Aug. 24, 1965 F. K. MAUST 3,201,965

STAGGERED SUPPORTING ARRANGEMENT FOR BACKED-UP ROLLER LEVELER

Original Filed Oct. 22, 1958

FIG. 1.

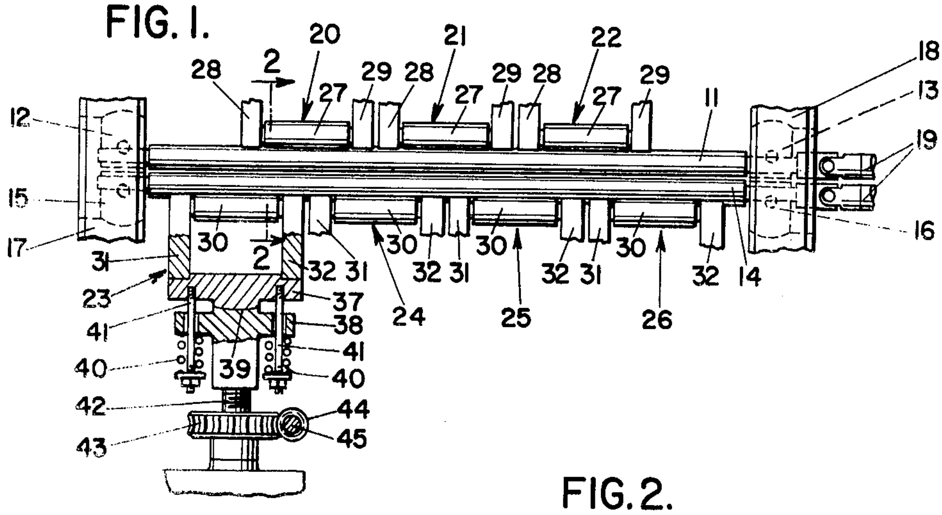



FIG. 2.

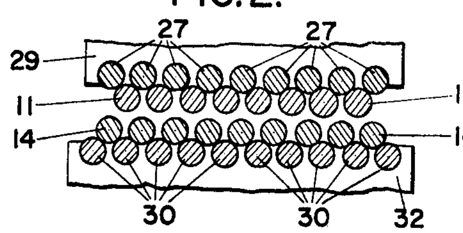



FIG. 3.

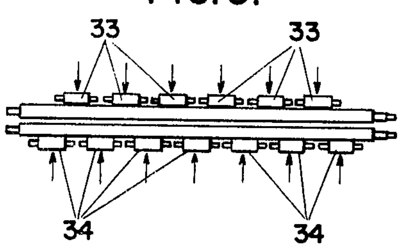
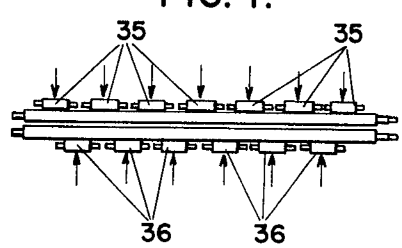



FIG. 4.

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**STAGGERED SUPPORTING ARRANGEMENT FOR BACKED-UP ROLLER LEVELER**


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Original application Oct. 22, 1958, Ser. No. 768,991, now Patent No. 3,078,908, dated Feb. 26, 1963. Divided and this application Dec. 10, 1962, Ser. No. 243,499
5 Claims. (Cl. 72—163)


This application constitutes a division of my application Serial Number 768,991, filed October 22, 1958, and now Patent Number 3,078,908, issued February 26, 1963.

This invention relates to backed-up roller levelers for flattening and straightening plate, sheet and coiled material and has particular reference to a novel arrangement of multiple adjustable supporting sections positioned in a novel way along the longitudinal axes of their associated work or straightening rolls.

In a backed-up roller leveler, the material is subjected to a succession of transverse waves by passing it between two banks of cooperating work rolls, each bank of work rolls producing a succession of half-waves in the material. Each bank of work rolls is backed-up by a series of short support or backing rolls with suitable adjusting means, also called broadly support roll sections. These are spaced along and are in contact with the work rolls. When it is desired to stretch preferentially short areas of the work material, then the support roll sections are adjusted differentially so that the work rolls are either deflected into convex, concave or sinuous deflection or working contours or are deflected into such a contour by the work material passing between the banks of work rolls. The particular adjusted deflection contours always depend on the setting of the support roll sections to accomplish certain desired results on the work material. The material to be leveled is thus subjected to waves whose amplitudes vary transversely of the material corresponding to the adjusted deflection contours of the work rolls.

In order to be effective, the work rolls of roller levelers must be small in diameter. Small diameter work rolls would deflect under load, however, for which reason the work rolls must be backed-up or supported by comparatively short and stiff supporting rolls. In practice, it is frequently found that the load carrying capacity of the support roll bearings would only require comparatively few support roll sections, but the flatness requirements of the trade have steadily grown more critical. To satisfy these demands for precision leveled material, backed-up roller levelers have also grown more elaborate and costly, because of the necessity of providing ever increasing numbers of support roll sections along the work rolls, usually not on account of load carrying problems, but in order to enable the operator to concentrate the correcting pressure precisely on those portions of the work material which need corrections. The high cost of present day backed-up roller levelers is directly traceable to the large number of support roll sections required along the longitudinal axes of the work rolls.

The problem of precision leveling with the least possible number of supporting sections has existed for many years. Many efforts have been made to overcome and solve this problem. The solutions previously presented have not proved successful. It has been suggested, for instance, to employ one small diameter deflectable work roll in groups of larger work rolls and to provide the small diameter work roll with laterally adjustable supports. The lateral displacement has proved impractical and, in addition to the mechanical difficulties, the deflection of only one single work roll has a very limited effectiveness as far as mill shape correction is concerned, because the portions of the work material to be corrected must be subjected to a multiplicity or successive tensile and compressive stresses in order to be effective.

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The accepted general practice has been heretofore to locate the support roll sections for the upper and lower banks of work rolls one directly above and in line with the other, namely, in the same vertical plane. FIG. 3 of my United States Patent No. 2,638,143 shows this usual arrangement in that the three upper and three lower flights of support roll sections are in vertical symmetry. Therefore, only three areas across the work material can be preferentially treated by applying more or less pressure.

One object of this invention is to provide a novel support roll arrangement by positioning at least two support roll sections of one work roll bank in staggered relation to three support roll sections of the other work roll bank, so that the respective center lines through said two first named support roll sections pass between adjacent bearing blocks of said three last named support roll sections.

Another object is to provide the aforementioned staggered upper and lower support roll sections with means for selectively and independently deflecting their associated work rolls into the desired working contours, so that the material is subjected to a multiplicity of waves transversely to the direction of passage of the material through cooperating banks of straightening rolls, forming a first series of alternate half-waves of varying transverse amplitude in the material by selectively deflecting one bank of straightening rolls to correct a first group of spaced apart localized areas across the width of the material and forming a second series of alternate half-waves of varying transverse amplitude by selectively deflecting the other bank of straightening rolls to correct a second group of spaced apart localized areas across the width of the material, the localized areas of said first group alternating across the width of the material with the localized areas of the second group in line with the aforementioned staggered positioning of the upper support roll sections relative to the lower support roll sections.

With these and other objects in view to be pointed out in the specification and in the appended claims, several forms in which the invention may be conveniently embodied in practice have been illustrated on the accompanying drawings, in which:

FIG. 1 is a partial front view of a backed-up roller leveler, partly in section, showing three upper support roll sections in staggered relation to four lower support roll sections.

FIG. 2 is a partial section along the line 2—2 of FIG. 1.

FIG. 3 shows a modification with six upper adjustable support roll sections and seven lower support roll sections in staggered relation thereto; and

FIG. 4 illustrates seven upper support roll sections and six lower support roll sections, both upper and lower support roll section being adjustable toward and away from their associated work rolls.

Referring now to FIGS. 1 and 2, the upper straightening or work rolls 11 are journalled at their ends in suitable bearing blocks 12 and 13. The lower work rolls 14 are similarly journalled in bearing blocks 15 and 16. These bearing blocks, in turn, are suitably located in left and righthand housings 17 and 18. The upper and lower work rolls may be driven in the usual manner by means of universal joints and drive spindles 19 from a gear-box (not shown) and prime mover (not shown), as is well known in the art.

The three upper support roll sections 20, 21 and 22 are identical to the four lower support roll sections 23, 24, 25 and 26. As the construction of these support roll sections and their adjustment is well known in the art, only support roll section **23** is shown in more detail, as an example. It consists in a multiplicity of short support or backing rolls **30** arranged to nest their associated work rolls **14** for the purpose of preventing them from any undesired vertical or horizontal deflection, as best seen in FIG. 2 of the drawing. The ends of the short backing rolls **30** are rotatably mounted in bearing blocks **31** and **32**. The support rolls **30** are usually rotated by frictional contact with their work rolls **14**. Bearing blocks **31** and **32** are secured to cradle **37**, which is supported on saddle **38**. Cradle **37** and saddle **38** have matching curvilinear sliding surfaces **39** to permit support rolls **30** to follow the deflection contour of the work rolls. The cradle **37** and saddle **38** are connected by spring rods **41** threaded in the cradle **37** and springs **40**. Adjusting screws **42**, wormwheels **43**, worms **44** and shafts **45** may be employed to adjust the support roll section toward or away from the work rolls **14** for the deflection of the latter into any desired deflection contour. By adjusting each one of the upper and lower support roll sections selectively, the patterns of transverse variation of the amplitudes of the half-waves produced in the material by the upper and lower work rolls may be changed to produce the best leveling results for a given mill shape of the distorted material. Instead of the adjusting means shown, wedges or similar means may be employed for the displacement of the support roll sections and reference is made to my United States Patent Number 2,638,143, column 6, "Deflection of upper straightening rolls."

The upper support roll sections **20**, **21** and **22** with their support rolls **27**, including bearing blocks **28** and **29** may be adjustable by similar means, as above described, to displace them towards and away from their associated upper work rolls **11**.

If the overall widths of the top and bottom support roll sections are all substantially alike as shown, the top and bottom support roll sections may be said to be uniformly staggered. Hence, the distances between the vertical center lines through any two adjacent support roll sections are the same, both for the top group of support roll sections **20**, **21**, **22**, as well as for the bottom group of support roll sections **23**, **24**, **25** and **26**. Consequently, the vertical center lines through the two adjacent support roll sections **21** and **22** pass midway between the three associated staggered support roll sections **24**, **25** and **26**. While this uniform stagger is usually desirable, the overall widths of adjacent support roll sections may differ, if it is so desired. However, according to the present invention, the condition must still be met that two adjacently positioned support roll sections, such as **21** and **22** of the upper work roll bank, must be so staggered with respect to three cooperative support roll sections **24**, **25** and **26** of the lower work roll bank that the respective vertical center lines through support roll sections **21** and **22** pass between adjacent bearing blocks **32** and **31** of support roll sections **24** and **25** and adjacent bearing bolcks **32** and **31** of adjacent support roll sections **25** and **26**, respectively. Inasmuch as the vertical center lines through adjacent adjustable support roll sections are equivalent to the respective positions of the available pressure points along the work rolls, the vertical center lines through the short areas of the work material, which may be given preferential pressure, coincide with the before mentioned vertical center lines through the several support roll sections. The required relation of staggering of associated support roll sections may also be defined by station that the total width of two adjacent support roll sections, such as **21** and **22**, must be substantially equal to the distance between the vertical center lines of the first and third support roll sections **24** and **26** of the three staggered associated support roll sections **24**, **25** and **26**. The width of a support roll section may be said to be substantially equivalent to the width of the support area which may be stretched by the adjustment of the support roll section relative to its work roll bank.



The new supporting arrangement for the vertically spaced apart upper and lower work rolls **11** and **14** may be described as consisting of a plurality of what may be termed supporting trios located in predetermined fixed positions along the longitudinal axes of the work rolls. Each supporting trio comprises one support section or support unit, such as **20**, for one roll bank **11** in combination with two coacting support sections or support units, such as **23** and **24**, for the other roll bank **14**. Support or back-up rolls **27** and **30** contact and support their respective work rolls **11** and **14** against undesired deflection. Coacting support sections **23** and **24**, FIG. 1, are positioned immediately below support section **20** and are symmetrical thereto, the vertical center line through support section **20** being located between the vertical center lines of said associated support sections **23** and **24**. In the closely spaced support section arrangement shown in FIG. 1, the group or series of upper support sections **20**, **21**, **22** are located in offset positions with respect to the lower series or group of support sections **23**, **24**, **25**, **26** so that the back-up rolls **27** of upper support section **20**, for instance, overlap adjacent ends of the back-up rolls **30** of lower coacting support sections **23** and **24**.

With three upper and four lower support roll sections as shown in FIG. 1, the operator of the leveler has the possibility of applying preferential stretching pressure to seven distinctly different areas across the width of the work material. In levelers of previously known designs, seven upper and seven lower support roll sections would have been required to obtain similar flexibility.

A very substantial part of the cost of the leveler is thus saved without sacrificing leveling efficiency. Furthermore, in case of need, it is physically impossible to provide the same number of pressure application points with previously known designs in the same space between the housings as it is with the staggered arrangement of the present invention. The reason is that a given width between the leveler housings permits a certain limited maximum number of support sections along the longitudinal axes of the upper and lower work rolls **11** and **14**, respectively. Therefore, in critical applications which may require the maximum possible points of pressure application, my new arrangement permits twice the number of such pressure application points-minus one-as compared with presently known backed-up roller levelers.

Different numbers of support roll sections may be employed. FIG. 3 shows, as an example, six support roll sections **33** for the upper work rolls located in staggered relation to seven support roll sections **34** for the lower work rolls. This results in thirteen pressure points across the width of the work material. Similarly, the greater number of support roll sections may be located along the upper straightening rolls, as shown in FIG. 4, where seven support rolls **35** in a row are shown along the longitudinal axes of the upper straightening rolls, while six support rolls **36** are placed along the longitudinal axes of the lower straightening rolls, as to alternate with the spaces between the upper support rolls **35**. In other words, the upper support rolls **35** are said to be staggered with respect to the lower support rolls **36** along the longitudinal axes of their respective work rolls **11** and **14**. It is thus seen that my new arrangement produces as many spaced apart pressure points across the width of the material as the number of support roll sections employed for both banks or rows of work rolls, namely thirteen in the arrangements shown in FIGS. 3 and 4.

The correction of the work material is accomplished by increasing or decreasing the amplitude of certain portions of the waves across the width of the material. Thus considering the arrangement shown in FIGS. 1 and 2, the amplitude of the half-waves formed in the material by the deflection of lower work rolls **14** is controllable at four points coinciding with the vertical center lines through each of the four support roll sections **23**, **24**, **25** and **26**. By raising or lowering each one of these support roll sections with respect to their associated work rolls **14**, the amplitudes of portions of the transverse half-waves directly above these supporting sections may be increased or decreased, respectively. This holds similarly for the variation of the amplitudes of the half-waves formed by the deflected upper work rolls **11** due to the displacement of support sections **20**, **21** and **22**. The portions of the half-waves whose amplitude can be varied are spaced apart along the work rolls equivalent to the center distance between support roll sections. In the present arrangement, the actual available spacing is reduced to one-half said center distance on account of the staggered relationship of upper support roll sections **20**, **21** and **22** with respect to lower support roll sections **23**, **24**, **25** and **26**, or it may be said that the group of short areas which may be corrected by the selective deflection of the lower work rolls is staggered with respect to the group of short areas which may be corrected by the selective deflection of the upper work rolls.

The principle of staggering support roll sections of one work roll bank with respect to the support roll sections of the other work roll bank may be applied to any of the support roll arrangements known in the art. It is convenient, but not essential, to provide an odd number of support roll sections for one bank of straightening rolls and an even number of support roll sections for the other bank of straightening rolls. Various other changes and modifications will be obvious to those skilled in the art. I desire, therefore, that only such limitations shall be placed upon my invention as are specifically set forth in the appended claims.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

**1.** In a roller leveler, two banks of straightening rolls, between which a distorted sheet is to pass, each bank comprising work rolls and supporting sections, an even number of supporting sections located along the longitudinal axis of the work rolls of one bank of straightening rolls, an odd number of supporting sections located along the longitudinal axis of the work rolls of the other bank of straightening rolls, central portions of the last named supporting sections being arranged between the central portions of adjacent pairs of the first supporting sections, end portions of the supporting sections of one bank overlapping end portions of adjacent pairs of supporting sections of the other bank, and means for adjusting each of said supporting means towards or away from its associated work rolls to deflect said work rolls for correcting and leveling the work material.

**2.** In a roller leveler, two banks of work rolls, between which the work material is to pass, an even number of supporting sections located along the longitudinal axis of and in contact with the work rolls of one of said banks, an odd number of supporting sections located along the longitudinal axis of and in contact with the work rolls of the other bank, each of said supporting sections comprising a series of short backing rolls spaced longitudinally of the axis of the work rolls, between which their associated work rolls are nested, bearing blocks for rotatably supporting said series of backing rolls, a cradle for mounting said bearing blocks, a saddle for supporting said cradle, means for displacing said saddle with said cradle and bearing blocks and backing rolls towards and away from said associated work rolls, the backing rolls of the supporting sections for the one bank of work rolls being so spaced as to register with the spaces between the backing rolls of the other bank of work rolls to obtain as many spaced apart pressure application points across the width of the work material and longitudinally of the axis of the work rolls as the total number of support sections employed, and the spacing and arrangement of the backing rolls of said banks being such as to overlap ends of the backing rolls of one bank with the ends of the backing rolls of the other bank.

**3.** In a roller leveler employing two banks of work rolls, the rolls of one bank being arranged between the rolls of the other bank, a plurality of support means spaced along the longitudinal axis of the work rolls of each of said work roll banks, and the supporting means of one bank being so spaced as to register with spaces between the supporting means of the other bank and with end portions of the supporting means of one bank overlapping portions of the supporting means in the other bank, whereby all of said supporting means will collectively operate upon the work roll banks in flexing work material throughout the full width of such material.

**4.** In a roller leveler according to claim **3**, wherein each supporting means includes means for selective adjustment toward and away from its associated work rolls in control of leveling of the work material.

**5.** In a roller leveler, two banks of work rolls positioned to flex work material between them, a plurality of supporting means located along the longitudinal axis of the work rolls of each of said work roll banks, at least part of the supporting means of one work roll bank being located in staggered relationship with respect to the supporting means of the other roll bank longitudinally of said work rolls, the supporting means for both work rolls collectively providing support throughout the major portion of the length of the work rolls in the full area defined by the longitudinal engagement of the supporting means with respect to the longitudinal axis of said work rolls, and means for adjusting each of said supporting means towards or away from its associated bank of work rolls to deflect these work rolls into a desired working contour for correcting the distorted sheet.

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