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[54] **APPARATUS FOR LEVELING THIN STRIP**

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[58] **Field of Search** 72/161, 164, 160

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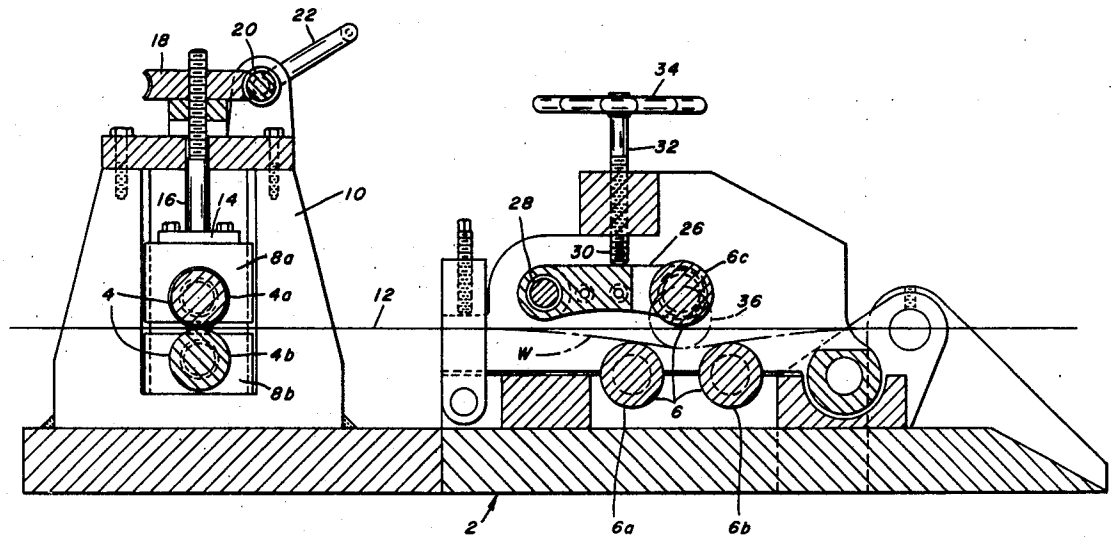
Primary Examiner—Milton S. Mehr

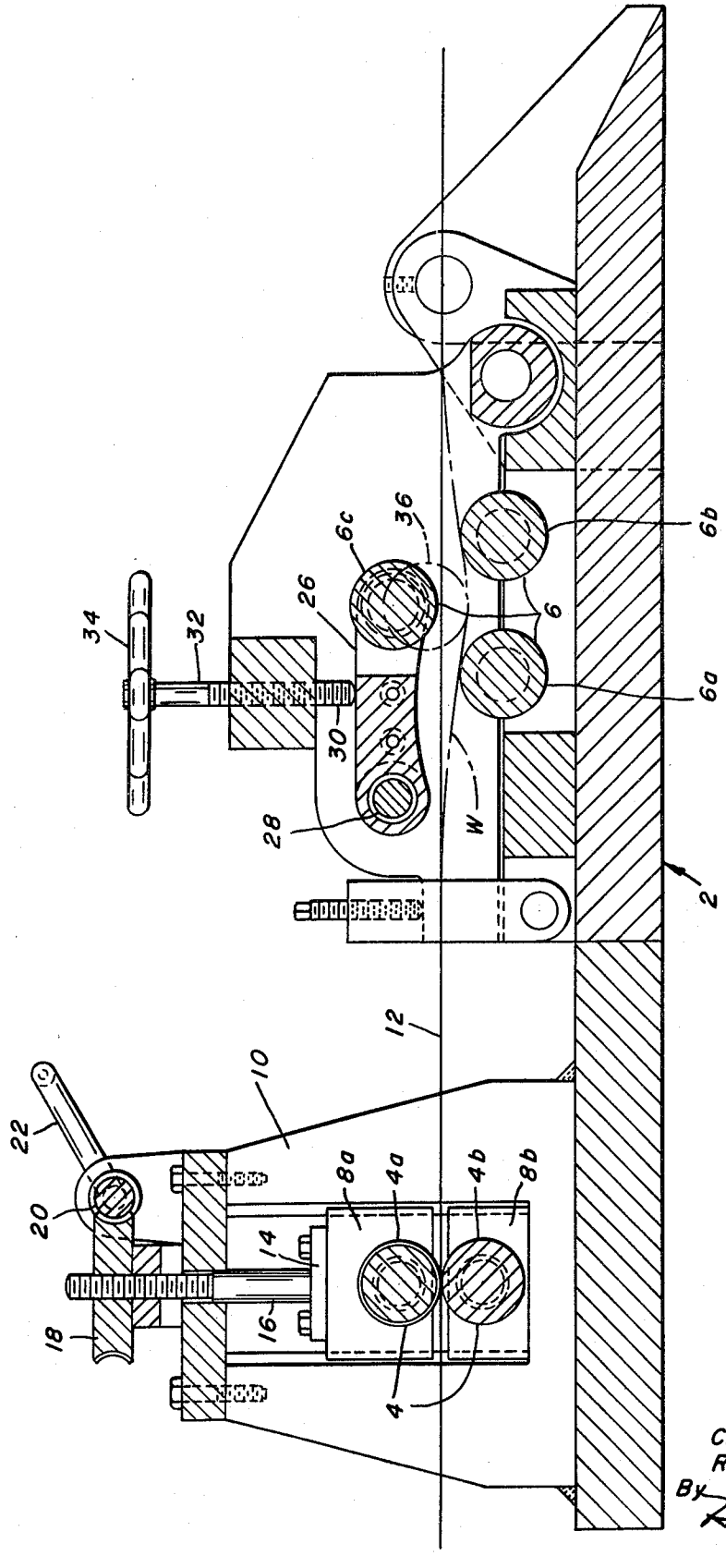
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[57] **ABSTRACT**

Apparatus for removing coil set, and dish, from thin gauge strip, such as electrical grade, hard temper steel, having a combination of rolls including a first pair of stacked rolls, one of which is substantially cylindrical in shape and the other of which is slightly concave so that passage of the material through the first pair of rolls will affect a slight elongation of the material at its edges. The apparatus contains a second group of rolls consisting of a cluster of staggered, or offset rolls of substantially cylindrical shape, whereby a workpiece passing therethrough is alternately flexed in opposite directions away from a straight pass line through the apparatus.

4 Claims, 1 Drawing Figure





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APPARATUS FOR LEVELING THIN STRIP

BACKGROUND OF THE INVENTION

In the manufacturing of flat rolled material such as strip of steel conventional operations for producing flat material which is suitable for many purposes are roller leveling and temper rolling. In those instances where the rolled product must have a high degree of flatness, stretcher leveling, sometimes known as tension leveling is employed. Conventional roller leveling is performed in a machine consisting of two rows of several small diameter horizontal rolls, mounted in a housing so that the top and bottom rolls are offset. A sheet or strip passing through the leveler is flexed upwardly and downwardly alternately, the rolls being positioned so that the amount of flexing decreases as the strip travels toward the exit end of the leveler with the rolls nearest the exit end performing chiefly as straightening function. These conventional roller levelers are large pieces of apparatus often costing several hundreds of thousands of dollars.

Stretcher leveling or tension leveling produces a flatness by stretching a sheet or strip lengthwise between jaws, the necessary force being supplied usually by a hydraulic system. The sheet or strip being leveled is usually elongated between one and three percent the elastic limit of the steel being exceeded to produce some permanent elongation. Since the width of a sheet is contracted by stretcher leveling, a suitable allowance must be made so that the flattened sheet is of adequate width. Alignment of the equipment required for stretcher or tension leveling is extremely critical and while flattening a product it is also often possible to enduce other deformations such as a twist.

In the production of strip material of medium or light gauge and of narrow width the strip is passed through a slitter thereby producing coils of narrow material of widths required by ultimate customers. In the running of strip material through slitters, the cutting action of the knives slitting the material often causes irregularities and deformation of strip. Where a customer imposes demanding tolerances on flatness for narrow width products it may be necessary to again flatten or level the material after slitting. Those familiar with the art will recognize that depending upon the condition of the knife edge and the width of the strip being slit the amount of deformation twist will vary. The releveling and flattening of such narrow slit material continues to be a problem in the industry since conventional levelers often induces a twist in narrow, thin material.

Thus, there exists a need for a flexible low cost, easily operated device for flattening light to medium gauge, narrow strip material to meet exacting customer requirements.

SUMMARY OF THE INVENTION

Apparatus for removing coil set and dish from a thin, narrow, strip of steel including a pair of stacked rolls disposed on the entry end of the apparatus, one of said rolls being substantially cylindrical in shape and the other being slightly concave, such that a workpiece being passed therebetween will be elongated at its edges and a cluster of cylindrical rolls disposed subsequent to said stacked rolls along said pass line, said rolls so arranged that upon passage of the workpiece through said cluster, said workpiece will be flexed away from the pass line, first in one direction and then the other.

DESCRIPTION OF THE DRAWINGS

Referring now to the Figure reference numeral **2** indicates a housing for the leveling apparatus of my invention, containing a pair of stacked rolls **4** and a cluster of offset rolls **6**. Stacked pair **4** has an upper roll **4*a***, which in the preferred embodiment is slightly concave and is mounted in chocks **8*a***, which in turn are contained in upper housing **10**. The lower roll **4*b*** of the stacked pair **4** is generally cylindrical in shape and is contained in chocks **8*b*** within upper housing **10**. The chocks **8*a*** and **8*b*** are keyed into housing **10** in a conventional tongue and groove arrangement wherein the chocks **8*a*** and **8*b*** contain the groove and the tongue is contained on housing **10**. Rolls **4*a*** and **4*b*** define a roll bite therebetween and are disposed on either side of a pass line **12** and subjected to rolling pressures through a plate **14**, acted upon as by example, a screwdown **16** which is actuated by gears **18** through worm **20** by crank **22**. Also contained within the housing **2** are cluster rolls **6** including lower rolls **6*a*** and **6*b*** and upper rolls **6*c***. Rolls **6*a*** and **6*b*** are disposed slightly below pass line **12** and supported by bearings (not shown). Upper roll **6*c*** is supported in rocker support **26**, pivotly mounted as at **28**. A screwdown **30** is mounted above with a screwdown shaft **32** operated by cranking means **34**, such that rocker arm **26** may be rotated downwardly toward rolls **6*a*** and **6*b*** causing roll **6*c*** to assume the dotted position shown as at **36**; when in such position the workpiece W will be deflected along the dotted line shown, first, being flexed downwardly between rolls **6*a*** and **6*c*** and then upwardly between rolls **6*b*** and **6*c***, removing the coil set of the workpiece W as it passes therebetween.

Conventionally, a strip of material such as a narrow strip of electrical steel less than two inches wide and of a gauge less than 0.020 which has been run through a slitter has been subjected to some deformation by action of the knives. This appears as a dish-shaped profile in the strip material. This deformation must be removed according to most customer's specifications. The apparatus of my invention accomplishes this, in addition to removal of coil set by passing the workpiece W through stacked rolls **4**. As workpiece W passes therebetween in the concave shape of roll **4*a***, operating in conjunction with cylindrical roll **4*b***, causes an elongation of the edges of the workpiece passing between the rolls. In order to accomplish removal of the dish, the degree of elongation of the edges may be controlled by the roll down force exerted through the rolling force generating means, including plate **14** and screwdown means **16**, **18** and **20**. We affect the removal of dish with nominal screwdown pressures available in my apparatus by using rolls of very small diameter. In the preferred embodiment the rolls **4*a*** and **4*b*** are 10 inches long and have a base diameter of 0.875 inches. It will be appreciated that the diameter of the concave roll is slightly less than this at its center being 0.001 inches in the preferred embodiment. Further, restricting the length of the rolls in my invention to about 10 inches long enables leveling of more narrow material. Acting in combination with dish removal rolls **4** are the rolls of cluster **6** for removing the irregularity of coil

set. Workpiece W upon exiting stacked rolls **4** passes into cluster rolls **6** and the diameter of each roll **6***a*, **6***b* and **6***c* also being smaller than is conventional. In the preferred embodiment these rolls are of 0.875 inches in diameter and bottom rolls **6***a* and **6***b* are 10 inches long with top roll **6***b* being 8¾ inches long, being so adapted to be received in rocking assembly **26**. Workpiece W as it passes through cluster **6** is first deflected downwardly between rolls **6***a* and **6***c* and then around roll **6***c* and deflected upwardly between rolls **6***b* and **6***c* back to the original pass line **12**. Because of the small diameter of my rolls **6***a*, **6***b* and **6***c* and the need to remove only coil set from the workpiece W, cluster **6** requires only three rolls to accomplish the removal of the coil set. It will be noted that there is only a single flexing in each direction of the workpiece W and no straightening is required contrary to that previously done in the art.

It will be appreciated by those familiar with the art that the strip flattening apparatus disclosed herein is much less complex than exists in the prior art and is extremely flexible and easy to use. In the preferred utilization of my flattening apparatus, housing **2** is installed on a table (not shown) between conventional uncoiling and recoiling reels (also not shown) and the workpiece is pulled through the rolls **4** and **6**. It will be noted that these rolls are pull-through type and are not driven. It will be also appreciated by those familiar with the art that the flexibility of the installation enables strip leveling to be performed in minimal space and with nominal investment, enabling significant reductions in total cost of producing flat material. It will also be apparent to those skilled in the art that the simplicity of the apparatus permits leveling of a narrow strip to exacting tolerances by one with considerably less experience than might be required by a conventional complex leveler.

We claim:

1. Apparatus for leveling metallic strip material comprising two stacked work rolls carried in chocks at their opposite ends and defining a roll bite therebetween through which metallic strip material passes as it travels along an essentially straight-line path of travel, means exerting forces on said chocks at essentially right angles to said straight-line path of travel to maintain said chocks in essentially fixed positions as strip material passes therebetween, one of said rolls having a true cylindrical shape and the other having a concave shape whereby the roll force exerted by said rolls will be greater at the edges of the strip material than at the center thereof, a cluster of three rolls through which said strip material passes after passing through said two stacked rolls, two of said three cluster rolls being on one side of the strip material and the third being on the other side between the first two, and means for forcing said third roll toward the other two whereby the strip material is caused to flex first in one direction and then in the other as it passes over the periphery of said third roll.

2. The apparatus of claim **1** wherein all of said recited rolls have a nominal diameter of less than one inch, the diameters of all rolls being essentially the same.

3. The apparatus of claim **2** wherein said third cluster roll is mounted on a rocker arm pivotal about a shaft extending transverse to the direction of strip movement through said rolls, and means between said shaft and said third cluster roll for forcing said rocker arm and said third cluster roll toward said first two cluster rolls.

4. The apparatus of claim **1** wherein said strip material is engaged by said work rolls in essentially line contact.

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