This invention relates to sheet and plate straightening machines of the roller leveler type and has more particular reference to mechanisms for adjusting the straightening rolls of such devices and their supports relative to each other to deflect the straightening rolls into the desired working contour, as illustrated in my copending application No. 717,610, filed March 27, 1934, of which the present invention constitutes a continuation in part and of which it forms an adjunct.

It has been found that the supporting mechanisms as shown in the aforementioned copending application, giving a positive support to the straightening rolls near each end thereof and along their middle, is quite effective for roller levelers employing average length of rolls, but may allow undesirable deflections of rolls between the supporting points, when very long, thin rolls must be used for flattening wide and thin sheets of great hardness. Such unintended roll deflections have a detrimental effect on the flattening result.

One object of this invention is to provide any desired number of supports for the straightening rolls of such machines.

A further object is to provide a multiplicity of non-adjustable and movable supports together with adjustable straightening roll ends for the deflection of the straightening rolls into the desired working contour and for a more rigid and more reliable support of the rolls during the straightening process.

A further object is to provide means to adjust any desired number of supports into convex or concave group formations and to regulate the straightening rolls with respect thereto for the deflection of these rolls to stretch short sections of a sheet.

A further object is to provide mechanism in roller levels for the deflection of the straightening rolls by displacing the supports in different directions relative to each other and by adjusting the straightening rolls with respect thereto.

A still further object of this invention is to provide means for equalizing the pressure in the bearings of the reinforcing rolls.

With these and other objects in view, to be pointed out in the specification and 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 sectional front view of a roller leveler along line 1—1 of Fig. 2.
Fig. 2 is a side view of the machine shown in Fig. 1.
Fig. 3 is a sectional top view on line 3—3 of Fig. 2.
Fig. 4 shows a diagrammatic view of the lower part of a construction with three supporting sections, similar to the one depicted in Fig. 1.
Fig. 5 is a diagrammatic view of a modification of a construction employing two rows of supporting rolls.
Fig. 6 shows a diagrammatic view of another modification with one-piece supporting rolls.
Fig. 7 illustrates in diagrammatic form a convex deflection of the lower straightening rolls of a mechanism as shown in Fig. 1.
Fig. 8 shows a modification of the construction shown in Fig. 1 with one-piece supporting rolls.
Fig. 9 is a sectional front view of the lower part of a roller leveler of modified design.
Fig. 10 shows a diagrammatic view of the design depicted in Fig. 9 with one-piece supporting rolls.
Fig. 11 illustrates in diagrammatic form a different modification of the construction shown in Fig. 9.
Fig. 12 is a diagrammatic view of a modification of Fig. 11, employing one-piece supporting rolls.
Fig. 13 shows in diagrammatic form the lower part of a roller leveler, employing a plurality of supporting sections which are regulated in identical directions as their straightening rolls for a deflection of the latter.
Fig. 14 is a diagrammatic view of a displacement of straightening rolls and one-piece supporting rolls into convex working contours.
Fig. 15 illustrates in diagrammatic form the plastic deformation of a sheet passed between upper and lower straightening rolls, whereby the pressure exerted by the sheet causes the deflection of the lower straightening rolls.
While the desired result in all the various constructions shown will be a convex or concave formation of the straightening rolls, it has been found necessary to disclose various possibilities of producing similar results by different arrangements of mechanism, which will embody adjustments of straightening rolls and supporting instrumentalities relatively to each other.
To facilitate the reading of the drawings, vertically placed arrows in Figs. 1 to 14 inclusive indicate the directions of adjustments of straightening roll ends and supporting instrumentalities rela-
tively to each other for deflecting the straightening rolls into convex working contours.

Referring to Figs. 1 to 3, the machine comprises a lower frame 1 and a detachable upper frame 2. Sets of straightening rolls or working rolls 3 and 4 are arranged in frame 1 and 2 respectively. Upper rolls 4 are staggered with respect to lower rolls 3 so that a sheet passed between both sets of straightening rolls, will be repeatedly flexed in opposite directions. The bearings 5 on each end of upper rolls 4 are mounted on frame 2. A plurality of supporting rolls 6, journaled in bearing-blocks 7, which are fixedly mounted on frame 2, may be provided for the unyielding reinforcement of upper working rolls 4. To provide adjustment when flattening sheets of varying thickness and to regulate the depth of the waves or corrugations to which a sheet is subjected during the straightening process, upper frame 2 with straightening rolls 4 and supporting rolls 6 may be raised, lowered or tilted with respect to the lower frame 1 as desired. To prevent means of tiltably mounted threaded spindles 8 and worm-wheels 9, which are in mesh with worms 10 on shafts 11. Helical springs 12 may be provided to counterbalance the weight of upper frame 2 to facilitate adjustment of the same by means of handwheels 13 on shafts 11.

Lower straightening rolls 3 are sustained at their ends 14 in bearing-blocks 15 which rest on pillow-blocks 16. Both blocks 14 and 15 may be provided with curvilinear sliding surfaces to permit bearing-blocks 14 to follow a movement of the working rolls 3. At each end, bearing-blocks 14 may be supported by spherical elements 16 which are shown in fixed position and suitably fastened to pillow-blocks 15. Cover-plates 17 are secured to blocks 14 to prevent a vertical displacement of these blocks relative to pillow-blocks 15.

It will be noted that bearing-blocks 14 are free to oscillate in the direction of the longitudinal axis of the working rolls 3 and that the bearings 16 of the curvilinear sliding surfaces of bearing-blocks 14 and 15 and spherical elements 16 coincide substantially with the center of the longitudinal axis of the bearings 16 of working rolls 3. Each one of the two movable pillow-blocks 15 is carried by two adjusting screws 18 which are secured in pillow-block 15 in frame 1 and 2. Screws 18 of each pillow-block 15 is located on the left hand side of the machine and possesses a right hand thread and the other one is located on the right hand side of the machine and has a left hand thread. This vertically displaced arrangement of screws 18, as shown in Fig. 2, will prevent the pillow-blocks 15 from tilting under load. The lower ends of screws 18 extend through the base 24 of the machine. Screws 18 are prevented from moving in either vertical direction by means of collars 25 at the lower end and worm-wheels 20 resting on the top surface of base 24. Worm-wheels 20 are secured tight to their respective screws 18 for the reason that their lower surfaces carry the weight and the pressure exerted on the straightening rolls 3 so that between the two worm-wheels 20 of each pillow-block 15 and in engagement with same is a worm 21 secured to shaft 22. It is obvious that in using one worm 21 for the operation of two worm-wheels 20, one of which is secured to each of the two opposite threads of each pillow-block 15, a uniform vertical movement will be imparted to each pillow-block.

Shaft 22 is supported by brackets 23. Pillow-blocks 15 are suitably guided on frame 1 and by guide plates or gib 26. For the support and for the deflection of the straightening rolls 3 a plurality of adjustable supporting sections is provided underneath and along the rolls 3. These supporting sections are denoted by the numerals 27, 28, 29, 30, 31 and 32 and are located intermediate the ends 18 of the straightening rolls 3. Each of the supporting sections 28, 30, 31 and 32 comprises a series of comparatively short reinforcing rolls arranged in staggered order with respect to the working rolls 3, Fig. 2. These reinforcing rolls are generally designated by the numeral 33. The ends 34 of rolls 33 are journaled in yokes or bridge elements 34, Fig. 1, which connect both bearings of each reinforcing roll 33. Supporting-blocks 35 carry yokes 34 which are free to tilt in the direction of the longitudinal axis of the reinforcing rolls 33, because yokes 34 and supporting-blocks 35 are provided with curvilinear sliding surfaces 36 which are in mesh with yokes 34 and blocks 35 coincide with those of their respective pins 37.

This novel and simple arrangement will equalize the bearing pressure in both bearings of each reinforcing roll 33, as the pressure exerted by the straightening rolls 3 against rolls 33 will cause the bridge elements 34 to tilt until an equilibrium is attained in both bearings. Furthermore, the pressure exerted on the reinforcing rolls 33 in Figs. 1 to 3, is absorbed by a total of twelve bearings, two for each of the six supporting sections, as compared with four bearings in the construction shown in Fig. 5 and similar supporting mechanisms illustrated in my copending application above referred to.

It will be obvious that the unit pressure in these reinforcing roll bearings will be smaller in the construction depicted in Figs. 1 to 3, than in supporting-blocks 35, because the reinforcing rolls 33 and 35 are in mesh and the identical roll dimensions for both constructions and identical dimensions of the sheets to be flattened.

It will be understood that the bearing arrangement shown for the reinforcing rolls 33 may be replaced by bearing arrangements as illustrated in Fig. 5 or any of the bearing arrangements used heretofore may be employed instead. Analogous to the mechanisms for the adjustment of pillow-blocks 15 previously described in detail and illustrated in Fig. 2, two vertically displaced adjusting screws 38 are threaded in each supporting-block 35. One of the adjusting screws 38 is located on the left hand side of the machine and possesses a right hand thread as illustrated in Fig. 6. The other end of the screws 38 is located on the right hand side of the machine and has a left hand thread. Each screw 38 carries a worm-wheel 39. Between the two worm-wheels 39 of each supporting-block 35 and in engagement with same is a worm 40 secured to common shaft 41. One of the two opposite threads of each worm-wheel 39 of the two worm-wheels 39 of each supporting-block, a uniform vertical movement is imparted to
each supporting-block when shaft 22 is rotated. The supporting sections are guided on shoulders 41 and gib 42, Fig. 3.

Handwheel 43 on one end of common shaft 22 serves to displace all supporting sections and to adjust the vertical displacement of the supporting sections with respect thereto for a deflection of these rolls.

Supporting sections 27 and 28, located along the middle of the rolls 3 may be carried by one supporting-block 35 so as to simplify the construction, because the lengths of displacement of the respective ends of rolls 3 and 28 are the same. Sections 27 and 28 move in identical directions. Symmetrically located supporting sections 29 and 30, being nearer to the midpoints of the straightening rolls and the straightening roll ends, are always displaced in respective opposite directions for the deflection of the straightening rolls into convex or concave working contours. As a consequence, the operation is symmetrical.

The straightening roll ends in the middle of the straightening rolls and the straightening roll ends are always displaced in respective opposite directions for the deflection of the straightening rolls into convex or concave working contours. As a consequence of the operation, the deflection of the straightening rolls into the middle of the straightening rolls, it will be apparent that two symmetrically located points on the longitudinal axis of the straightening rolls intermediate the midpoint and each end of the straightening rolls will not change their neutral locations shown in Fig. 1, regardless of whether or not the straightening rolls have been deflected into convex working contours (Fig. 7) or concave working contours. These two points which mark the location of the change in direction of the vertical straightening roll displacement will be referred to as "neutral points".

In the construction shown in Fig. 1, it is arbitrarily assumed that one of the "neutral points" is located between sections 27 and 28 and that the other one between sections 29 and 30. The supporting sections 27 and 28 which are located in between these "neutral points" are illustrated to be adjustable in the respective opposite direction to all the other supporting sections as well as to the ends 18 of the straightening rolls 3. Due to the deflection of the straightening rolls, the lengths of displacement of the several supporting sections 29, 30, 31, 32 and pillow-blocks 15 sustaining the ends 18 of the straightening rolls, respectively be adjusted to meet the distances of displacement between the "neutral points" of both ends of the straightening rolls, which distances must be maintained at all times. The "neutral points" of the upper working rolls 3 and the lower working rolls 3 will be maintained at a distance of 18. It will be noted that the supporting sections have been disposed into a convex group.

In addition to that, the ratio of gearing for the supporting sections and the adjusting screws 25 for sections 29 and 30 may be finer than that for sections 31 and 32, while the ratio of gearing is identical for these sections. A shorter length of displacement is thereby attained for sections 29 and 30 than for sections 31 and 32.

The ratio of gearing of worm-gear drives for the pillow-blocks 15 of the working rolls 3, or the pitch of the screws 25 for sections 29 and 30, may be finer than that for sections 31 and 32, or the pitch of the screws 25 for sections 31 and 32, may differ from that for sections 29 and 30.

It will be understood that the locations of the "neutral points" on the longitudinal axis of the straightening rolls may be varied as desired. By way of example, the "neutral points" in Fig. 6 are assumed to be between adjacent ends of elements 82 and, respectively, and between adjacent ends of elements 82 and 83', respectively. In Fig. 8, on the other hand, the "neutral points" are assumed to be between sections 82 and 83 and between sections 82 and 83, respectively.

To flatten distorted sheets, it is essential to stretch the short sections of the elements and to compress the long sections of the elements located in the middle of the straightening rolls. This is effected by subjecting the sheet to waves of differing transverse amplitude by deflecting the straightening rolls into convex or concave working contours, as shown diagrammatically in Figs. 7, 14 and 15. Usually only one set of straightening rolls is deflected. All the illustrations of the middle section show the ratio of gearing for these sections. A shorter length of displacement is thereby attained for sections 29 and 30 than for sections 31 and 32.

In order to obtain the change in direction of vertical straightening roll displacement previously described, the worm-gear drive for supporting sections 29 and 30 may be turned in the opposite direction to the drives for sections 29, 30, 31, 32 and pillow-blocks 15.

In addition to that, the ratio of gearing for sections 29 and 30 may be_finer than that of sections 31 and 32, or the pitch of the screws 25 for sections 29 and 30 may be finer than that of sections 31 and 32, while the ratio of gearing is identical for these sections. A shorter length of displacement is thereby attained for sections 29 and 30 than for sections 31 and 32.

To produce a convex deflection of the straightening rolls 3 in mechanism shown in Figs. 1 to 3, handwheel 43 would be turned in the opposite direction as indicated by the arrow in Fig. 2. As a result, middle supporting sections 27 and 28 will be raised and sections 29, 30, 31 and 32 will be lowered in such a manner that sections 31 and 32 will be displaced greater distances than sections 29 and 30. Simultaneously, straightening rolls 3 will be lowered at their ends 18, because their worm-gear drives act in the same direction as those of supporting sections 29, 30, 31 and 32.

Fig. 7 shows the new relative positions of supporting sections and straightening rolls after the above described adjustments for a convex deflection of the straightening rolls 3 have been effected. It will be noted, that the supporting sections have been disposed into a convex group.
formation to conform with the convex deflection desired for the straightening rolls 3. The straightening rolls 3 have been positively deflect-
ed over the adjusted supporting sections, which unyieldingly support the straightening rolls in their deflected condition. The tilting movements of the supporting sections in a sidewise direction, caused by the deflection of the straightening rolls 3, may be clearly seen in Fig. 7.

When turning the handwheel 43 in clockwise direction, the sections 27 and 28 will be lowered; sections 29 and 30 will be raised smaller distances than sections 31 and 32, so that all supporting sections are grouped into a concave formation. Straightening rolls 3 will be raised from their neutral locations shown in Figs. 1 to 3, and so positioned with respect to their adjusted supporting sections, that rolls 3 will be deflected unto the supporting sections by the pressure created by a sheet which is flexed between straightening rolls 3 and 4. Consequently, straightening rolls 3 will assume concave contours, similarly as shown in Fig. 15 for a modified adjusting mechanism.

The horizontal roll positions shown in Figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 and 13 and the relative locations of their supporting sections, bearing blocks and supporting blocks will be referred to as the neutral locations of these elements, irrespective of any tilting movement of the same.

To clearly understand the various diagrammatic views of Figs. 4 to 15, it should be borne in mind that whenever the pillow-blocks 18 are lowered, the bearing ends 16 of the straightening rolls are forced to follow this downward movement of the pillow-blocks 14, because spherical elements 16, Fig. 2, are provided with suitable locking means to prevent any vertical displacement between bearing blocks 14 and pillow-blocks 15. The one-piece supporting rolls in Figs. 6, 8, 10, 12 and 14 are provided with the same tiltable bearing arrangement as the straightening rolls, so that no vertical movement of their bearing-blocks with respect to their supporting blocks can take place.

Fig. 4 shows diagrammatically a modification of the mechanism described in conjunction with Figs. 1 to 3. The difference resides principally in the redimensioning of supporting sections 427, 431 and 432, and the construction and adjustments are the same as previously described. From the explanations given in conjunction with Fig. 1, it will be evident that one "neutral point" on the straightening roll axis in Fig. 4 is located between the adjacent ends of sections 427 and 431, and the other one between adjacent ends of sections 427 and 432. This arrangement will be suitable for a leveler having straightening rolls 50 with a lower ratio between their length and their diameter than that shown in Fig. 1.

Fig. 5 is a modified form of the design illustrated in Fig. 4, with the difference that two rows of supporting rolls 44 and 45 are employed instead of three supporting sections.

Figs. 6 and 8 illustrate other modified forms of the mechanism shown in Figs. 1 to 3. The respective one-piece supporting rolls 46 and 45 have been interposed between the straightening rolls and their supporting sections. To provide the desired support for the deflected straightening rolls, the supporting rolls have to be deflected into contours which conform with those desired for the straightening rolls. Figs. 6 and 8 differ only with respect to the number of supporting sections employed to support any desired number of such sections. A detailed description will therefore be given for the mechanism shown in Fig. 8 to cover both modifications.

For a deflection of the one-piece supporting rolls 46 and their straightening rolls 45, the supporting sections 827, 828, 829, 830 and 831 can be displaced into either convex or concave group formations. To effect such group formations, section 827 will be displaced a greater distance in the same direction as the adjoining sections 828 and 829. The outer sections 830 and 831 will be adjusted in opposite direction thereto. The ends of supporting rolls 846 will be adjusted for their deflection in the same direction, but a greater distance than sections 830 and 831, and the ends 818 of the straightening rolls will be regulated still greater distances than their supporting rolls 846.

An adjustment of the mechanism for convex roll deflections will consequently result in positioning the supporting sections into a convex group formation, in deflecting the supporting rolls 846 over the latter and the straightening rolls 803 over the deflected supporting rolls 846, thus producing locations of rolls and supporting sections similar to those shown in Fig. 14.

To obtain concave roll deflections, the supporting sections will be adjusted into a concave group formation. The one-piece supporting rolls 846 will be raised from their neutral locations, Fig. 8, by means of adjustable bearings 832, and straightening rolls 803 will be lifted away from the supporting rolls 846 by means of their adjusting screws 819. The pressure exerted by a sheet flexed between the upper and lower straightening rolls, will deflect the lower straightening rolls 803 unto their one-piece supporting rolls 846. Thereafter, the straightening rolls 803 and supporting rolls 846 will be deflected into concave contours until the positive support of the reinforcing rolls 833 of the supporting sections is encountered.

Contrary to the conditions prevailing with respect to the straightening rolls and one-piece supporting rolls, the length of the reinforcing rolls 833 is very short compared to their diameter. Therefore, no deflection of practical importance can occur in rolls 833 during the straightening operation. Furthermore, the unsupported lengths of deflected one-piece supporting rolls 846 are restricted to the short distances existing between two adjacent supporting sections, as for instance sections 828 and 831.

So far, no neutral supporting means have been employed. All the constructions previously described embody a combination of adjustable supports, which act in opposite directions relative to each other, and an adjustment of the straightening rolls with respect thereto, so as to produce the desired deflection of the straightening rolls.

Figs. 9 to 15 illustrate the application of any desired number of supporting sections, employing neutral supporting means in combination with adjustable supports. The neutral supporting
means may be located in the middle of the straightening rolls or away therefrom.

The construction illustrated in Fig. 10 depicts the lower part of a roller leveler, which embodies 5 mechanisms for adjusting the straightening rolls and their supporting means in opposite directions relative to each other, so as to create a desired working contour for the straightening rolls. The supporting sections 321 and 322 are maintained in neutral locations, but may tilt with the deflection of the working rolls 905. In order to produce convex or concave group formations of all supporting sections, the adjustable sections 927, 929 and 930 will be regulated.

In identical directions, differing, however, in amount of displacement, depending on their distances from the neutral supporting sections 921 and 922. It is apparent that the straightening rolls 993 will have to be adjusted in opposite direction to the displacement of the adjustable supporting sections to deflect the straightening rolls 905 into their working contours. Sections 920 and 924, which are located adjacent to the neutral sections 921 and 922, will always be displaced shorter distances from their neutral locations than sections 925 and 926.

Neutral supporting sections 921 and 922 may be suitably fastened to lower frame member as shown in Fig. 9. Sections 921 and 922 are not displaced in height to participate in the formation of the desired working contour of their associated straightening rolls 905. This is in contrast to the adjustable supporting or backing means 927, 929, and 930. Therefore, the neutral supporting sections may also be referred to as non-adjustable supporting or backing means.

Fig. 10 illustrates the same mechanism as shown in Fig. 9, however, adjusted for a concave roll deflection to stretch the edge sections of a sheet. Like elements in Figs. 9 and 10 have received like numerals. A sheet 50 is shown to pass between upper straightening rolls 904, which are not shown in Fig. 9, and lower straightening rolls 903. The upper straightening rolls 904 are assumed to be maintained in horizontal positions by means of a proper supporting arrangement as shown for instance in Fig. 1. The pressure exerted when flexing the sheet between the straightening rolls 903 and the lower rolls 9034 up to their supporting sections as shown.

Fig. 10 shows a modification of the mechanism of Fig. 9 in that the one-piece supporting rolls 1046 have been placed between the straightening 1003 and the reinforcing rolls 1033 of the support sections 1027, 1028 and 1029. The bearing ends of each supporting roll 1046 will be maintained in neutral locations and are not adjustable in height, analogously to non-adjustable backing means 931 and 932. Fig. 9, wherein the supporting sections 1027, 1028 and 1029 will be raised or lowered with respect to the bearing ends of supporting rolls 1046. At the same time, the straightening rolls 1003 will be adjusted in opposite direction to the raised or lowered supporting sections, so as to deflect the supporting rolls 1046 and their straightening rolls 1033 into substantially identical contours.

Fig. 11 is a modification of Fig. 9. Additional adjustable supporting sections 47 and 48 have been provided between the neutral supporting sections 1121 and 1122, and each end of the straightening rolls 1103. For a deflection of the straightening rolls 1103, all sections will be disposed into either convex or concave group formations and to effect such group formations, sections 47 and 48 will be displaced in the same direction, but smaller distances than the straightening rolls 1103, while supporting section 1127 is moved in the respective opposite direction.

The close relationship between the construction illustrated in Fig. 11 and that of Fig. 4 will be apparent, if neutral sections 1121 and 1122 are assumed to be eliminated in Fig. 11, because the remaining mechanism is then the exact duplicate of that of Fig. 4. On account of movements of sections 1121 and 621 in opposite directions to section 621, Fig. 4, it was pointed out that the two "neutral points" on the straightening roll axis are assumed to be located between sections 627 and 631 and between sections 427 and 423, respectively. These two "neutral points" of Fig. 4 are made quite tangible in Fig. 11 by placing neutral sections 1121 and 1122 respectively, in the vertical plane of each "neutral point." Fig. 12 shows a modification of the mechanism illustrated in Fig. 11. The main difference resides in the embodiment of one-piece supporting rolls 1320 with a plurality of supporting sections, for the purpose already stated in connection with one-piece roll arrangement. The bearing ends of one-piece supporting rolls 1320 are shown adjustable in the same direction as the ends of straightening rolls 1250, while the centrally located supporting section is displaced in opposite direction thereto. The supporting sections located adjacent each end of supporting rolls 1320 are depressed to remain stationary corresponding to non-adjustable supporting sections 921 and 922, Fig. 9 and sections 1131 and 1132, Fig. 11.

Fig. 13 depicts a mechanism wherein the adjustment of the adjustable supporting sections and the adjustment of the straightening rolls are in the same direction, while the supporting section 1327 is maintained in neutral or fixed location and positioned substantially in the middle of the straightening rolls. For the deflection of the straightening rolls 1303, the adjustable sections are raised with respect to the neutral or fixed supporting section 1327; so that all sections are disposed into convex or concave group formations, respectively. For the purpose of the supporting sections 1325 and 1328 adjacent to the neutral middle section 1327, will always be displaced shorter distances than sections 1331 and 1330 which are farther away from the neutral middle section 1327.

Fig. 14 represents a modification of the device shown in Fig. 13. One-piece supporting rolls 1446 are placed between straightening rolls 1403 and the reinforcing rolls 1433 of the supporting sections. The device has been shown adjusted for a convex deflection of the rolls. The supporting rolls 1446 are shown positively deflected over the convex formation of all supporting sections. Straightening rolls 1403 in turn are shown deflected over the one-piece supporting rolls 1446. This roll deflection is suitable for stretching the middle sections of a sheet in preference to its edge sections.

It is evident that the lengths of displacement of elements 1429, 1430, 1432 and 1418 at one side of the mechanism, as well as the corresponding elements located at the other side of the mechanism, increase with their distances from the neutral or fixed supporting section 1427.

Whenever possible, supporting sections have been shown symmetrical to the middle of the straightening rolls to obtain equal distances of
displacement, which simplifies the construction and permits the application of duplicate worm-gear driven, spindles, and so forth. It will be understood that the ends of said related straightening rolls will always be displaced greater distances from
their neutral locations than those backing means which are located away from the middle.

5. In mechanisms of the character described, two sets of straightening rolls positioned to repeatedly flex a sheet passed between them, support- ing elements for one set of said rolls, said supporting elements being located near both ends of said rolls and adapted to maintain neutral locations, a plurality of backing means for said set of neutral means being arranged along said set of rolls and located between said neutral supporting elements, means adapted to positively raise or lower said backing means with respect to said neutral supporting elements, further means to adjust the ends of said set of straightening rolls in opposite respective direc-
tion thereto for a deflection of said one set of rolls.

6. In mechanisms of the character described, two sets of straightening rolls, two rows of supporting rolls or one set of supporting rolls having adjacent ends, means to displace said adjacent ends of said rows of supporting rolls toward or away from said set of straightening rolls, further means to regulate the outside ends of said rows of supporting rolls and the ends of said set of straightening rolls in opposite direction thereto in such a manner that the distance of displacement of said outside ends of said rows of supporting rolls is always shorter than the displacement of said straightening roll ends.

7. In mechanisms of the character described, two sets of straightening rolls positioned to repeatedly flex a sheet passed between them, supporting elements for said straightening rolls near both ends thereof adapted to maintain neutral locations, a plurality of backing means for said straightening rolls arranged between said neutral supporting elements, means adapted to positively adjust said backing means toward or away from their related straightening rolls and to displace said backing means with respect to one another and with respect to their related neutral supporting elements in such a manner that said backing means and said supporting elements will be positioned into convex or concave group formations, further means adapted to adjust the ends of said related straightening rolls in opposite direction to said adjustment of their backing means for a deflection of said rolls.

8. In mechanisms of the character described, straightening rolls between which a work sheet is to pass, supporting elements for said straightening rolls adapted to maintain neutral locations, said supporting elements being located away from the middle of their related straightening rolls, backing means for said rolls arranged between said neutral supporting elements, supplementary backing means for said rolls located between each end thereof and said neutral elements, means to raise or lower, backing means between said elements, further means to regulate in opposite directions said related rolls and their supplementary backing means which are located between each end thereof and said neutral supporting elements in such a manner that said backing means located between each end of said rolls and their related supporting elements are displaced shorter dis-
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In mechanisms of the character described, two sets of straightening rolls positioned to repeatedly flex a sheet passed between them, supporting elements for one set of said rolls, said supporting elements being located substantially central to said rolls, means to maintain said supporting elements in said neutral location, a multiplicity of backing means located between said neutral supporting elements and each end of said set of straightening rolls, means adapted to positively raise or lower said backing means relative to said neutral supporting elements, further means to regulate the ends of said one set of rolls relatively thereto in identical directions as said raised or lowered backing means for a deflection of said set of rolls to stretch short sections of a sheet.

10. In mechanisms of the character described, straightening rolls between which a work sheet is to pass, a multiplicity of the ends of their related straightening rolls, backing means arranged along said supporting rolls, means to displace the ends of said supporting rolls and said backing means relatively to each other in such a manner that said backing rollers are disposed into convex or concave group formations for the support of said straightening rolls when the latter are deflected.

15. In mechanisms of the character described, straightening rolls between which a work sheet is to pass, a multiplicity of the ends of their related straightening rolls, said backing rollers to support said straightening rolls intermediate their ends, bridge bodies rotatably sustaining both ends of said short backing rollers, supporting means tiltable carrying said bridge bodies, bearing elements sustaining the ends of said straightening rolls, and adjustable means to displace bearing elements of said straightening rolls and said bridge bodies of said backing rollers relatively to each other in such a manner that said backing rollers are disposed into convex or concave group formations for the support of said straightening rolls when the latter are deflected.

20. In mechanisms of the character described, straightening rolls, adjustable elements for the ends of said straightening rolls, a multiplicity of backing elements for said straightening rolls, said backing elements being located between the ends of said straightening rolls, means to positively adjust said backing elements for said rolls in opposite directions to each other to move said backing elements into their supporting positions, and further means to regulate the ends of their related straightening rolls toward or away from said oppositely adjusted backing elements for a deflection of said rolls to stretch short sections of a sheet.

25. In mechanisms of the character described, straightening rolls, adjustable elements for the ends of said straightening rolls, a multiplicity of adjustable and non-adjustable backing means located intermediate said adjustable elements, and auxiliary means to displace said adjustable elements of backing means with respect to said non-adjustable backing means for a deflection of said straightening rolls.

30. In mechanisms of the character described, straightening rolls and supporting rolls, adjustable and non-adjustable backing means for said supporting rolls, said backing means being located intermediate the ends of said supporting rolls, and adjustable elements for the ends of said straightening rolls and for the ends of said supporting rolls.

35. In mechanisms of the character described, straightening rolls and supporting rolls, adjustable and non-adjustable backing means for said supporting rolls, said backing means being located intermediate the ends of said supporting rolls, said supporting means being arranged along said supporting rolls, means to adjust said supporting means toward or away from said supporting rolls, further means adapted to regulate the ends of the related straightening rolls in opposite direction thereto to deflect said related straightening rolls and their one-piece supporting rolls into identical working contours.

40. In mechanisms of the character described, straightening rolls positioned to repeatedly flex a sheet passed between them, one-piece supporting rolls for said straightening rolls, means to maintain the ends of said supporting rolls in neutral locations, a plurality of backing means arranged along said supporting rolls, means to adjust said backing means toward or away from said supporting rolls, further means adapted to regulate the ends of the related straightening rolls in opposite direction thereto to deflect said related straightening rolls and their one-piece supporting rolls into identical working contours.

45. In mechanisms of the character described, straightening rolls between which a work sheet is to pass, supporting elements for said straightening rolls adapted to maintain neutral locations, a multiplicity of backing means for said straightening rolls, said backing means being located along said rolls intermediate their ends, adjustable means to displace the ends of said straightening rolls and said backing means relatively to each other and with respect to said neutral supporting elements in such a manner that said backing means are brought into convex or concave group formations for the support of said straightening rolls in their deflected condition.

50. In mechanisms of the character described, straightening rolls between which a work sheet is to pass, a multiplicity of the ends of their related straightening rolls, backing means along said supporting rolls, and adjustable means to raise or lower said backing means for the deflection of said straightening rolls and said supporting rolls into similar working contours.
20. In mechanisms of the character described, straightening rolls, adjustable elements for the ends of said straightening rolls, two rows of supporting rolls located intermediate said adjustable elements, said supporting rolls having adjacent ends, means to raise or lower said adjacent ends of said rows of supporting rolls, and further means to displace the outside ends of said rows of supporting rolls and the ends of said straightening rolls relative to said raised or lowered adjacent ends of said rows of supporting rolls.

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