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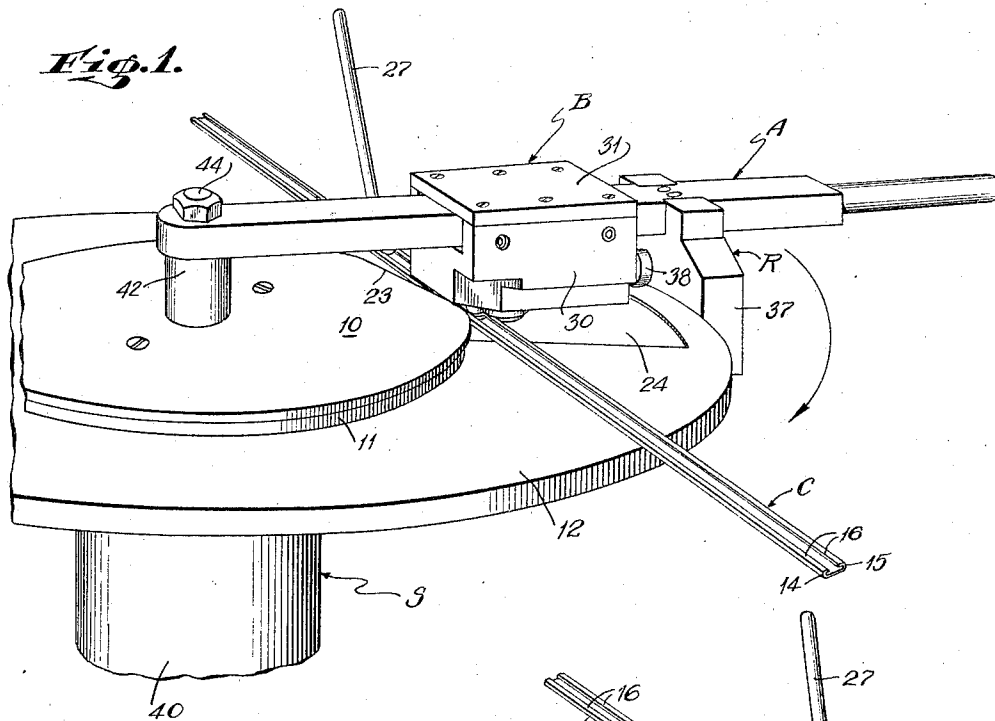
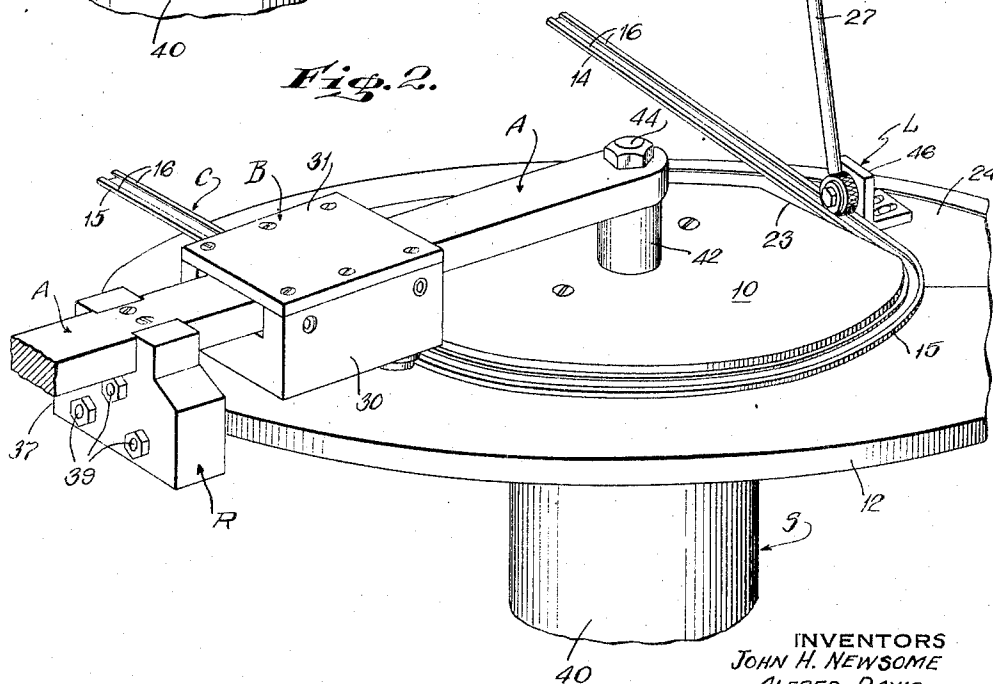
J. H. NEWSOME ET AL

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APPARATUS FOR BENDING CHANNELS OR THE LIKE

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3 Sheets-Sheet 1



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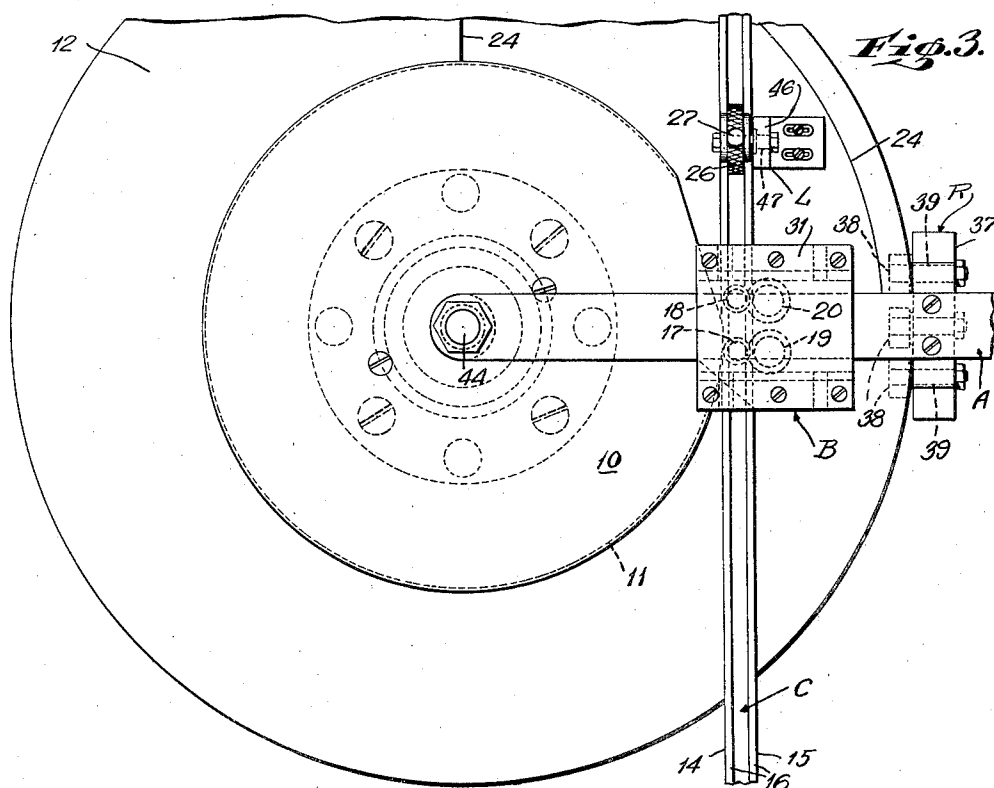
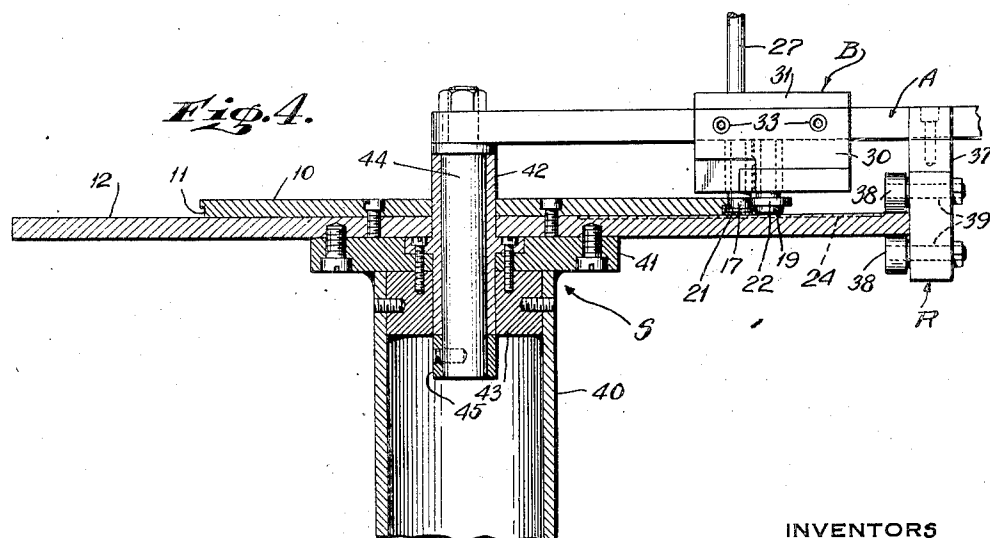
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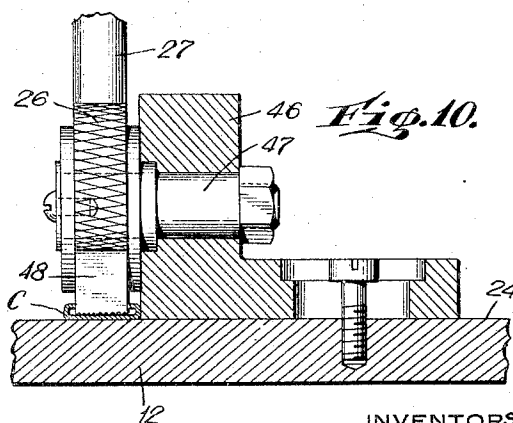
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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APPARATUS FOR BENDING CHANNELS OR THE LIKE

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This invention relates to the bending or shaping of channels or the like. The novel apparatus of this invention is particularly applicable to the bending of open-box channels, that is, rectangular in shape but having a partially open top, such as may be formed by a flange extending inwardly from the top of each side wall of the channel. However, it will be understood that the principles of this invention are applicable to the bending of channel having many different cross-sectional forms.

There are many instances of use for which it is necessary to change the shape of a channel of the above type, such as bending or shaping a straight channel to form a circular, or other curved or partially curved, shape. Normally, it is essential that the cross-sectional shape be unchanged after bending. Prior to this invention, no really satisfactory way of accomplishing this had been developed. In one method, used relatively extensively for bending open-box channels, the channel, which may be formed of aluminum, steel or the like, is filled with molten lead or other material which has a lower melting point than the material of the channel. After the lead has solidified, the channel is bent to the desired shape, the solid lead within the channel forcing the channel to maintain substantially its cross-sectional shape. The lead is then melted out, and the curved channel is ready for use. To carry out such a method is expensive, not only because of the equipment, but also because a considerable amount of lead is tied up in inventory. In addition, the necessary equipment takes up a large amount of floor space, the number of operations required is excessive, and the method itself is time-consuming.

Among the objects of this invention are to provide novel apparatus for bending a channel, and more particularly an open-box channel or the like; to provide such apparatus for bending a channel in cold condition; to provide such an apparatus which is capable of performing the bending in a single operation; while maintaining the desired cross-sectional shape of the channel; to provide such apparatus which, through adjustability or changeability of parts, can be utilized to bend channel or the like to various radii or curves; to provide such apparatus which can be used for bending channel having various cross-sectional shapes or forms; to provide such apparatus which is readily adjustable but which is highly accurate and maintains such accuracy during extensive operations; and to provide such apparatus which is simple in design and efficient

in operation. Other objects and novel features of this invention will become apparent from the description which follows.

In accordance with this invention, a channel—
5 and more particularly a box-shaped channel having a partially enclosed top—is shaped or bent to a desired curvature by exerting pressure against or supporting successive portions of the walls and the top of the channel at two or more spaced
10 points, both inside and outside. The two or more spaced points within the interior of the channel and the two or more spaced points on each side of the channel, at which pressure or support is maintained, are preferably in lateral alignment.
15 A relative movement, longitudinally of the channel, of the points of pressure or support is effected, the movement of these points with respect to the initial position of these points on the channel conforming to the desired shape to be imparted to the channel. In further accordance with
20 this invention, pressure or support may be maintained along one side of the channel as the relative movement progresses, so that at the end of the bending operation, pressure or support is
25 applied along the entire side of the channel, from the initial to the terminal positions. Preferably, the side chosen is located on the inside of the curve. Also, one end of the channel is preferably
30 clamped or retained in a relatively fixed position, while the points of pressure or support are moved along a path corresponding to the curvature to be imparted to the channel.

Further objects and advantages of our invention
35 will be apparent from the following description considered in connection with the accompanying drawings, which form a part of this specification and of which

Fig. 1 is a perspective view of apparatus constructed in accordance with this invention, with
40 a channel in position for bending;

Fig. 2 is a perspective view of the apparatus, similar to Fig. 1, with the channel partially bent;

Fig. 3 is a top view of the apparatus shown in
45 Fig. 1;

Fig. 4 is a vertical mid-section of the apparatus shown in Fig. 3;

Fig. 5 is a top view, on an enlarged scale, of a roller box, between the rollers of which the
50 channel is inserted;

Fig. 6 is a vertical section taken through the roller box along line 6-6 of Fig. 5;

Fig. 7 is a vertical transverse section taken through the roller box along line 7-7 of Fig. 5;

Fig. 8 is a horizontal section illustrating the

engagement of the rollers with the channel, taken along line 8-8 of Fig. 7;

Fig. 9 is a side view of a channel clamping device forming a portion of the apparatus; and

Fig. 10 is a vertical section of the clamping device.

Apparatus of this invention, as shown in Figs. 1 and 2, comprises generally a plurality of channel engaging rollers which are carried by an adjustable box B, which is in turn mounted on a pivoted arm A. The rollers engage both interior and exterior surfaces of the channel, as described more particularly later, and bend the channel around a central plate 10 as arm A is rotated from the position of Fig. 1 to that of Fig. 2, and beyond. An end of the channel may be held in fixed position, as by a clamping device L, so that during rotation of the arm, the channel will be wrapped around plate 10, the edge of which conforms to the longitudinal contour to be imparted to the channel. The edge of plate 10 is provided with a groove 11 which substantially conforms in lateral section to one side of the channel. The foregoing parts, and a base plate 12, which restrains downward movement of the channel during bending and also provides a convenient working surface, may be mounted at a suitable height atop a support S. The arm A may, if desired, be supported and guided at the periphery of plate 12 by a roller support R.

Channel C is substantially box shaped in cross-section, with an opening at the top. Thus, as in Figs. 1 and 2, each side 14 or 15 of the channel is provided with an inwardly extending flange 16 at the top edge thereof. As shown in Figs. 5 and 8, the rollers journaled in box B comprise spaced inner rollers 17 and 18, and equally spaced outer rollers 19 and 20, rollers 17 and 19 comprising a forward pair and rollers 18 and 20 comprising a rear pair. The lower ends of inner rollers 17 and 18 fit within the channel, being provided with flanges 21 which extend to sides 14 and 15 and up to flanges 16. Each outer roller 19 and 20 is aligned with the corresponding inner roller, and conforms in lateral shape to edge 15 and the top of its flange 16, thus being provided with a laterally extending flange 22.

As is illustrated in Figs. 1 and 4, groove 11 substantially corresponds in shape to side 14 and the top of its flange 16, thus forming an overhanging lip, as shown. Central plate 10, which may be affixed to base plate 12 in any suitable manner, as by cap screws, as shown, is preferably replaced by a central plate of the correct dimensions for producing bends of different radii or bending channels of different sizes. Plate 10 is circular, except for a bevel section 23, which with a depression 24 formed in a quadrant of base plate 12, permit readier insertion of a channel into the device.

Plate 10 is preferably situated on the inside of the curve to which the channel is to be bent. Side 14 of the channel is shown as being situated on the inside of the curve, and side 15 on the outside, but these positions may be reversed, since the channel is symmetrical about its longitudinal axis, groove 11 will conform to the corresponding side of the channel. Also, although the periphery of plate 10 is shown as circular, it will be understood that it may vary in radius, conforming to any desired contour or curve to be imparted to the channel.

As is evident from Figs. 1 and 4, each inner roller 17 or 18 cooperates with the corresponding outer roller 19 or 20, groove 11, and base plate

12, to form openings at two spaced points having substantially the same cross-sectional shape as the channel. Plate 10 is, of course, flush with the top surface of base plate 12, and the clearance between the bottom of outer rollers 19 and 20, and this top surface, is made as small as possible. The clearance between the bottom of inner rollers 17 and 18 and the surface of plate 12 is substantially the thickness of the base of the channel.

To bend channel C, after the foregoing various parts of the apparatus have been adjusted to correct position, the end of the channel may be pushed between the inner and outer rollers, with the arm A in a position slightly to the rear of that shown in Figs. 1 and 3. In such a position, inner wall 14 of the channel clears bevel-section 23, and the bottom of the channel is spaced above depression 24. This reduces considerably the amount of effort required, as the clearance between the bottom of the rollers and the top surface of plate 13 is relatively small; and the position of the inner rollers is such that the circumference of groove 11 extends outwardly to a point between the inner rollers.

When the channel has been inserted between the inner and outer rollers, arm A is moved to the position shown in Figs. 1 and 3, so that the channel is under a knurled cam 26 of clamping device L. To clamp the channel, a handle 27 is moved downwardly so that the knurled outer surface of cam 26 will engage the bottom of the channel.

After the end of the channel has been clamped securely, arm A is then moved in a clockwise direction, as in the direction of the arrow of Fig. 1, so that the channel is pulled by the rollers around the edge of plate 10. The minimum clearance between the bottom of the inner roller and top of plate 12 insures that the channel will not twist or warp laterally while being bent, and the pressure against or support of the walls and top of the channel, both inside and out, at two spaced points, insures that the desired cross-sectional shape of the channel will be maintained. As is indicated by operations with apparatus constructed in accordance with this invention, the metal of the channel flows during the bending operation, the metal in the inside wall of the channel tending to be compressed with that in the outside wall tending to be stretched. Although not definitely proven, it is believed that the first pair of rollers bend the channel to the desired radius, while the second pair of rollers, in conjunction with groove 11, reshape the channel to the desired cross-sectional form. After the rollers have passed beyond the end of the channel, at a point somewhere around the periphery of plate 10, the clamping device is loosened and the bent channel removed. Normally, it is desirable to saw off a portion of the end of the bent channel, since the inner edge extends beyond the outer edge, due to the reactions and flow of metal. Also, in certain instances, as when a flattened elliptical outline is to be formed by several channel sections, it may be desirable to leave a straight portion at one end of a semi-circle or quadrant.

Box B is adjustable both longitudinally and laterally along arm A, and includes a lower block 30 and a cap 31. Lower block 30, as seen in Figs. 5 and 6, is provided with a groove 32 sufficiently wider than arm A to permit lateral adjustment. Four set screws 33 extend through the side wall of block 30, to engage the sides of arm A

and hold box B in any adjusted position. As shown in Fig. 5, the set screws may be screwed in different distances so that box B is tipped or twisted with respect to arm A, to thereby provide a clearance between forward roller 17 and groove 11 different from the clearance between rear roller 18 and groove 11.

The channel engaging rollers are journaled in lower block 30, which is provided with suitable holes for four bushings 34, one for each of rollers 17, 18, 19 and 20. The bushings and rollers may be held in place in any suitable manner, such as by a press fit between each bushing and block 30 and a washer and cap screw assembly 35 affixed to the upper end of each roller.

The support R, as is illustrated in Figs. 3 and 4, includes a block 37, secured to arm A in any suitable manner, such as by cap screws as shown. Three rollers 38, one above and two below plate 12, are mounted on bearing pins 39. Use of roller support R may be found unnecessary in many operations.

Support S, as is shown in Fig. 4, includes pedestal 40 and a bearing plate 41, welded or affixed in any other suitable manner atop the pedestal. Plate 12 and a bushing 42 are secured to bearing plate 41 such as by cap screws, while an annular collar 43, which maintains the rigidity of bushing 42, is similarly secured to pedestal 40 beneath plate 41. Arm A is bolted to the upper end of a pin 44, for which bushing 42 forms a bearing, and a collar 45 is attached to the lower end of the pin to restrain axial movement of the pin and arm A.

Clamping device L, as shown in Figs. 9 and 10, includes a right angle bracket 46 fastened to plate 12 in depression 24 in any suitable manner, as by cap screws. A pin 47 extends horizontally from the upright leg of the bracket to provide a pivot for the cam 26. The cam is also provided with a bevel section 48, which when at the bottom of the cam, permits the channel to be inserted or removed from the side, the bevel section clearing the top of the channel. After insertion of the channel, handle 27 is rotated in the direction of the curved arrow of Fig. 9 to clamp the channel. The radius of cam 30 beyond bevel section 48 increases so that, when a pull is exerted on channel C in the direction of the straight arrow of Fig. 9, the cam will tend to be pulled into tighter engagement with the channel, thus locking the channel more securely.

The lateral position of the rollers, and the respective clearances between the inner rollers and groove 11 in accordance with the tilt of box B, may vary in accordance with the size of channel to be bent and the radius of curvature desired. Normally, box B is tilted slightly with respect to arm A so that the rear inner roller 18 is closer to groove 11 than the forward inner roller 17; also, the space between the forward rollers is slightly less than the space between the rear rollers. For many operations, the inside of box B may be tilted rearwardly to provide an angle of about 4° between the axis of the box and arm A. However, it may be found desirable to increase or decrease this angle for a particular operation, since the final width of the channel may be made slightly greater by decreasing the angle, or slightly less by increasing the angle. In addition, the radius of curvature of the channel may be varied slightly by moving box B forwardly or rearwardly with respect to arm A, the radius of curvature of the channel tending to become larger when box B is moved rearwardly. Also, it may

sometimes be found desirable to slant the side and upper edges of groove 11, which apparently assists in overcoming the tendency for the channel to spring out of shape after bending. There are, of course, limitations to the changes in radius, etc., which may be obtained by the above adjustments.

As an example of one operation carried out in accordance with this invention, but not in limitation thereof, a channel section 0.580 in. wide, 0.516 in. high, and provided with a top opening 0.410 in. wide, was bent to a 1¼ in. radius. The side of groove 11 was tilted outwardly at the bottom at an angle of 12°, and the upper edge of the groove was tilted upwardly at an angle at 4°, while the distance between the wall of groove 32 and arm A was ¼ in. greater at the rear inside corner than at the rear outside corner. The rollers and groove were otherwise proportioned and adjusted in accordance with the size of the channel, the radius of the periphery of plate 10 being slightly less than that desired finally, to compensate for a corresponding slight spring in the channel after bending.

When the curvature to be imparted to the channel varies in radius, or includes some curved and some straight portions, box B should, of course, be mounted so as to follow the curve. This may be accomplished by a spring of suitable pressure acting to force the box toward plate 10, or a suitable cam follower engaging a slot conforming to the periphery of plate 10. Other ways of accomplishing the desired motion of box B will suggest themselves to those skilled in the art.

Although the apparatus in accordance with this invention have been described in connection with bending channel having straight side walls and flanges, it will be understood that the side walls or flanges may be curved or have some other configuration. In addition, although one embodiment of this invention has been described in detail, it will be understood that various changes may be made and that other modifications may exist without departing from the spirit and scope of this invention, as defined in the appended claims.

What is claimed is:

1. In an apparatus for bending a channel having a web and a pair of flanges, a plate having a curved edge conforming to the curvature to be imparted to the channel, an arm pivotally mounted with respect to said plate, two pairs of rollers rotatably carried by said arm, one roller of each pair being located so as to enter said channel between the flanges thereof and being spaced from the curved edges of said plate a distance substantially equal to the thickness of one of said flanges, the diameter of said one roller of each pair being substantially equal to the space between said flanges, the other roller of each pair being located so as to contact the outside of the other flange at points opposite the points of contact between said one roller of each pair and the inside of said other flange, and means for rotating said arm to cause said rollers to travel parallel to said curved edge to thereby bend the channel in conformity with the curvature of said edge.

2. In a apparatus for bending a channel having a web and a pair of flanges, a plate having a curved edge conforming to the curvature to be imparted to the channel, an arm pivotally mounted with respect to said plate, a supporting structure carried by said arm, two pairs of roll-

ers rotatably mounted in said structure, one roller of each pair being located so as to enter said channel between the flanges thereof and being spaced from the curved edge of said plate a distance substantially equal to the thickness of one of said flanges, the diameter of the first-named roller of each pair being substantially equal to the space between said flanges, the other roller of each pair being located so as to contact the outside of the other flange at points opposite the points of contact between said first-

mentioned roller of each pair and the inside of said other flange, means for adjusting the position of said supporting structure on said arm so as to vary the spacing between the respective first-mentioned rollers and the curved edge of said plate, and means for rotating said arm to cause said rollers to travel parallel to said curved edge to thereby bend the channel in conformity with the curvature of said edge.

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