

Oct. 11, 1955

W. L. SIEGERIST

2,720,243

BAR AND TUBE STRAIGHTENING MACHINE

Filed June 20, 1951

3 Sheets-Sheet 1

FIG. 1.

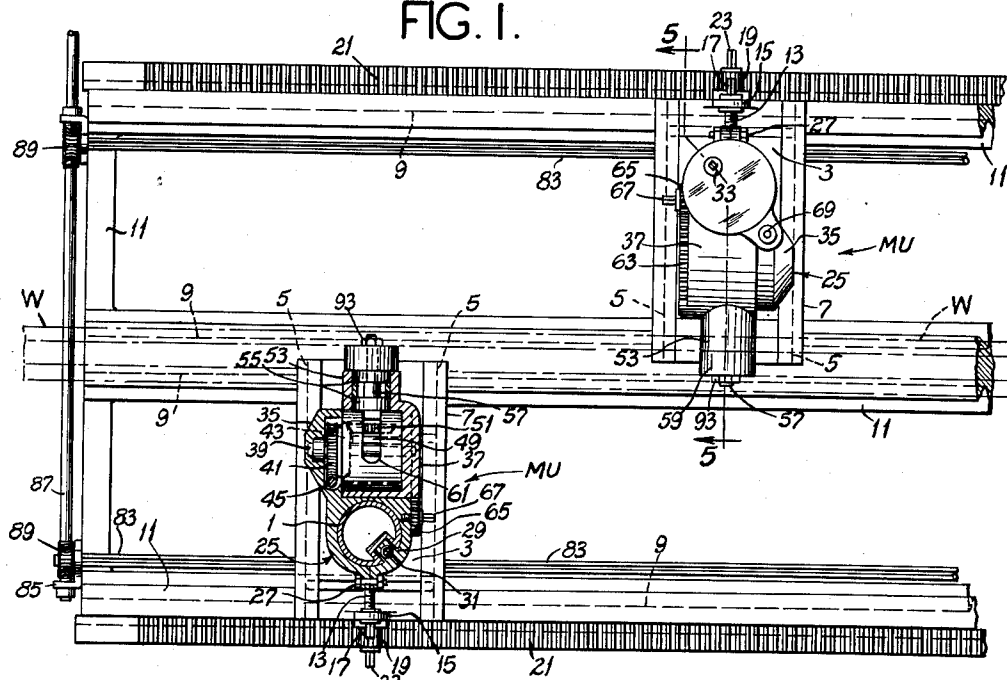
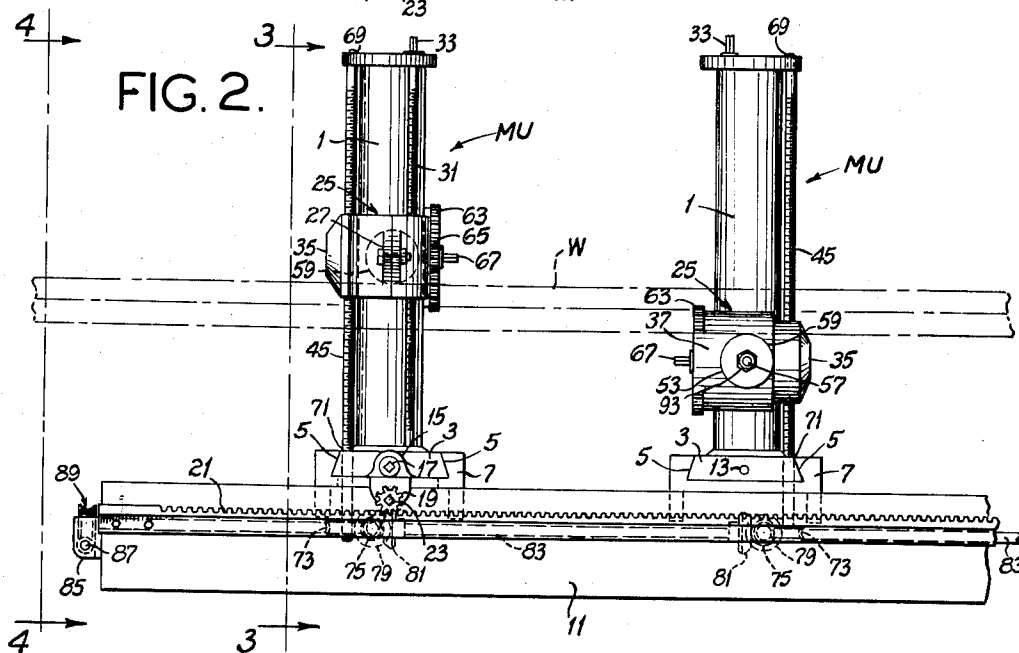


FIG. 2.



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FIG. 3.

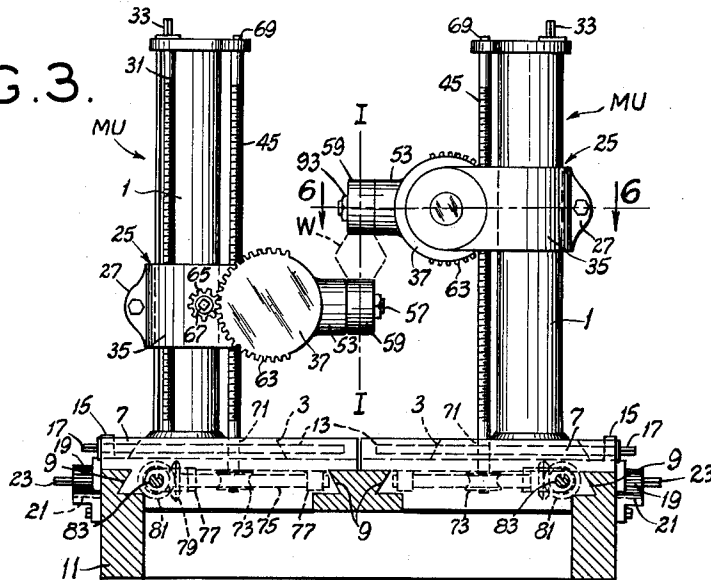


FIG. 5.

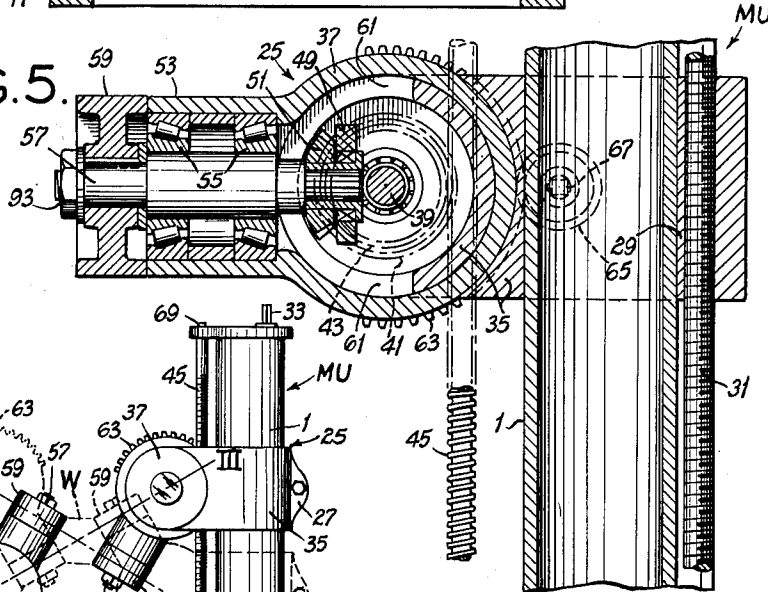
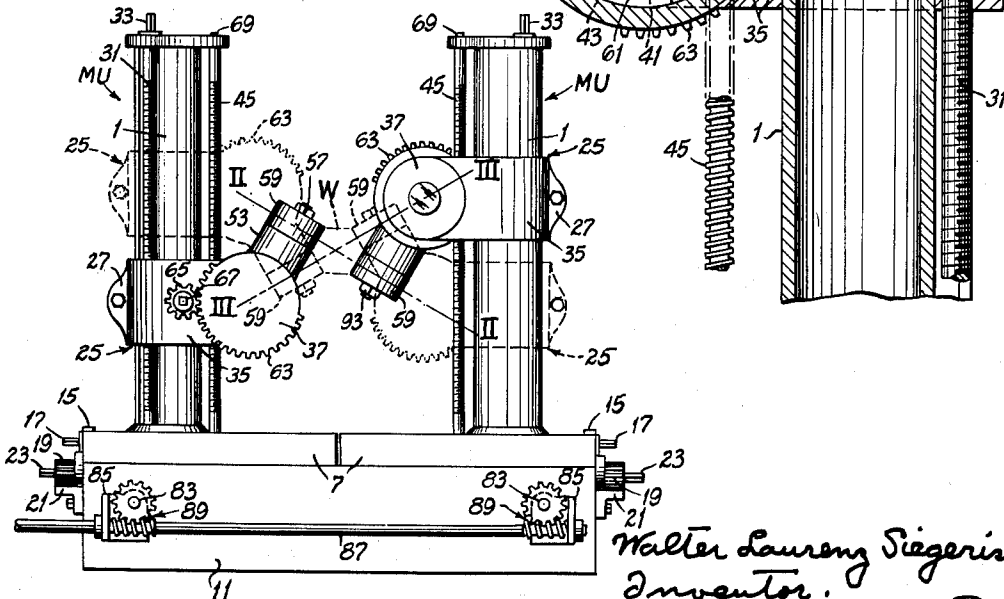


FIG. 4.



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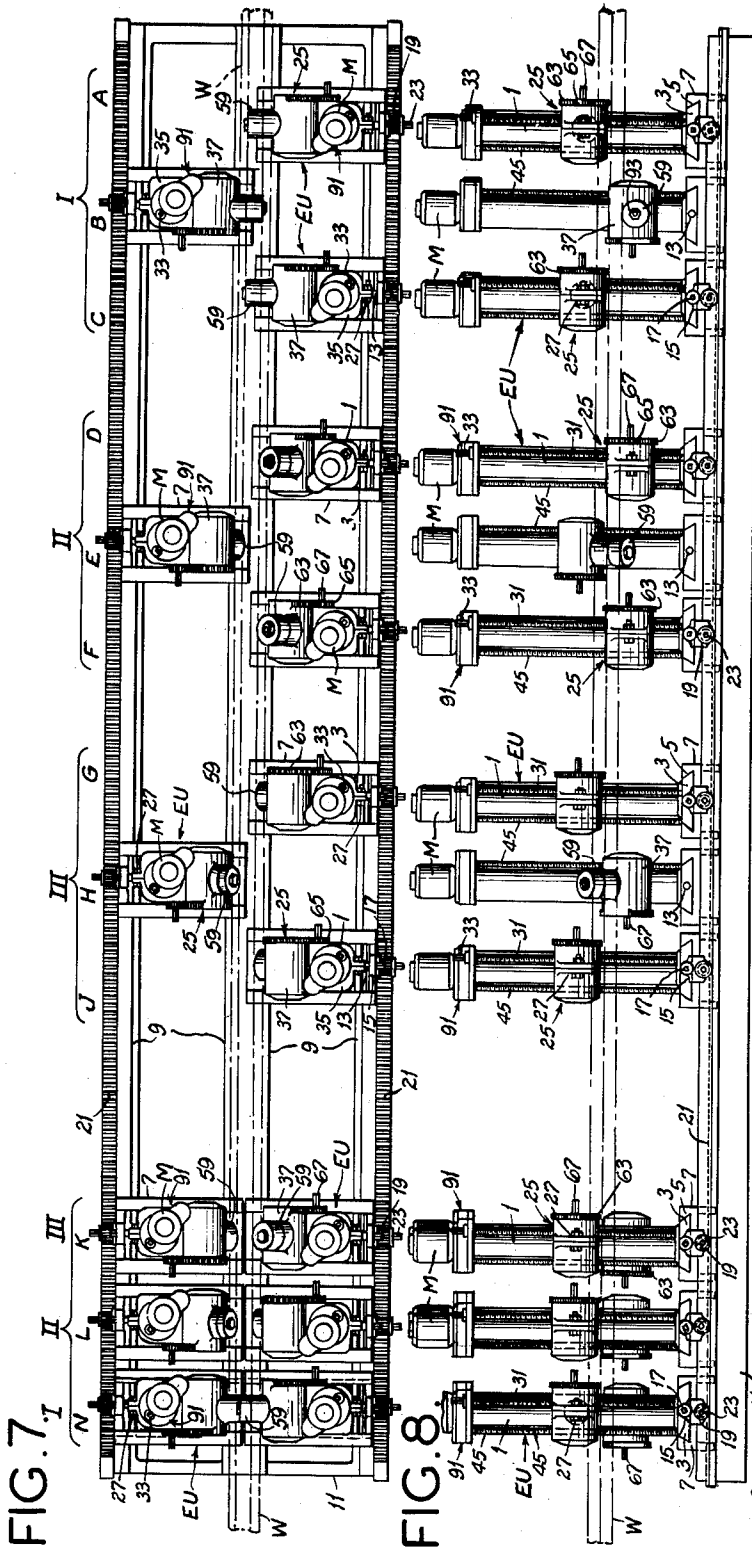
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BAR AND TUBE STRAIGHTENING MACHINE

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Application June 20, 1951, Serial No. 232,490

5 Claims. (Cl. 153—104)

This invention relates to bar and tube straightening machines, and with regard to certain more specific features, to machinery for straightening elongate bars, tubes and the like having various sectional shapes such as produced by extrusion, continuous casting, stretch-forming, rolling, drawing or the like.

Such production requires heating and mechanical action, or a combination of both, followed by cooling. Articles thus produced are not straight, containing sweeps, bends, hooks and other deviations from a straight line caused by internal stresses induced by the stated manufacturing methods. Some of these articles (for example, extruded shapes) are often unsymmetrical in cross section, presenting different section-moduli in different planes. As a result the articles, particularly when their cross-sectional shapes are complex, often deviate from straightness in several planes, requiring a multiplicity of straightening actions. Moreover, the perimeters of the sections sometimes are distorted from production or distort during the straightening process, requiring correction.

Most machines of the type described have been capable of removing deviation from straightness in one plane only, thereby necessitating a pass through the machine for each plane of deviation, which is time-consuming and costly. A few machines could in one continuous operation simultaneously remove some deviations from simpler sections in two planes. At best they were of a construction which subjected the sections to severe bends, sometimes uncontrollable. Moreover, the roll pressures reached a magnitude under which the surface of the section was unduly worked and the rolls imparted marks due to pressure and rubbing friction. The above disadvantages resulted in an unduly high proportion of an unsaleable product.

The broad object of this invention is to provide shape-straightening apparatus which in one continuous operation or pass will remove deviations from straightness in shaped sections of any complexity and variation in section-moduli in various planes.

Another object of the invention is to correct such faults or irregularities in the section perimeter as may occur during corrections for extreme deviations from straightness.

Another object of the invention is to provide means for applying corrective roll pressures such that there is the least amount of surface working and no objectionable marking due to roll action.

Other objects will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the

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structures hereinafter described, and the scope of which will be indicated in the following claims.

In the accompanying drawings, in which several of various possible embodiments of the invention are illustrated,

Fig. 1 is a fragmentary top plan view of one form of the invention, showing two mechanically driven roll units, certain parts being shown in horizontal section;

Fig. 2 is a front elevation of Fig. 1;

Fig. 3 is a cross section taken on line 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 3, except that it is drawn as an end elevation viewed from line 4—4 of Fig. 2, and shows in solid lines certain possible alternative roll adjustments and in dotted lines certain other possible roll adjustments;

Fig. 5 is an enlarged vertical section taken on line 5—5 of Fig. 1;

Fig. 6 is a horizontal section taken on line 6—6 of Fig. 3;

Fig. 7 is a formal plan view of a complete machine, the roll units in this case being individually motor driven; and,

Fig. 8 is a front elevation of Fig. 7.

Similar reference characters indicate corresponding parts throughout the several views of the drawings.

In the following description, reference will be made to certain roll units. These have two different forms, depending upon whether they are to be driven mechanically in tandem or by means of individual electric motors. The former are shown in Figs. 1—5 and the latter in Figs. 7 and 8. Figs. 7 and 8 also illustrate by way of example a distribution of a small number of roll units on a bed. The bed length, number of units, and their spacing may be changed freely within purview of the invention. It is to be understood that the roll units shown in Figs. 1—3 may be set up in corresponding arrangements. The generic designation U refers to these roll units or stands, regardless of which form they are. Prefix characters M and E distinguish them. Thus MU designates the mechanically driven units and EU designates the electrically driven units.

Referring now more particularly to Figs. 1—4, only two units are shown, but as many may be used as are required for a given straightening problem. Each unit MU consists of a post 1 supported upon a cross carriage 3 having a sliding support in dovetail cross guides 5 of a traverse carriage 7. Each traverse carriage 7 slides in dovetailed guideways 9 of the bed 11 of the machine. The cross carriage provides for cross adjustments of the post 1 and the carriage 7 provides for longitudinal or traverse adjustments of the post 1 with respect to the length of the bed 11. As shown in Fig. 3, the bed 11 carries two sets of guideways 9 for accommodating two sets of posts. In Figs. 1—4 only one post of each set is shown, but it will be understood that more may be used in each set of ways 9 as will be shown later in connection with Figs. 7 and 8.

Cross adjustment of each post is effected by means of a screw 13 threaded into the carriage 3. The screw has a collar portion which is rotary but held against longitudinal movement in a lug 15 on the carriage 7. Thus by applying a hand crank to a crank-engaging end 17 on the screw, the screw may be rotated to cause cross movements of the carriage 3. A rotary pinion 19 which is borne on the carriage 7 engages a rack 21 attached to the side of the bed 11. This pinion may be turned by means of a crank applied to a crank-engaging extension 23. This provides for traverse adjusting movements of the post 1.

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Sliding on the post 1 is a head 25 adapted to be clamped at any desired vertical position by clamp means 27. The head 25 is splined to the post 1, as shown at numeral 29. Threaded through the head is an elevator screw 31 which has a crank-engaging portion 33 whereby it may be rotated. This adjusts the elevation of the head 25 on the post 1 when the clamp 27 is released.

The head 25 consists of two main parts, i. e., a cylindric pocket member 35 and a roll support 37 in rotary cooperation with the pocket member 35. Rotation is in a plane perpendicular to the guideways 9 and about an axis parallel thereto. On this axis within members 35 and 37 is a shaft 39 supporting a rotary gear cluster consisting of a worm wheel 41 and a bevel gear 43. The worm wheel meshes with a worm 45 which passes freely through an opening 47 in head 25. When the post 1 is adjusted vertically, the worm wheel 41 may roll freely along the worm 45. On the other hand, when the post 1 is clamped, rotation of the worm 45 will drive the worm wheel 41 and thus will drive the bevel gear 43. Within the roll support 37 is a wall 49 which forms a rotary support for a bevel gear 51. The latter meshes with bevel gear 43.

Extending from the roll support 37 is a boss 53 forming a journal box for bearings 55. These bearings 55 support a stub shaft 57 to which is attached at one end an interchangeable roll 59. At the other end the shaft 57 has a splined removable engagement with interior splines in the gear 51. This end of the shaft 57 enters the pocket member 35 through a semi-circular slot 61. Thus the assembly of the roll 59, bearings 55, and the shaft 57 may be inserted into the journal box 53 and it is possible to rotate the roll support 37 on the pocket member 35. In doing so, the bevel gear 51 has a planetary rolling motion on gear 43, these gears functioning as a planetary train. In order to adjust the rotary position of the roll support 37, it is provided exteriorly with sector gear teeth 63 which mesh with a pinion 65 rotary on the head 25 and adjustable by means of a crank applied to a crank-receiving member 67.

Suitable position locks are provided for the roll support 37 and also for the carriages 3 and 7 when these members have been adjusted. Since there is a wide variety of locking means known for such purposes, detailed description of them will be unnecessary.

A mechanical drive is provided for the worm 45, which is supported in a top bearing 69 on post 1 and a bottom bearing 71 in the first carriage 3. At its lower end it carries a worm wheel 73 meshing with a worm 75, the latter being carried in bearings 77 of the second carriage 7. This worm 75 also carries a bevel gear 79 meshed with a bevel gear 81, also having a rotary bearing in carriage 7. This bevel gear 81 is splined to a drive shaft 83 which is rotary in bearings on the bed 11. One of these bearings is shown in a bearing block 85 which also carries a bearing for a drive shaft 87. A worm and worm wheel combination 89 transmits motion from drive shaft 87 to shaft 83. Thus rotation of the shaft 83 causes rotation of worm 75 through gears 81 and 79 in any position of the carriage 7 along the guideways 9. When carriage 3 is adjusted with respect to carriage 7, the worm wheel 73 may roll along the worm 75. Rotary motion of the worm 75 is transmitted from worm wheel 73 to the worm 45, which passes through the opening 47 in the head 25. Thus motion is ultimately transmitted to the roll 59 through gears 41, 43 and 51. Motion may be transmitted from the drive shaft 87 to the roll 59 in any adjusted positions of the carriage 7, carriage 3, head 25 and roll support 37.

In Figs. 1, 2 and 3 are shown two roll stands in random positions in their respective guideways 9 of the bed 11, with their roll heads 25 adjusted to horizontal positions and vertically spaced for acceptance between the vertically positioned rolls of a workpiece W located in working position. Workpiece W in this case is hexagonal by way of example. These roll heads 25 work on the upper and lower faces of the workpiece W in plane I. In Fig. 4 is shown in solid lines how the heads may be adjusted

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to work on two additional faces of the workpiece W in plane II. In dotted lines is shown how the heads may be adjusted to work on two additional faces of the workpiece W in plane III. Obviously, by multiplying the pairs of roll units MU and their adjustments, more pairs of faces of any more complicated workpiece W may be operated upon simultaneously.

In Figs. 7 and 8 is shown a possible arrangement for a near minimum number of roll units for straightening and correction of a cross section of a hexagonal bar. These Figs. 7 and 8 illustrate another form of electrically operated roll unit EU which will first be described before describing the operation of the stated arrangement. In this case the roll stands and the bed are the same as already described, except that the mechanical drive on the post 1 to the worms 45 is eliminated and individual motor drives are used for the roll units. The eliminated parts are 73, 75, 77, 79, 81, 83, 85, 87 and 89. The vertical worms 45 are not mechanically driven in tandem from the drive shaft 87. On the other hand, each worm 45 (in Figs. 7 and 8) is driven by an individual electric motor M mounted on the top of each respective post 1. Each motor is connected to its respective worm 45 through a gear-reduction unit 91. This alternative construction simplifies the drive and makes the invention applicable to arrangements employing many more roll units in a given machine. The number may be extended indefinitely by lengthening the bed 11. In operation, suitable wiring, including the necessary switching arrangement, is used to energize motors M.

Over-all operation on hexagonal bars will now be described in connection with Figs. 7 and 8. It should be understood that although Figs. 7 and 8 show the individual motor-driven roll units EU for the roll units, this operation is not essentially different if the mechanically driven roll units MU of Figs. 1-4 be substituted for those shown in Figs. 7 and 8. In either case, the units may be set up as shown by way of example in Figs. 7 and 8.

In Figs. 7 and 8 are indicated twelve stations A, B, C, D, E, F, G, H, J, K, L, N. Stations A—B—C constitute one straightening group working in the vertical plane I; stations D—E—F constitute a second group working in one 60° plane II; stations G—H—J constitute a third group working in another 60° plane III; and stations K—L—N constitute a rolling group, the pairs of rolls of which work, in planes I, II and III, respectively.

Although the number of stations in each group is indicated as being three in number and equally spaced apart, it will be understood that there may be more groups, more station units per group and that the spacing between stations may be adjusted to effect proper straightening of any types of sweeps, bends, hooks and other deviations. For example, station B may be closer to either station A or C, and stations A and C may be farther apart, et cetera. In the rolling group N—L—K, opposite units are located coplanar so that the axis of the roll of one is in the plane of the roll axis of the other.

It is an important feature of the invention that the planes of the axes of rolls of the units on one side of the bed can pass the planes of the axes of nearby rolls of units on the other side. Two advantages result:

First, any two rolls operating on opposite sides of the workpiece W in any group such as C—B—A, may be brought together as close as necessary to straighten out any given deformation, or as far apart as necessary for the same purpose. Adjustments in other groups such as F—E—D or J—H—G may differ so as to take care of various deformations met with in the various planes I, II, III.

Second, the axes of the rolls of opposite units may be brought into a common plane as in group N—L—K, or their planes may pass one another. Thus many variations of adjustment are possible which were not possible

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in former machines, wherein the roll supports prevented such adjustments.

In the group N—L—K the rolls of opposite units work on opposite sides of the perimeter of the workpiece, so as to effect a squeezing action which reforms the perimeter of the bar section if this perimeter has been distorted by any of the straightening actions in the preceding straightening groups, assuming that the work is fed in from the right in Figs. 7 and 8. If the work is fed in from the left the group N—L—K corrects such perimeter errors as may have existed prior to entry of the work into the machine. Thus it is clear that the invention provides much greater flexibility than was available in prior machines in correcting the various deformations that may occur in the various planes of a bar or workpiece.

Although plain cylindric rolls 59 are shown in the drawings for accepting the flat faces of hexagonal stock, the faces of some or all of these rolls may be grooved or otherwise shaped to accept any shape of stock, such as, for example, angle sections, H-sections, or the odd shapes met with from extrusion processes. It is such shapes which often have the various section-moduli in various planes, which were usually difficult and often impossible to handle in prior-art machines. Obviously, the roll shape to be employed at any station will depend upon the shape of the section presented to the roll in the plane being handled at that station. It may be noted in this connection that the rolls 59 are interchangeable, as indicated by the holding nut and collar shown at 93.

Since in either form of the invention all of the rolls are powered, they act as a unit in forcing the work through the machine, thus obviating galling, scuffing and the like.

In some instances it may be desirable to have some of the rolls 59 operate as idler rolls, in which event one of the gears such as 51 may be removed from the roll-driving trains of the units which it is desired to have act in an idling capacity.

In view of the above, the various advantages of the invention will be clear, such as, for example, the following:

(a) As many or as few units MU or EU as desired may be used on a bed II of any desirable length. Any unit on one side of the bed may be adjusted to one side or the other of nearby units on the other side of the bed, or be made coplanar. Hence all kinds of straightening forces and moments may be applied, including opposite squeezing forces on a given perimeter.

(b) Any complicated work section may be accommodated and worked upon in any number of planes.

(c) One pass of the most complicated work through the machine is sufficient to take out all sweeps, bends, hooks and other deviations, as well as to reform the perimeter of the cross section.

(d) A minimum amount of surface working and roll marking is obtained because the variety of adjustments available between the rolls permits adjustment to maximum efficiency for each roll operation.

(e) All roll units or stands may be made identical for the mechanically driven application of Figs. 1-5, or for the electrically driven application shown in Figs. 7 and 8. Moreover, only minor changes are needed to convert a mechanically driven unit into an electrically driven unit.

(f) The machine is very flexible in its applications and adjustments, so that it can be adjusted to straighten practically any and all distortions that may be encountered in any number of planes in work of complex sections.

(g) Each unit of either the mechanically or electrically driven form of the invention is practically the same as every other unit, so that they may be used interchangeably in either of the guides of the bed.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

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As many changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A bar and tube straightening machine comprising a bed having a longitudinal guideway, a first carriage movable along said guideway and itself having cross guides, a transversely movable second carriage in the cross guides, an upright member carried by the transversely movable second carriage, a roll head vertically movable on the upright member, a rotary roll holder on said vertically movable roll head and adapted to rotate on an axis parallel to said longitudinal guideway, a vertical rotary worm supported by the upright member, a worm wheel driven by said rotary worm and adapted to traverse it upon vertical movement of the vertically movable roll head, a first bevel gear driven by said worm, a roll borne in said roll holder on an axis in a plane perpendicular to the axis of rotation of the roll holder, a second bevel gear meshing with said first bevel gear and connected with the roll, whereby the roll may be driven from said worm in any position of the roll holder and a planetary action obtained between said bevel gears upon adjustment of the roll holder.

2. Apparatus made according to claim 1, including a motor drive on the upright member adapted to drive said worm.

3. Apparatus made according to claim 1, including a splined drive shaft extending parallel to said longitudinal guide, a gear box having a gear slidably splined to said shaft and carried on said first carriage, a driven member extending from said gear box and driving a horizontal worm rotary on an axis parallel to the movement of said second carriage, and a worm wheel on the vertical worm and meshing with the horizontal worm, whereby a drive is established to the roll in any adjusted positions of said first carriage, second carriage, roll head and roll holder.

4. In a straightening machine for elongate workpieces such as extrusions, bars, tubes and the like of various sectional shapes, a bed having two longitudinal guideways located parallel to the longitudinal axis of a workpiece passing through the machine, and roll units guided by the guideways for longitudinal movement along the bed, each roll unit comprising a first slide adjustable on the bed to different positions along the length of the bed, a second slide adjustable on the first slide to different positions transversely of the bed, a third slide adjustable on the second slide to positions of different spacing from the bed, a roll shaft having a pivotal connection with the third slide, the axis of said connection being perpendicular to the roll shaft axis and parallel to the length of the bed so that the shaft is adjustable to different angular positions in a plane transverse to the guideways, and a rotatable roll on the shaft, whereby the plane of rotation of said roll may be tilted relative to the bed while remaining parallel to said longitudinal axis of a workpiece passing through the machine.

5. In a straightening machine for elongate workpieces such as bars, tubes and the like, a bed having two longitudinal guideways, and roll units guided by the guideways for longitudinal movement along the bed, each roll unit comprising a first slide adjustable on the bed to different positions along the length of the bed, a second slide adjustable on the first slide to different positions transversely of the bed, a third slide adjustable on the second slide to positions of different spacing from the bed, a shaft having a pivotal connection with the third slide, the axis of said connection being transverse to the shaft axis and parallel to the length of the bed so that the shaft is adjustable to different angular positions in a plane transverse to the bed, a roll fixed on each shaft, and means for driving the rolls in any position of adjustment.

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