Sept. 2, 1941. R. T. TODD 2,254,461

ROLLER LEVELER

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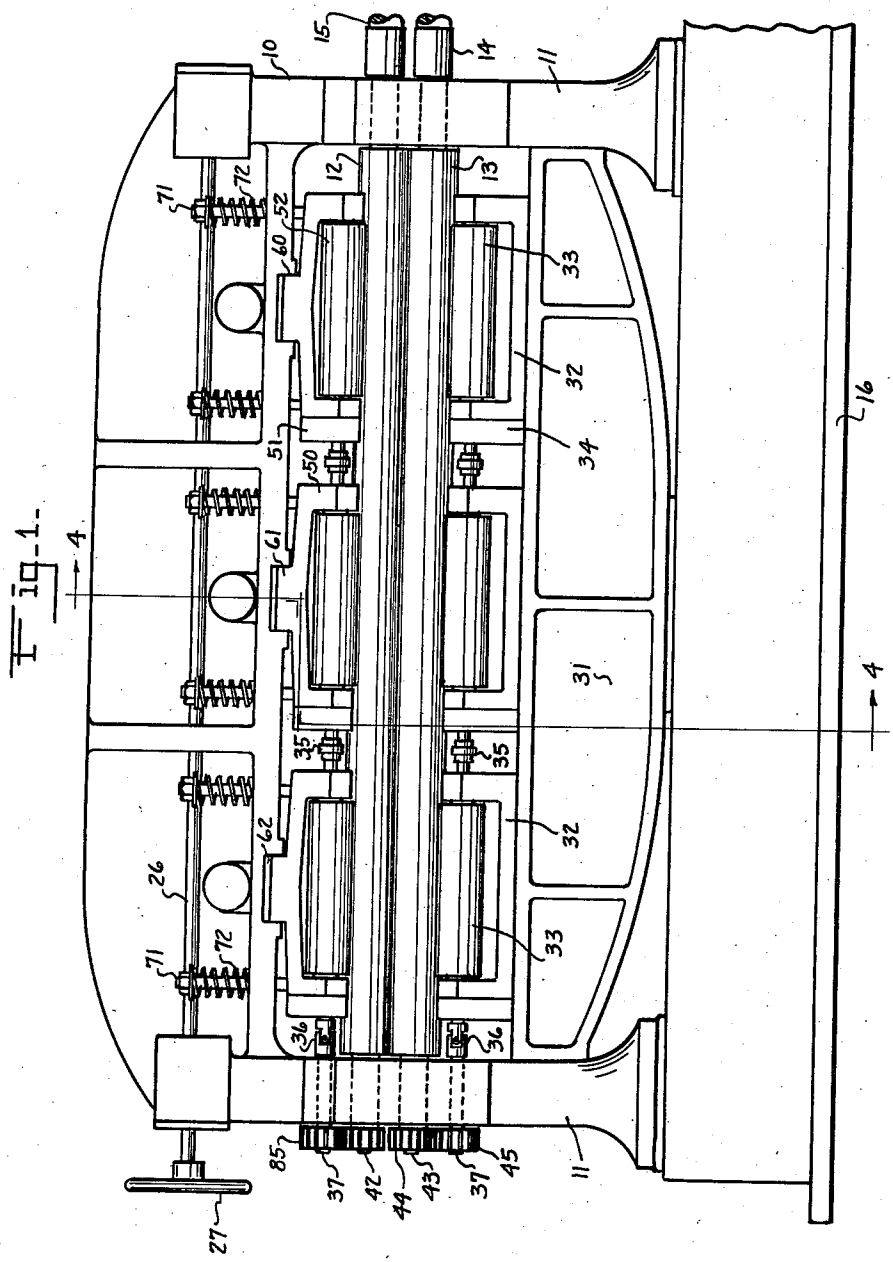


Fig. 1.

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Fig. 2.

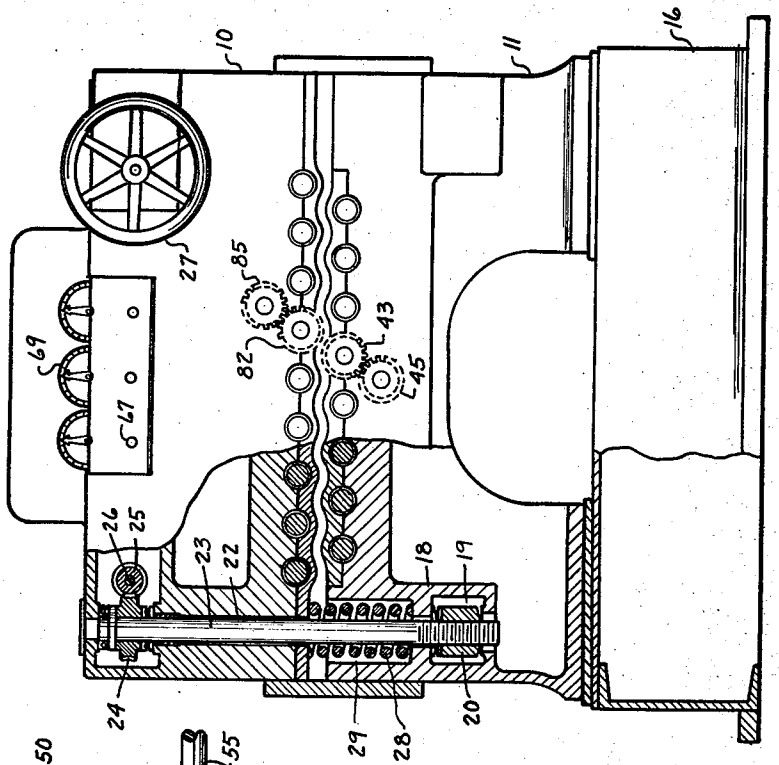
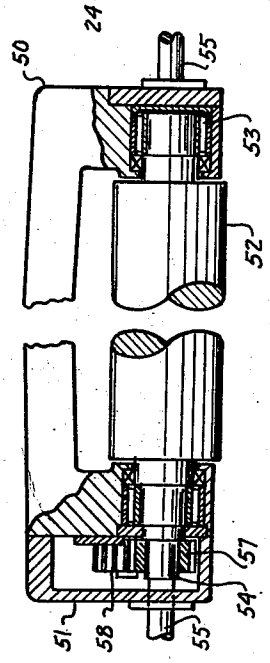


Fig. 3.



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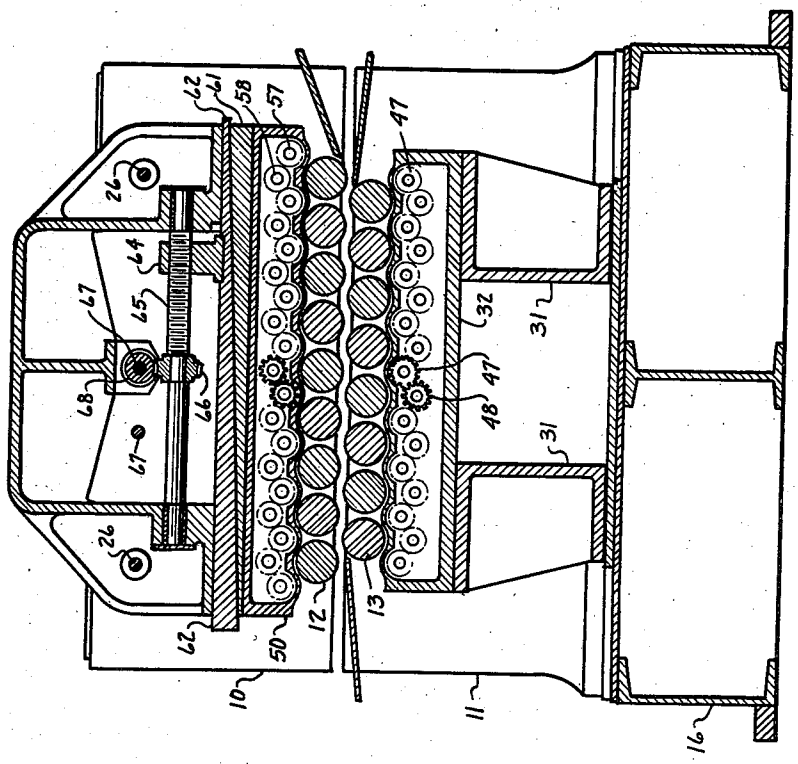
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Fig. 4.



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UNITED STATES PATENT OFFICE

2,254,461

ROLLER LEVELER

Russell T. Todd, Youngstown, Ohio, assignor to McKay Machine Company, Youngstown, Ohio, a corporation of Ohio

Application November 17, 1938, Serial No. 240,981

14 Claims. (Cl. 153—54)

This invention relates to the art of processing metal sheets and strip and more particularly to certain improvements in the design and construction of a machine used to work and flatten the sheets or strip preparatory to their fabrication into vehicle bodies and other articles of commerce. Continued improvement in the quality, uniformity, and finish of metal sheets and strip results from increased precision and efficiency of production and processing machinery while the maintenance of high productive speeds in the use of such machinery enables the improved finished material to be produced at reasonable cost.

The machine to which the features of the present invention are particularly applicable consists principally of a series of metal working rolls of relatively small diameter arranged in staggered relation to define a sinuous path of travel for the sheets or strip passing through the machine. Such machines, commonly termed "roller levelers" have as their principal function the subjection of the sheets or strip to a series of reverse bendings progressing from a selected maximum to zero amplitude whereby the stock is cold worked to relieve inherent stresses thus improving the physical qualities of the stock and removing bulges and the like therefrom to give a smooth level surface to the stock.

The extent of working of the metal determining the quality of the product is governed, in machines of the kind mentioned, by the diameter of and intervals between the rolls aforementioned—a decrease in the diameter of and intervals between the rolls resulting in sharper bending and consequently greater working of the material being passed therethrough. The use of small diametered rolls particularly in machines capable of processing wide sheets wherein the rolls are relatively long requires means to support the rolls at one or more points intermediate their ends. To provide for such support a series of rigidly supported secondary backing up rolls is positioned both above the upper set of working rolls and below the lower set of working rolls and have rolling contact with the working rolls thus preventing the expansive force exerted by the material being processed from deflecting the working rolls.

Heretofore, in machines of the kind described, the practice has been to mount the back-up rolls on rigidly supported bearings in such manner that the rolls were free to rotate individually when engaged by the driven working rolls. Inasmuch as the back-up rolls were driven only by peripheral contact with the working rolls, considerable pressure must be maintained between the rolls to insure uniform rotation of the back-up rolls and such pressure is maintained when stock is in the machine. However, when the machine is unloaded the pressure is removed and in fact the upper working rolls may move out of contact with their back-up rolls due to the inherent deflection of the working rolls and in this condition of the parts the back-up rolls will idle to a stop while the working rolls continue their uniform driven rotation. Now as material is fed between the working rolls, the rolls will be violently urged into engagement with the back-up rolls but because of their inertia they will momentarily remain at rest and then progressively attain synchronous speed. The attendant sliding between the roll surfaces results in rapid wear of the same, the formation of flat spots on the back-up rolls thereby causing chattering of the machine, and in general excessive wear of the moving parts of the machine.

It is the primary object of my invention to provide a construction for the purpose described in which the objectionable characteristics enumerated above are eliminated. This is accomplished by providing operative means for driving the back-up rolls in synchronism with the working rolls. Accordingly, a more specific object of my invention is the provision of means, in a backed-up roller leveler, for driving the back-up rolls in synchronism with the working rolls. Another specific object of the invention is the provision of improved back-up rolls and supports therefor in a machine of the kind mentioned.

A further object of my invention is the provision of improved means for adjusting the relative position between the lower and upper series of working rolls and the position of the upper back-up rolls relative to the upper working rolls. Both adjustments may be performed by an operator positioned to one side of the path of travel of material through the machine and the former is operative to maintain a considerable interval between the series of working rolls thus facilitating inspection and cleaning of the rolls.

These and other objects and advantages of the invention will become apparent from a consideration of the drawings and the following detailed specification wherein there is disclosed certain preferred embodiments of the invention.

In the drawings:

Figure 1 is an end view of a machine con-

structed in accordance with the principles of my invention;

Figure 2 is a side view, partly in section, of the machine of Figure 1;

Figure 3 is a broken end view, partly in section, of a back-up roll support; and

Figure 4 is a sectional view, taken along the line 4—4 of Figure 1.

Referring now to Figures 1, 2 and 4, the machine illustrating the application of the principles of the invention may consist generally of upper and lower frames 10 and 11, respectively, each rotatably supporting a series of metal working rolls 12 and 13, respectively. The latter are individually driven at uniform speed through couplings 14 by shafts 15 which in turn are suitably driven from a gear assembly, not shown. Lower frame 11 is rigidly supported on a box-like base 16 and in turn is arranged to adjustably support the upper frame 10 by means now to be described. Extending inwardly from the ends of each of the side members of the lower frame 10 are the projections 18 (see Figure 2) which are provided at their lower ends with the chambers 19 for the reception of the internally threaded members 20. The chambers 19 are each provided in the upper and lower walls with aligning apertures through which extend the supporting and adjusting screws 23. Screws 23 extend above the lower frame 11 and up through bores 22 in the upper frame 10. A worm wheel 24, held against axial movement in the frame 10, is keyed to each of the screws 23 and in turn are actuated by worm gears 25 supported and rotated by the transversely extending shafts 26. The machine is provided with two such shafts extending across the machine and outwardly of one side thereof where operating hand wheels 27 may be conveniently attached. The lower portions of screws 23 are screw-threadedly connected with the members 20 which members are held against rotation by any suitable expedient, not shown. A heavy coil spring 28, partially housed with a recess 29 in lower frame 11, surrounds each of the screws 23 and by having their upper ends abutting against the lower face of the upper frame 10 and their lower ends resting on the frame 11 operate to maintain the two frames in spaced relation. The extent of such spacing or the interval between the two frames may be varied by rotating wheels 27 thus rotating screws 23 and causing the latter to thread into or out of the members 20 thereby raising or lowering the screws and consequently raising or lowering the upper frame 10. Suitable means, not shown, prevents axial movement of the screws 23 relative to the frame 10. It should be observed that since the two forward screws 23 are both driven by one of the shafts 26 and the two rearward screws are driven by the other of the shafts, the tilt or angularity of the upper series of rolls 12 as well as the interval between the two series of rolls may be varied. Thus the extent of flexure and rate of diminishment thereof to which the material being processed is subjected may be controlled.

Chambers 19 are of sufficient size to loosely receive the members 20 and with the parts in operative position the members will be urged into engagement with the upper walls of the chambers. If, however, it is desired to widely separate the upper and lower frames 10 and 11 for purposes of inspection, cleaning, etc., continued rotation of wheels 27 and screws 23 in the proper direction will release the expansive forces exerted by springs 28 and cause the members 20 to rest on the bottom walls of chambers 19 thus providing a rigid support for the upper frame when in upper raised position. This feature is of advantage in that without the addition of any complicating or expensive mechanism means integral with the machine is provided for raising and maintaining in raised position the upper roll assembly whereby inspection, cleaning and other maintenance operations are facilitated.

The machine specifically disclosed is provided with three separate groups of upper and lower back-up rolls although it should be readily understood that a single group or any number of such groups may be provided depending on the design of and the use intended for the machine. Because of minimum deflection in shafts of short length the best practice is to construct the back-up rolls of short length and take care of the longer working rolls by utilizing a number of such back-up rolls spaced axially along the working rolls. In the machine illustrated, a plurality of transversely extending beams 31 are incorporated in the lower frame 11 to form a support for the generally U-shaped back-up roll housings 32. A plurality of parallel back-up rolls 33 have their supporting shafts journaled in the side portions of the housings 32 with the shafts extending outwardly through one side portion into the gear case 34 contiguous therewith. A gear 47 is keyed to each of said shafts so extended and intermediate each adjacent pair of gears 47 is a meshing idler gear 48 the latter being suitably mounted within the gear cases on a transversely extending pin, not shown, or other expedient. Since the gears 47 and 48 are respectively identical the rolls 33 will rotate in the same direction and at uniform speed. Certain of the extending shafts above mentioned are lengthened considerably to extend outwardly beyond the outer walls of the housing 32 and gear case 34 for the purpose, as shown in Figure 1, of being connected with a flexible or universal coupling as shown at 35 and 36. The supporting shaft of one of the driven lower working rolls is extended at 43 to receive the gear 44 which meshes with a gear 45 keyed to the parallel shaft 37 the inner end of which is coupled by means of the universal coupling 36 with the adjacent lengthened shaft of a back-up roll 33. But one such coupling is required in the lower roll assembly as the back-up rolls in a group are all interconnected by the gears 47 and 48. The groups are interconnected by the couplings 35 which are attached to the lengthened back-up roll shaft above mentioned.

The upper frame 10 is provided with three downwardly opening longitudinally extending slots 60 each adapted to receive a tapering rib 61 on the upper back-up roll housings 50. Aside from the rib noted, the housings 50 are generally similar to the lower housings 32. Each is provided with a gear case 51 corresponding to the lower gear case and the upper back-up rolls 52 which are identical with the lower rolls 33 are similarly supported, interconnected and driven. For the latter purpose, one of the upper driven working rolls 12 is provided with an extended shaft 42 on which is keyed the gear 82 meshing with gear 85 keyed on the parallel shaft 37. Shaft 37 drives the first group of back-up rolls through universal coupling 36 and the succeeding groups are successively connected through couplings 35. Referring to Figure 3, which is a broken end view partly in section of

an upper back-up roll support or housing, the front back-up roll 52 is carried by a shaft 55 which is elongated, as shown, for connection with the couplings 36 and 35 or 35 and 35 depending on the position which the particular support or housing has relative to the upper frame 10. Roll 52 is journaled in the housing 50 in the antifriction bearings 53 and that portion of the shaft 55 which passes through the gear case 51 provided with an enlargement 54 on which is keyed the gear 57. As indicated in Figure 4, each of the rolls 52, whether provided with an elongated coupling shaft or not, is provided with a similar gear 57 housed in gear case 51. As indicated in Figures 3 and 4, gears 58 are interposed between the gears 57 and are in mesh with gears 57. It should be obvious from the above description that each of the back-up rolls are positively driven in accordance with the speed of rotation of the driven working rolls. The peripheral speeds of the working rolls and the back-up rolls are equal at all times insuring rolling contact whenever engagement is effected. The smoothness of operation of the machine is enhanced and the working and moving elements thereof will have longer life.

Referring now to Figures 1 and 4 of the drawings, the housings 50 for the upper back-up rolls 52 are suspended from the rods 71 which are urged to upward position by the springs 72. The housings are thus maintained in engagement with the adjustable abutments consisting of the tapered slides 62 positioned within the slots 60 and cooperating with the tapered ribs 61 of the housings to raise or lower the housings individually relative to the upper frame 10. To provide the adjustments, each of the members 62 have an upwardly extending member 64 rigidly secured thereto and provided with a threaded bore to receive the threaded shaft 65 extending longitudinally of the machine. The shaft 65 is held against axial movement but is adapted to be rotated by a transversely extending shaft 67 through worm 68 and worm wheel 66 keyed on shaft 65. It should be obvious that rotation of shaft 67 results in longitudinal movement of the tapered member 62 and consequent vertical adjustment of the back-up roll housing. One such adjusting assembly is provided for each of the upper back-up roll housings, the worm wheels 66 being positioned on the shafts 65 in stepped relation to enable the respective operating shafts 67 to be positioned side by side in non-interfering relation. The latter shafts extend outwardly of the side of the machine on the same side as the hand wheels 27 where their ends may be engaged by a crank or other suitable tool for rotating them. Suitable indicators 69 may also be provided to indicate the adjusted positions of the housings. It can thus be seen that the present invention provides a simply constructed arrangement for independently varying the vertical positions of the back-up roll housings relative to the upper working roll carrying frame and that these adjustments as well as the adjustment of the interval and angularity between the upper and lower series of working rolls may be effected by a single operator positioned to one side of the path of travel of the material being processed.

The above specifically described embodiments of the invention should be considered as illustrative only as obviously many changes may be made therein without departing from the spirit or scope of my invention, the extent of which is indicated by the subjoined claims.

What I claim is:

1. In a machine of the character described, the combination of upper and lower series of metal working rolls arranged in offset relation to define a sinuous path of travel for material passing therebetween, a plurality of groups of rigidly supported back-up rolls positioned immediately above said upper series and immediately below said lower series and adapted to limit the outward flexure of said working rolls, a unitary housing rotatably supporting each of the rolls of a group, means carried by each of the housings to interconnect each of the rolls of the group supported by the housing whereby the rolls of the group will rotate in unison, means to interconnect certain of the rolls of the different groups whereby all the back-up rolls will rotate in unison, and means to drive certain of said back-up rolls in accordance with the speed of rotation of the working rolls, said means mechanically interconnecting certain of said back-up rolls with certain of said working rolls.

2. In a machine of the character described, the combination of upper and lower frames adapted to rotatably support upper and lower series of metal working rolls, said upper and lower series being arranged in offset relation whereby a sinuous path of travel for material passing therebetween may be provided, means to vary the interval and angularity between said upper and lower frames, means to drive said rolls at uniform speed, a plurality of housings rigidly supported on said lower frame below said lower series and spaced axially along the rolls of the lower series, a plurality of back-up rolls rotatably supported on each of said housings and adapted to normally engage and support the lower working rolls, means carried by each of said housings to rotatably interconnect each of the rolls carried by the housing, means to interconnect the back-up rolls of the different housings, means to interconnect at least one of the rolls of said lower series of working rolls with at least one of said back-up rolls whereby all the rolls carried by the lower frame will rotate at uniform speed, a plurality of housings supported on said upper frame above said upper series of working rolls and spaced axially therealong, a plurality of back-up rolls rotatably supported on each of said housings and adapted to engage and restrain the upper working rolls, means carried by each of said last mentioned housings to rotatably interconnect each of the rolls carried thereby, means to interconnect at least one of the rolls carried by each of the last mentioned housings, means to interconnect at least one of the upper working rolls with at least one of the upper back-up rolls whereby all the rolls carried by the upper frame will rotate in unison, and means to individually and vertically adjust the position of each of said last mentioned housings with respect to said upper frame.

3. In a machine of the character described, the combination of upper and lower frames adapted to rotatably support upper and lower metal working rolls, said upper and lower rolls being arranged in offset relation whereby a sinuous path of travel may be provided for material passing therebetween, means to vary the interval and angularity between said frames, means to drive said rolls at uniform speed, a plurality of back-up rolls rotatably supported by said lower

frame and adapted to engage and restrain the lower working rolls, means to rotatably interconnect said back-up rolls and means comprising a flexible coupling to interconnect at least one of said lower working rolls with at least one of said back-up rolls whereby all the rolls carried by said lower frame will rotate at synchronous speed, a plurality of upper back-up rolls rotatably supported by the upper frame and adapted to engage and restrain the upper working rolls, and means comprising a flexible coupling interconnecting said upper back-up rolls and at least one of said upper working rolls whereby all the rolls carried by said upper frame will rotate at synchronous speed.

4. In a roller leveler, the combination of upper and lower frames for the rotatable support of metal working rolls, means to vary the interval and angularity between said frames comprising resilient means normally tending to separate said frames, means opposing the forces exerted by said resilient means comprising screws axially fixed in one of said frames and threaded into members non-rotatably carried in the other of said frames, means carried by the said one of said frames to rotate said screws, means in the said other of said frames to limit the axial movement of said members, the arrangement being such that continued rotation of said screws in one direction results first in the release of the forces exerted by said resilient means and thereafter in the support of the said one frame by the said members.

5. In a roller leveler, the combination of a fixed roller frame for the rotatable support of metal working rolls, an upper frame for the rotatable support of metal working rolls, means to vary the interval and angularity between said frames, said upper frame comprising a horizontally disposed portion and downwardly extending portions at the ends of said horizontal portion, a groove extending at right angles to the axes of said rolls in the lower surface of said horizontal portion, a roll carrying frame adapted to rotatably support back-up rolls immediately above the rolls carried by said upper frame and provided with a rib adapted to be partially received within said groove, a wedge in said groove above said rib and means to move said wedge longitudinally in said groove.

6. Apparatus according to claim 5 in which said last mentioned means comprises a shaft extending outwardly of the path of travel of the material through said leveler.

7. Apparatus according to claim 5 in which said last mentioned means comprises a screw-threaded shaft parallel with and above said groove, means to prevent axial movement of said shaft, a screw threaded connection between said wedge and said shaft and means to rotate said shaft comprising a second shaft extending angularly outward from said first mentioned shaft.

8. Apparatus of the character described comprising upper and lower metal working rolls arranged in staggered relation to define a sinuous path of travel for material passing therebetween, back-up rolls normally engaging and restraining the upper of said metal working rolls, an elongated housing substantially inverted U-shaped in section overlying said upper metal working rolls, said back-up rolls being journaled in the side walls of said housing and having their shafts extending outwardly of the outer face of one of said walls, means outwardly of said face to interconnect each of said shafts whereby all the back-up rolls will be caused to rotate in unison, and means comprising a flexible coupling rotatably connected with one of said upper metal working rolls to rotate said back-up rolls in accordance with the speed of rotation of said upper metal working rolls.

9. Apparatus of the character described comprising in combination a fixed frame for the rotatable support of metal working rolls, an upper frame for the rotatable support of metal working rolls, means to vary the interval and angularity between said frames, said upper frame comprising a horizontally disposed portion and downwardly extending portions at the ends of said horizontal portion, a groove extending at right angles to the axes of the rolls in the lower surface of said horizontal portion, a roll carrying frame adapted to rotatably support back-up rolls immediately above the rolls carried by said upper frame and provided with a rib adapted to be partially received within said groove, a longitudinally movable wedge in said groove above said rib, means to rotate in unison the rolls carried by said upper and lower frames, means mechanically interconnecting said back-up rolls whereby said back-up rolls rotate in unison, a shaft journaled in one of said downwardly extending portions, means rotatably interconnecting said shaft and said second mentioned rolls, and a flexible coupling joining said shaft and said second mentioned means.

10. Apparatus of the character described comprising in combination a fixed frame for the rotatable support of metal working rolls, an upper frame having a horizontally disposed portion and downwardly extending portions at the ends of the horizontally disposed portion, upper metal working rolls journaled in said downwardly extending portions, a roll carrying frame interposed between said horizontally disposed portion and said last mentioned rolls and adapted to rotatably support back-up rolls immediately above said upper rolls, means to rotate said first and second mentioned rolls in unison, means mechanically interconnecting said back-up rolls whereby said back-up rolls rotate in unison, a shaft journaled in one of said downwardly extending portions, means rotatably interconnecting said shaft and said second mentioned rolls, and a flexible coupling joining said shaft and said second mentioned means.

11. In a roller leveler, the combination of upper and lower frames for the rotatable support of metal working rolls, means to vary the interval and angularity between said frames, a secondary frame carried by each of said upper and lower frames and each adapted to rotatably support a plurality of back-up rolls, said back-up rolls being keyed to shafts journaled in said secondary frames, said shafts extending outwardly of said secondary frames, means outwardly of said secondary frames to rotatably interconnect the shafts journaled therein, means to rotate said working rolls in unison, and means to mechanically interconnect certain of said working rolls with certain of said back-up roll carrying shafts whereby all of said rolls will rotate in unison.

12. In a roller leveler, the combination of upper and lower frames for the rotatable support of metal working rolls, means to vary the interval and angularity between said frames, means to rotate said metal working rolls in unison, a secondary frame carried by each of said upper and lower frames and each adapted to rotatably support a plurality of back-up rolls, said back-up rolls being keyed to shafts journaled in said sec-

ondary frames, said secondary frames being movable relative to said upper and lower frames whereby the pressure exerted by said back-up rolls on said metal working rolls may be varied, means to mechanically interconnect each of the shafts journaled in a secondary frame whereby all the back-up rolls in each secondary frame will be rotatably interconnected, means comprising a flexible coupling interconnecting one of the metal working rolls of the lower frame with one of the back-up roll carrying shafts of the lower secondary frame, and means comprising a flexible coupling interconnecting one of the metal working rolls of the upper frame with one of the back-up roll carrying shafts of the upper secondary frame whereby all the rolls of the leveler are positively driven at the same peripheral speeds.

13. In a machine of the character described the combination of upper and lower series of metal working rolls arranged in offset relation to define a sinuous path of travel for sheet metal passing therebetween, a plurality of rigidly supported back-up rolls positioned immediately above said upper series and adapted to limit the upward flexure of said upper metal working rolls, a unitary housing rotatably supporting each of said back-up rolls, means to rotatably interconnect each of said back-up rolls, means to rotatably and mechanically interconnect certain of said back-up rolls with certain of said upper metal working rolls whereby all the back-up rolls will rotate in unison and in accordance with the speed of rotation of said upper metal working rolls.

14. Apparatus according to claim 13 further including means engaging said housing to vary the pressure between said back-up rolls and upper metal working rolls, the means rotatably interconnecting certain of said back-up rolls with certain of said upper metal working rolls including a flexible coupling.

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