6.

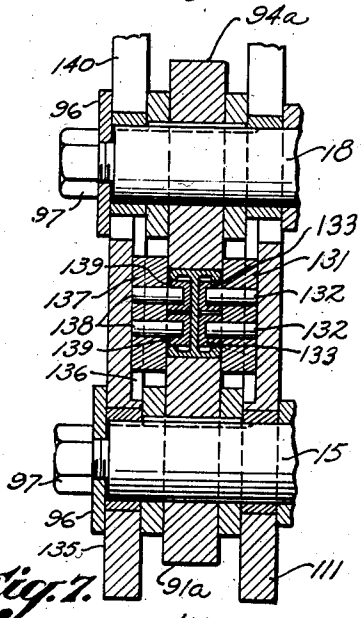


Fig. 7.

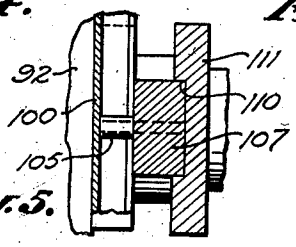


Fig. 5.

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PINCH TYPE BENDING ROLL

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Application May 5, 1942, Serial No. 441,852

9 Claims. (Cl. 153—56)

This invention relates generally to bending rolls of the pinch type, and is more particularly concerned with improvements in pinch type bending rolls permitting the effective rolling of stock of channel cross-section.

In pinch type bending rolls, the stock to be rolled or bent is passed between two pinch rolls which closely support or "pinch" the metal between them as it is bent. A supporting roll supports one side of the stock just ahead of the two pinch rolls, and a bending roll engages and deflects it just beyond them, causing the metal to bend at the pinch rolls. The position of the bending roll with reference to the pinch rolls of course determines the amount of bend or curvature imparted to the stock.

The aim in such bending rolls is to confine and support the metal closely at the pinch rolls, i. e., at the point of bend, so as to effectively control the flow of the metal in such a way as to assure obtainment of the desired bend or curvature, without introducing twist or other distortions. It has heretofore been found impossible, however, to handle stock of channel cross-section in such bending rolls, particularly when the stock is composed of some of the hardened aluminum alloys, for the reason that the flanges of the channel are unsupported from their inner sides, and tend to buckle, kink, or otherwise fail at the point of the bend, i. e., at the pinch rolls, with the result that the channel twists and buckles and refuses completely to assume the desired curvature.

The primary object of the present invention is accordingly the provision, in a pinch type bending roll, of means enabling the rolling and bending of stock of channel cross-section, even when formed of materials particularly difficult to handle, such as hardened aluminum alloys.

In accordance with the invention, the bending roll is equipped with a pair of loading rolls which engage and load the inside of the channel-shaped stock opposite the points of engagement by the pinch rolls. These loading rolls adequately support the channel from inside during the bending operation, and serve to prevent buckling and kinking of the stock, to the end that it comes from the roll with perfectly smooth curvature, and without twist.

The invention will be better understood by now referring to the following detailed description of a present illustrative embodiment thereof, reference for this purpose being had to the accompanying drawings, in which:

Fig. 1 is an end elevation of a bending roll of the pinch type equipped with the improvements of the present invention;

Fig. 1*a* is a detail taken on line 1*a*—1*a* of Fig. 1;

Fig. 2 is an elevation showing the opposite end of the bending roll illustrated in Fig. 1;

Fig. 3 is a longitudinal vertical section taken on line 3—3 of Fig. 1;

Fig. 3*a* is a detail section taken on line 3*a*—3*a* of Fig. 3;

Fig. 4 is an enlarged detail taken from Fig. 3;

Fig. 5 is a detail section taken on line 5—5 of Fig. 4;

Fig. 6 is a view similar to Fig. 4, but showing a modification; and

Fig. 7 is a view similar to Fig. 4, but showing another modification.

For the purpose of clearly disclosing the improvements provided by the present invention, we have shown in the drawings and will describe a complete bending roll of the pinch type equipped with the improvements provided by the present invention; it is to be understood, however, that this is for illustrative purposes only, and that the present invention is also adaptable to bending rolls of other design.

In the drawings, numeral 10 designates generally a main frame made up of parallel vertical side plates 11 and 12 connected by tie rods 12—*a*. Angle members 13 secured to plates 11 and 12 at the bottom provide feet adapted to engage a bench or other horizontal supporting surface.

A horizontal main drive shaft 15 is journaled in suitable bearings in frame plates 11 and 12, being driven from its right hand end, as viewed in Fig. 3, from any suitable power means, not illustrated, while its opposite end projects somewhat forwardly of frame plate 11, as shown. Above and in alignment with shaft 15, frame plates 11 and 12 are formed with vertical guide slots 16 for vertically adjustable bearing blocks 17, and journaled in said blocks 17 is a pinch roll shaft 18, the latter being thus disposed above main drive shaft 15, and being usually parallel to or nearly parallel to shaft 15.

Vertical lead screws 20 disposed in frame plate guide slots 16 have at their lower ends reduced screw threaded portions 21 set into bearing blocks 17, and jam nuts 21*a* on said screw threaded portions 21 are set tightly against blocks 17 to prevent rotation of the lead screws after they have been adjusted. The lead screws 20 extend upwardly through housings 22 mounted on the tops of the frame plates 11 and 12. These housings 22 confine worm wheels 23, which sur-

round and have screw threaded engagement with the lead screws 20. Meshing with worm wheels 23 are worms 24, which are contained within housings 22, and are mounted on a horizontal shaft 25 having on one end a crank 26, the shaft 25 being journaled in housings 22 in any suitable manner.

Operation of crank 26 elevates or lowers the lead screws 20, and therefore the bearing blocks 17 and pinch roll shaft 18. If it should be desired to have shaft 18 at a slight angle with reference to shaft 15, as is sometimes desirable, for a reason which will appear hereinafter, this is accomplished by loosening one or the other of jam nuts 21*a* and rotating the corresponding lead screw 20 until the shaft 18 is at the desired angle, after which the nut 21*a* is reset.

Pinch roll shaft 18 is driven from main drive shaft 15 by any suitable gear arrangement permitting vertical adjustment of shaft 18 with reference to shaft 15, a gear arrangement permitting such adjustment is designated at 30 in the drawings. This gear arrangement includes a spur gear 31 keyed on drive shaft 15, a spur gear 32 keyed on shaft 18, an idler gear 33 meshing with and driven by gear 31, and another idler gear 34 meshing with idler gear 33 and also with gear 32 (see Fig. 2). Idler gear 33 is carried by a shaft 35 mounted in arms 36 positioned on opposite sides of gears 31 and 33 and provided at their one ends with circular openings 37 which rotatably receive bushings 38 on drive shaft 15. A clamp screw 40 passing through the other or swinging ends of said arms 36 projects through an arcuate slot 41 in frame plate 12, a suitable washer 42 being placed on said screw between frame plate 12 and the arm 36 adjacent thereto, and a clamp nut 43 on the portion of screw 40 that projects through the slot 41 being set up against plate 12 to clamp the arms 36 in any position of angular adjustment. Shaft 45 carrying gear 34 is supported in the forward ends of a pair of swinging arms 46, the rearward ends of which have openings 47 passing shaft 18 and receiving co-axial bosses 48 formed on the two sides of gear 32 (see Fig. 3), while the two shafts 35 and 45 are connected by links 49 which serve to hold the gears 33 and 34 in mesh. It will be evident that, clamp screw 40 being loosened, pinch shaft 18 and its gear 32 may be vertically adjusted without interfering with the mesh of the gears 31, 33, 34 and 32, the arms 36 and 46 simply swinging somewhat and the several gears rolling slightly on one another as the adjustment is made.

A bending roll shaft 50, arranged parallel to and to one side of drive shaft 15, is journaled at its two ends in a pair of journal blocks 51 which are slidably mounted in guide ways 52 (see Fig. 1) in the two arms 53 of a swinging bending roll carriage, generally designated by numeral 54. This carriage 54, which also includes a cross-bar 60 connecting the outer ends of arms 53, is received in the space between the two end plates 11 and 12 of the main frame, and the inner ends of its two arms 53 have perforations 55 receiving suitable bushings surrounding drive shaft 15. The shaft 15 thus rotates within, and at the same time supports, the arms 53 of carriage 54, while the latter is capable of angular adjustment about the axis of shaft 15. The carriage 54 may be set in any position of angular adjustment by means of a suitable clamp screw 56 passing through an arcuate slot 57 in frame plate 11 and threaded into a lug 58 formed on the adjacent carriage arm 53. It will now be clear that movement of journal blocks 51 along slots 52 in arms 53 of the carriage 54 will adjust the spacing of shaft 50 carried by said blocks with reference to drive shaft 15, and also, that angular adjustment of the carriage 54 by swinging movement thereof about shaft 15 will adjust the elevation of shaft 50 with reference to shaft 15.

There remains for description suitable means by which these adjustments may be made. Movement of journal blocks 51 along slots 52 is accomplished by means of screws 59 having screw threaded engagement with the cross-bar 60 of carriage 54, and carrying the blocks 51 at their ends, the screws being turned by means of cranks 59*a*. The cross bar 60 of carriage 54 carries bearings 61 for the two end portions of a horizontal shaft 62, the extremities of which project beyond said bearings and carry spur gears 63 in mesh with arcuate rack gears 64 which are concentric with the pivot axis of the carriage 54, and which are mounted on the two frame plates 11 and 12. Cross bar 60 also carries, midway between its two arms 53, a mounting 66 for a shaft 67 carrying a worm 68 meshing with a worm wheel 69 fast on shaft 62. Clamp screw 56 being loosened, rotation of shaft 67, as by means of manual crank 67*a*, effects rotation of shaft 62 through wormwheel 69 and worm 68, and therefore rotation of spur gears 63 with resulting translation of the latter along rack 64, thereby effecting angular adjustment of carriage 54 about the axis of main drive shaft 15.

Drive shaft 15 and bending roll shaft 50 are drivingly interconnected by a suitable means which will permit the described adjustments of carriage 54 and of shaft 50 to be made. A sprocket 70 tightly mounted on drive shaft 15 is connected by chain 71 with a sprocket 72 which is relatively rotatable on an intermediate shaft 73, and the sprocket 72 is fast with another sprocket 74, also relatively rotatable on shaft 73, and connected by chain 75 with a sprocket 76 fast on the shaft 50.

Shafts 15 and 73 are spaced by means of a pair of connecting links 80, and shafts 73 and 50 by means of a pair of connecting links 81, shafts 15 and 50 being relatively rotatable within the ends of the respective arms 80 and 81. Shaft 50 is thus driven through chains 71 and 75 from main drive shaft 15, and it will be understood that the described driving interconnection between said shafts permits the shaft 50 to be adjusted toward and from the shaft 15, as well as the angular position of the carriage to be adjusted, the angle between the connecting arms 80 and 81 increasing or decreasing in accordance with such adjustments, without interference with the described chain driving interconnections.

The end of bending roll shaft 50 corresponding to frame plate 11 projects through a frame opening 85 in the latter and carries at its end, outside of plate 11, a usual bending roll 86, the latter being understood to be in the usual form of a cylinder or disc, having a width dimension, parallel to shaft 50, adequate to engage and support the full width of the stock S to be engaged thereby. On the opposite side of drive shaft 15 from the bending roll 86 is an initial supporting roll 87, which is rotatably mounted on a suitable mandrel 88 secured to frame plate 11 by means of a clamp screw 89 passing through a slot 89′ in plate 11, the slot 89′ permitting vertical adjustment of roll 87,

as will be understood. This roll 87 is also generally cylindrical in form, and of a width adequate to engage the full width of stock S. It will be understood that the two rolls 87 and 86 are in alignment, one behind the other, and are of comparable width, so that the stock engaging and traveling over the cylindrical periphery of initial roll 87 will subsequently engage and travel over the cylindrical periphery of bending roll 86.

Keyed on the portion of drive shaft 15 projecting beyond frame plate 11 are three flat discs 90, 91 and 92, of progressively increasing diameters, and keyed on the corresponding portion of shaft 18 are three similar discs 93, 94 and 95, said discs being placed in face to face contact, and being confined on their respective shafts by means of washers 96 and screws 97 threaded into the ends of the shafts. The inside rolls 90 and 93 are spacers, the intermediate rolls 91 and 94 are the pinch rolls, which are adjusted by means of the vertically adjustable shaft 18 to firmly engage the lateral edges or surfaces of the stock to be rolled, and the outside rolls 92 and 95 serve to back up and confine the back or outside surface of the stock. The pinch and bending rolls being driven by power rotation of drive shaft 15, the stock passes first over the initial supporting roll 87, then between the pinch rolls 91 and 94, and finally over the bending roll 86, the position of which determines the curvature which will be imparted to the stock, though the actual bending occurs between the pinch rolls. In the example of Figs. 3 and 4, the stock is a channel member having web 100, flanges 101, and inwardly turned flange portions 102. As illustrated, the flanges 101 are engaged by the peripheries of pinch rolls 91 and 94, while the web 100 is backed up by the larger diameter rolls 92 and 95.

Now, without support from inside the channel, it is practically impossible to impart a smooth curvature to such a channel member, particularly when the channel is composed of certain materials such as hardened aluminum alloys. Accordingly, the present invention provides means for loading the channel from the inside, whereby the flanges 101 are maintained in firm contact with the peripheries of the pinch rolls 91 and 94. This end is accomplished by the provision of a pair of small, cylindrical loading rolls 104 and 105, rotatably mounted on parallel studs 106 projecting from a carrier block 107 positioned adjacent the flange portions 102, said rolls being received inside the channel and arranged so as to engage and support the edges of the flange portions 102, in the manner clearly illustrated in Figs. 3 and 4. The front face of the loading roll carrier block 107 will be seen in Figs. 3 and 4 to be located between the spacer rolls 90 and 93, and to overlap and be confined by portions of the pinch rolls 91 and 94. The rearward portion of the block 107 is received and is vertically slidable within a vertical guide groove 110 formed in the adjacent face of a guide plate 111, positioned between the spacer rolls 90 and 93 and collars 112 and 113 fastened on the shafts 15 and 18, respectively. As illustrated, the lower portion of plate 111 has a bushed opening 115 which passes drive shaft 15, and has a vertical slot 116 passing the vertically adjustable shaft 18. The plate 111 is thus carried by drive shaft 15, which is rotatable within its lower portion, and is supported in upright position by shaft 18. The loading roll carrier block thus floats vertically on plate 111, permitting it to conform to any irregularities on the surfaces of the channel shaped stock S.

Fig. 6 shows a modification designed to accommodate a channel member without the inwardly bent flange portions 102 of Fig. 4; in other words, the channel in Fig. 6 has merely the usual web 120 and side flanges 121. In this instance, the loading rolls 104*a* are arranged to engage the full inside surfaces of the flanges 121, being mounted on studs 122 supported by a carrier block 123, which floats vertically on plate 111, as before, all as clearly illustrated in Fig. 6. The loading rolls 104*a* thus engage and load the full inside surfaces of the flanges 121.

Fig. 7 shows another modification, illustrating the use of loading rollers for stock of I-beam cross-section, which may be treated, in effect, as the equivalent of two channel members back to back. The set-up here is in general the same as before, but with the exception that the pinch rolls 91 and 94 are replaced by the widened pinch rolls 91*a* and 94*a* matching the width of the flanges 130 of the I-beam, and the rolls 92 and 95 are removed and their place occupied by a second loading roll carrier block and guide plate assembly. Thus, the guide plate 111 supports block 131 carrying studs 132 bearing cylindrical loading rolls 133 entering in the channel on the one side of the I-beam member and supporting the flanges on that side, as illustrated. And a second guide plate 135, which may be exactly similar to the plate 111, is supported on the extremities of the shafts 15 and 18 by the washers 96 and screws 97, being provided with a vertical guide slot 136 receiving and guiding carrier block 137 from which project studs 138 bearing cylindrical loading rolls 139 entering into the channel on the other side of the I-beam and supporting the flanges on that side, all as clearly illustrated in Fig. 7. It will of course be understood that the guide plate 135 is rotatably supported by the shaft 15, and that the vertical slot 140 formed in its upper portion passes shaft 18, all in a manner similar to the corresponding arrangements for the first-described guide plate 111. Thus by this means stock of I-beam cross-section may be effectively loaded from inside the flanges of its channel formations.

The described loading rolls adequately support the channel members from inside their flanges at the point of bend of the metal, serving to control the metal as it bends, and preventing it from giving way, buckling, kinking, or twisting. To aid in eliminating all tendency to twist, the shaft carrying the upper pinch roll is sometimes tilted to a very slight angle, thus causing the flanges of the channel to be pinched somewhat more tightly at one edge than the other. By so pinching the flange at one edge, its thickness is slightly reduced at that edge, the displaced metal tending to flow longitudinally of the channel member, and by this means the flange may be caused to bend or twist somewhat toward the other edge. Proper adjustment of this pinching action on the flanges enables complete correction of or compensation for any tendency to twist, provided, of course, the loading rolls are employed to support the flanges from inside. As an alternative to adjustment of the angle of the upper pinch roll shaft, the pinch rolls may be made with a very slight taper, and a roll of proper taper selected for each job to be handled. Inasmuch as the taper to be employed will be very

slight, no attempt to illustrate such taper is made in the drawings.

We have now described and illustrated certain specific means by which the invention may be carried into practical effect. It is to be understood, however, that this is for illustrative purposes only, and that various changes in design, structure and arrangement may be made without departing from the spirit and scope of the invention or of the appended claims.

We claim:

1. In a bending roll having two pinch rolls between which a metal strip of channel cross-section may be passed, with the flanges of the channel in engagement with the peripheries of the pinch rolls: a floating carrier member positioned adjacent the open side of the channel strip and mounted to float in a direction transversely thereof, and a pair of loading rolls rotatably mounted on said carrier and entering into said channel and engaging and supporting said flanges against said pinch rolls.

2. In a banding roll having two pinch rolls between which a metal strip of channel cross-section may be passed, with the flanges of the channel in engagement with the peripheries of the pinch rolls: a floating carrier member positioned adjacent the open side of the channel strip and mounted to float in a direction transversely thereof, a pair of parallel studs mounted on said carrier member and projecting therefrom into said channel, and a pair of loading rolls rotatably mounted on said studs within said channel and engaging and supporting said flanges against said pinch rolls.

3. In a bending roll having two pinch rolls between which a metal strip of channel cross-section may be passed, with the flanges of the channel in engagement with the peripheries of the pinch rolls: a carrier block positioned adjacent the open side of the channel strip, a guide member having a guide way supporting and guiding said block for movement in a direction substantially parallel to a line intersecting the axes of the two pinch rolls, and a pair of loading rolls rotatably mounted on said carrier block and entering into said channel and engaging and supporting said flanges against said pinch rolls.

4. In a bending roll having two parallel pinch roll shafts bearing a pair of pinch rolls between which a metal strip of channel cross-section may be passed, with the flanges of the channel in engagement with the peripheries of the pinch rolls: a carrier block positioned adjacent the open side of the channel strip, a guide member having a guide way supporting and guiding said block for movement in a direction substantially parallel to a line intersecting the axes of the two pinch rolls, said guide member being supported by one of said pinch roll shafts and having an elongated slot passing the other of said shafts, and a pair of loading rolls rotatably mounted on said carrier block and entering into said channel and engaging and supporting said flanges against said pinch rolls.

5. In a pinch type bending roll having two pinch rolls positioned on spaced, substantially parallel axes so as to present opposed peripheries defining an opening through which a metal strip of channel cross-section may be passed, such strip including a web and a pair of flanges turned at right angles from the two longitudinal edges thereof, and said pinch rolls being adapted to receive said strip therebetween with the outside surfaces of the two flanges of the channel in facial engagement with the peripheral faces of said pinch rolls: a pair of loading rolls, one for each of said flanges, positioned between the opposed peripheries of said pinch rolls and adapted to support said flanges against the opposed peripheral faces of said pinch rolls.

6. In a pinch type bending roll having two pinch rolls positioned on spaced, substantially parallel axes so as to present opposed peripheries defining an opening through while a metal strip of channel cross-section may be passed, such strip including a web and a pair of flanges turned at right angles from the two longitudinal edges thereof, and said pinch rolls being adapted to receive said strip therebetween with the outside surfaces of the two flanges of the channel in facial engagement with the peripheral faces of said pinch rolls: a pair of parallel cylindrical loading rolls, one for each of said flanges, positioned inside the channel defined by said strip and between the opposed peripheries of said pinch rolls and adapted to engage and support said flanges against the opposed peripheral faces of said pinch rolls.

7. In a pinch type bending roll having two pinch rolls positioned on spaced, substantially parallel axes so as to present opposed peripheries defining an opening through which a metal strip of channel cross-section may be passed, such strip including a web and a pair of flanges extending at right angles from the two longitudinal edges thereof, and said flanges having inwardly turned flange portions extending toward one another and presenting spaced parallel longitudinally extending edges, said pinch rolls being adapted to receive said strip therebetween with the outside surfaces of the two flanges of the channel in facial engagement with the peripheral faces of said pinch rolls: a pair of loading rolls positioned between the opposed peripheries of said pinch rolls and adapted to engage said longitudinally extending edges of said flange portions to support said flanges against the opposed peripheral faces of said pinch rolls.

8. In a pinch type bending roll having two pinch rolls positioned on spaced, substantially parallel axes so as to present opposed peripheries defining an opening through which a metal strip of channel cross-section may be passed, such strip including a web and a pair of flanges turned at right angles from the two longitudinal edges thereof, and said pinch rolls being adapted to receive said strip therebetween with the outside surfaces of the two flanges of the channel in facial engagement with the peripheral faces of said pinch rolls: a carrier member positioned opposite the open side of the channel shaped strip and supported for free floating movement in a direction substantially parallel to a line intersecting the axes of the two pinch rolls, and a pair of loading rolls mounted on said carrier member, said rolls being positioned by said carrier member between the opposed peripheries of said pinch rolls and in supporting relation with said flanges in a manner to support said flanges against the opposed peripheral faces of said pinch rolls.

9. In a pinch type bending roll having two pinch rolls positioned on spaced, substantially parallel axes so as to present opposed peripheries defining an opening through which a metal strip of channel cross-section may be passed, such strip including a web and a pair of flanges turned at right angles from the two longitudinal edges thereof, and said pinch rolls being adapted to receive said strip therebetween with the outside surfaces of the two flanges of the channel in facial engage-

ment with the peripheral faces of said pinch rolls: a carrier member positioned opposite the open side of the channel shaped strip and supported for free floating movement in a direction substantially parallel to a line intersecting the axes of the two pinch rolls, and a pair of parallel, cylindrical loading rolls rotatably mounted on said carrier member on transversely spaced axes parallel to the axes of said pinch rolls, said rolls being adapted to enter into the channel of said strip and support said flanges against the opposed peripheral faces of said pinch rolls.

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