Feb. 17, 1942. F. K. MÄUSSNEST 2,273,122

ROLL STRUCTURE FOR EMPLOYING SMALL DIAMETER WORKING ROLLS IN THE LEVELING OF SHEET AND STRIP MATERIAL

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FIG. 1.

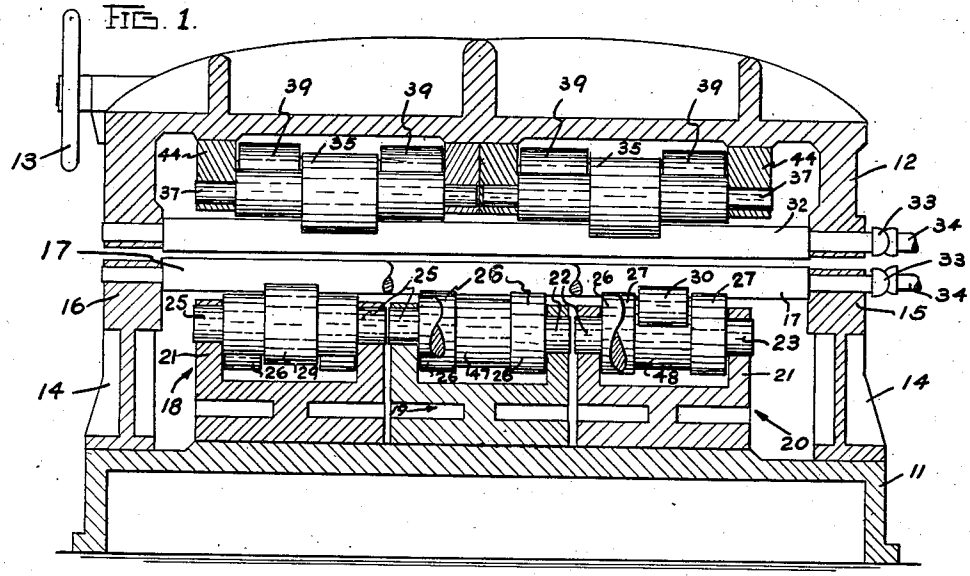


FIG. 2.

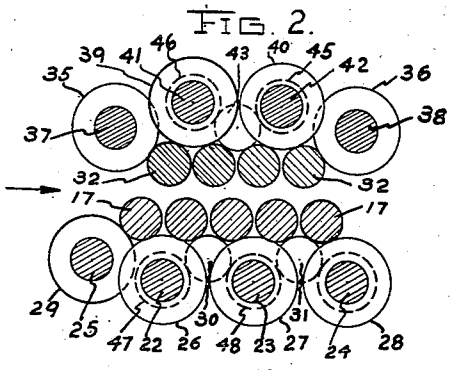


FIG. 3.

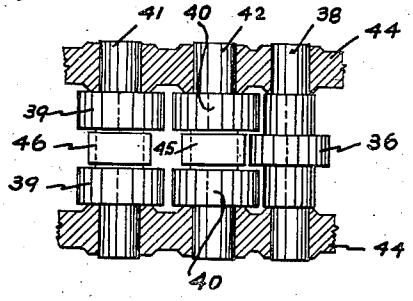


FIG. 4.

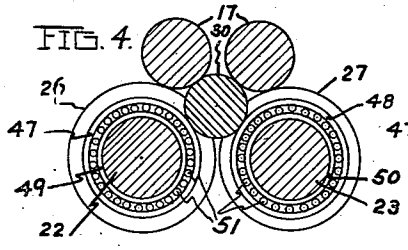


FIG. 5.

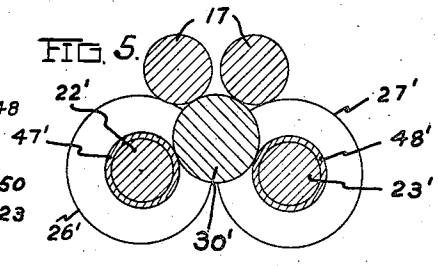


FIG. 6.

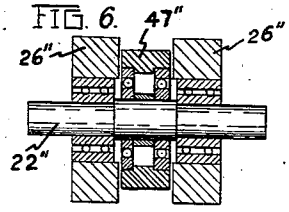
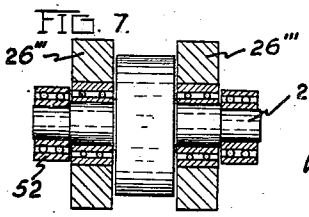


FIG. 7.



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ROLL STRUCTURE FOR EMPLOYING SMALL DIAMETER WORKING ROLLS IN THE LEVELING OF SHEET AND STRIP MATERIAL

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14 Claims. (Cl. 153—54)

This invention relates in general to a new and improved roll structure for employing small diameter working rolls in the leveling of sheet and strip material.

As is well known, good straightening results can only be obtained by using closely spaced, small diameter working or straightening rolls through which the metal is passed so as to subject it to reverse bends of minimum radii.

The metal sheets to be leveled and straightened are usually comparatively wide, and the straightening rolls are, therefore, of necessity long and slender. These slender straightening rolls would obviously deflect when a sheet is passed between them, and for this reason they have to be backed up.

Various supporting roll arrangements have been proposed in the past, such as supporting rolls of approximately the same diameter as the straightening rolls, these supporting rolls being arranged in staggered order relative to the straightening rolls, so as to support the straightening rolls not only against vertical, but also against horizontal deflection. The objection to this supporting roll arrangement is that the supporting rolls can only be approximately as large in diameter as the straightening rolls are. Hence, the load carrying capacity of the supporting roll bearings is restricted.

It has also been suggested to employ supporting rolls which are substantially larger in diameter than the straightening rolls and in direct contact with them. Then adjacent supporting rolls were proposed in staggered relationship to each other so that the supporting rolls would alternatively contact opposite flanks of the straightening rolls. This roll arrangement requires narrow, overhung supporting rolls. A large percentage of the available room for supporting the straightening rolls is taken up by bearings, leaving only a much reduced portion of the total straighening roll length for contact with the supporting rolls.

Large diameter backing rolls not in direct contact with the straightening rolls, but with small diameter spacer rolls interposed between straightening rolls and backing rolls have also been used in the past. The spacer rolls in actual contact with the straightening rolls must of necessity be substantially smaller in diameter than the straightening rolls to make these spacer rolls effective. In addition to a wedging action, these small diameter spacer rolls have to revolve at a faster rate than the straightening rolls, thus causing objectionable wear on the spacer rolls, on the straightening rolls proper, as well as on the large diameter backing rolls.

The object of this invention is to eliminate these shortcomings and to provide a supporting roll arrangement for symmetrically backing up small diameter straightening rolls by employing a combination of large and substantially smaller backing rolls in direct contact with said small diameter straightening rolls.

Another object is to provide any desired number of supporting roll sections consisting of large and smaller backing rolls along the length of the straightening rolls.

A further object is to provide a supporting roll arrangement in which the relative size of the large supporting rolls and smaller backing rolls may be readily varied to suit different applications.

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 drawing in which:

Fig. 1 is a sectional front view of a roller leveler of which subsequent lower supporting and lower straightening rolls are partly broken away;

Fig. 2 shows a diagrammatic view of the upper and lower straightening and supporting roll arrangement of the machine shown in Fig. 1;

Fig. 3 is a partial sectional top view of the upper supporting rolls at the exit side of the upper roll bank;

Fig. 4 shows a cross section to an enlarged scale of two lower straightening rolls and their associated large supporting rolls and smaller backing roll;

Fig. 5 is a modification of the roll arrangement illustrated in Fig. 4, depicting a different bearing arrangement and a different ratio between the smaller backing roll and its large supporting rolls;

Fig. 6 shows a cross section of a fixed supporting roll shaft with rotatable supporting rolls and rotatable sleeve;

Fig. 7 illustrates a modification of the bearing arrangement shown in Fig. 6, in that the shaft is not fixed but free to rotate.

In the embodiment of the invention which I have chosen to illustrate, the machine comprises a lower base 11 and an upper detachable section 12, both of which represent the main frame of a conventional type sheet or plate straightening machine. It is necessary to adjust the upper frame 12 with respect to the lower frame 11 of the machine. For this purpose a handwheel 13 is arranged and the adjustment may be effected in any conventional way such as by means of worm gear train and threaded screws (not shown). To the base 11 of the lower section two uprights 14 are secured in any suitable manner. These uprights terminate in bearing blocks 15 and 16 at their upper ends, carrying rotatably the ends of lower straightening rolls 17.

Underneath the lower straightening rolls 17

are located supporting elements to prevent these straightening rolls from undesired lateral and vertical deflection. Three supporting roll sections 18, 19, and 20 are arranged along the lower straightening rolls. These three lower supporting roll sections may be identical in design as shown. Each section consists of a bearing block 21 suitably mounted on base 11. The bearing block 21 carries rotatably the shafts 22, 23, 24, and 25 on which the large supporting rolls 26, 27, 28, and the end backing roll 29 (Figs. 1 and 2) are respectively mounted. The leveler illustrated comprises a train of five closely spaced lower straightening rolls 17. Supporting rolls 26 and 27 are in contact each with two of the straightening rolls 17 and supporting roll 28 is in contact with the exit straightening roll 17. Between the supporting rolls 26, 27, and 27, 28, smaller backing rolls 30 and 31 are arranged which contact those flanks of the straightening rolls 17 which are not supported by the large supporting rolls. Consequently, the large supporting rolls 26, 27 and 28 and the end backing roll 29 in combination with the small backing rolls 30 and 31, support all straightening rolls 17 against deflection in every direction.

The upper straightening rolls 32 are journaled at their ends in frame 12. Each one of the upper and lower straightening rolls 32 and 17 may be rotated by means of universal couplings 33 and drive spindles 34 actuated in any conventional manner, as for instance from a gearbox (not shown). The upper straightening rolls 32 are supported against deflection by a combination of end backing rolls 35 and 36 on shafts 37 and 38, large supporting rolls 39 and 40 on shafts 41 and 42 respectively, and small backing rolls 43, in a similar manner as the lower straightening rolls 17 already described. The upper bank of straightening rolls in the leveler depicted comprises a train or bank of four straightening rolls. The basic supporting roll arrangement is identical for the top and bottom straightening rolls with the exception that on account of the provision of four rolls 32 in the top train, it may be convenient to arrange two end backing rolls 35 and 36. These end backing rolls 35, 36, and supporting rolls 39, 40, are revolubly journaled in bearing blocks 44. To illustrate that any desired number of supporting sections may be used along the straightening rolls, the upper supporting arrangement is depicted as consisting of two identical supporting sections as against three supporting sections for the lower straightening rolls. The number of supporting sections employed is dependent on the diameter and length of the straightening rolls, the work-load to be handled, and the straightening speed desired. The number of supporting sections may also be influenced by the deflection mechanism for intentionally flexing the straightening rolls for correcting the mill shape of the work-material. While for simplicity's sake non-adjustable supports have been depicted in the drawing, it is understood that the several supporting roll arrangements may be employed in combination with any one of the deflecting mechanisms known in the art.

Fig. 3 illustrates in greater detail the arrangement of the end backing roll 36 and the two supporting rolls 40 and 39.

The end backing roll 36, Fig. 3, is shown integral with shaft 38 and rotatably mounted in bearing blocks 44. It will be noted that this end backing roll 36 takes the place of a small backing roll usch as 43. It does not contact sleeve 45, but absorbs the load in its own bearings in block 44. Supporting rolls 39 and 40 are identical. Two such supporting rolls may be symmetrically fastened to each of the shafts 41 and 42 respectively, as shown. These shafts 41 and 42 are free to rotate in bearing blocks 44. Between associated supporting rolls 39 and 40, sleeves 46 and 45 are mounted freely rotatable on shafts 41 and 42 respectively.

Referring to Figs. 1 and 2, it will be seen that the small backing roll 43 rests against sleeves 45 and 46 and has no bearings at its ends. The work-load absorbed by these small backing rolls 43 is transmitted through the sleeves 45 and 46 to the main bearings at the ends of shafts 42 and 41, respectively.

Fig. 4 shows diagrammatically one basic lower roll unit consisting of two supporting rolls 26 and 27, their sleeves 47 and 48 respectively, their associated backing roll 30, and two straightening rolls 17. All the supporting sections are built-up based on these roll units by using when necessary end backing rolls such as 29, 35, and 36. It will be seen that sleeves 47 and 48 in this arrangement really consist of roller bearings mounted on shafts 22 and 23 respectively. The inner races 49 and 50 are fast to shafts 22 and 23 respectively, and the outer races or sleeves 47 and 48 represent the outside races of the roller bearing.

It is assumed that the straightening direction of the leveler is from left to right as indicated by arrow in Fig. 2. Then the straightening rolls 17 will travel in a clockwise direction, and consequently supporting rolls 26 and 27, in contact with the outside flanks of the straightening rolls 17, will travel in counter-clockwise directions. Inasmuch as supporting rolls 26 and 27 are fastened to shafts 22 and 23 respectively, these shafts 22 and 23 with their associated inner races 49 and 50 will also revolve in counter-clockwise directions. The backing roll 30, in contact with the inner flanks of straightening rolls 17, will travel in counter-clockwise direction. The pressure exerted by the straightening rolls 17 on backing roll 30, when work-material is passed through the leveler, is transmitted directly to the sleeves 47 and 48 and these sleeves will consequently rotate in clockwise directions. It should be noted that with the inner races 49 and 50 traveling in counter-clockwise direction and the outer races or sleeves 47 and 48 traveling in clockwise direction, the small rollers 51 of the roller bearings will rotate at a relatively fast speed in a clockwise direction around their own longitudinal axes so that minimum friction is created between the rotating parts. These small rollers 51 will also have a relatively slow rotation around the longitudinal axes of their associated shafts 22 and 23 respectively. In fact, due to the described arrangement of the bearings, the respective directions of rotation of the sleeves, of the backing roll, and of the straightening rolls, are all in perfect harmony and assist each other in maintaining the desired rotation with minimum frictional losses, and consequently with a minimum amount of wear between the several rotating elements.

It is pointed out that, instead of the roll arrangement shown, three identical supporting rolls may be used for supporting the four upper straightening rolls 32. This roll arrangement would then necessitate a total of two small backing rolls with no end backing rolls. This ar-

rangement is not specially shown, because it would be identical to the support shown for the lower straightening rolls 17 with the first straightening roll on the entry side and its end backing roll 29 eliminated. A number of other variations in the supporting roll arrangement may be similarly obtained depending upon the number of straightening rolls of which the upper and lower trains are made up. While it is desirable from a manufacturing point of view to provide identical supporting roll sections along one train of straightening rolls, as shown in connection with sections 18, 19, and 20, Fig. 1, this is not essential and each section may have its individual supporting roll arrangement differing from that of the others.

Fig. 5 illustrates a bearing arrangement similar to that of Fig. 4. Instead of employing roller bearings for the sleeves as in Fig. 4, the sleeves 47' and 48' are solid bushings rotatably mounted on shafts 22' and 23'. It will be noted that with a clockwise rotation of the straightening rolls 17, similarly as described in connection with Fig. 4, the shafts 22' and 23' rotate in counter-clockwise directions, and the sleeves 47' and 48' revolve in clockwise directions. Because shafts 22' and 23' rotate in opposite directions to sleeves 47' and 48', there will be slightly higher frictional losses than with the roller bearings shown in Fig. 4, aside from the fact that, generally speaking, a roller bearing in itself causes less friction than a solid bushing or sleeve. It will be noted in Fig. 5 that the straightening rolls 17 and the supporting rolls 26' and 27' are approximately of the same size as those depicted in Fig. 4, but the backing roll 30' is of considerably larger diameter than supporting roll 30 in Fig. 4. On the other hand, the outside diameters of the sleeves 47' and 48' are smaller than those in Fig. 4. It may thus be clearly seen by comparing Figs. 4 and 5 that any desired diameter ratio between supporting rolls, backing rolls, and straightening rolls may be obtained with my new supporting roll arrangement. The horizontal tangent to the upper surface of the backing roll 30' is nearer the common horizontal tangent to the upper surface of supporting rolls 26' and 27' than in the corresponding arrangement illustrated in Fig. 4. In other words, the distances between the top points on rolls 30' and 26', 27', may be varied as desired to support loads at different levels which makes this supporting arrangement also applicable to conveyors and the like. It is understood that regardless of the ratio of these various roll sizes, either bushings, roller bearings, or any other type of anti-friction bearings may be employed.

In Figs. 1 to 5 inclusive, it was assumed that all the shafts such as 22, 23, 24, 41, 42, carrying the supporting rolls were rotatably mounted at their ends. This, however, is not essential in the application of my proposed supporting arrangement, as may be noted from Fig. 6 which shows a cross section through one modified supporting roll shaft unit. If the bearing arrangement according to Fig. 6 is employed, the outside ends of shaft 22'' may be fixed against rotation in their bearing blocks. The supporting rolls 26'' may be mounted on anti-friction bearings as shown to be freely rotatable on shaft 22''. Sleeve 47'' may also be mounted on roller bearings on the fixed shaft 22'', thus allowing supporting rolls 26'' and sleeve 47'' independent and opposite rotations.

Fig. 7 shows a further modification of the bearing arrangement previously shown in Figs. 1 to 5 inclusive, in that the shaft 22''' is freely rotatable in anti-friction bearings 52. Contrary to Figs. 1 to 5 inclusive, however, the sleeve may either be an integral part of shaft 22''' as shown, or keyed to this shaft to force sleeve and shaft to rotate as a unit. On the other hand, supporting rolls 26''' are shown to be mounted in anti-friction bearings on shaft 22''' to allow the supporting rolls 26''' rotation in opposite direction to shaft 22'''.

The various bearing and roll arrangements shown are susceptible to a number of other modifications without departing from the spirit of the present invention. For instance, referring to Fig. 3, only one supporting roll 39 may be mounted in the middle of shaft 41 to take the position of the sleeve 46, and two sleeves may be mounted in the present positions of supporting rolls 39. Then two backing rolls 43 would be provided instead of one as shown, without changing the effectiveness of the proposed supporting arrangement. Therefore, the scope of the invention is to be restricted only by the limitations contained in the appended claims.

I claim:

1. A supporting roll structure of the character described comprising at least two revolubly mounted supporting rolls of relatively large diameter, said supporting rolls including elements freely rotatable around the same axes of rotation as said supporting rolls, at least one backing roll of relatively smaller diameter than said supporting rolls, said backing roll being spaced between two adjacent supporting rolls so as to contact said freely rotatable elements for rotating said backing roll in the same direction as its associated supporting rolls.

2. A supporting roll structure comprising at least two work-engaging rolls, supporting rolls of relatively large diameter in contact with opposed flanks of said work-engaging rolls, sleeves freely rotatable around the same axes of rotation as said supporting rolls, relatively smaller backing rolls revolubly engaging adjacent flanks of said work-engaging rolls and said sleeves for supporting said work-engaging rolls against undesired vertical and horizontal deflection under load.

3. A supporting roll structure for a train of closely and substantially evenly spaced work-engaging rolls comprising supporting rolls of relatively large diameter in contact with and spaced between successive pairs of work-engaging rolls, backing rolls interposed between two adjacent supporting rolls and revolubly engaging their associated work-engaging rolls, said supporting rolls and said backing-rolls combining in their action to maintain said associated work-engaging rolls against undesired deflection.

4. A roll structure comprising a plurality of straightening rolls, supporting rolls positioned between and revolubly contacting the inside flanks of successive pairs of straightening rolls, said supporting rolls being provided with rotatably mounted sleeves, backing rolls located between adjacent supporting rolls and revolubly engaging the outside flanks of said pairs of straightening rolls and said sleeves for supporting said straightening rolls against undesired vertical and horizontal deflection under load.

5. In a sheet flattening device at least two work rolls for engagement with one surface of the sheet to be flattened, two supporting rolls spaced symmetrically with respect to said work rolls, said supporting rolls revolubly engaging at a cer-

tain level those flanks of their associated work rolls which are turned away from each other, elements freely rotatable around the same axes of rotation as said supporting rolls, at least one backing means positioned between said work rolls and rotatably contacting their adjacent flanks at a higher level than said supporting rolls for backing-up said work rolls against undesired vertical and horizontal deflections under load.

6. In a supporting mechanism of the character described, work rolls, supporting rolls of relatively larger diameter than said work rolls, said supporting rolls being symmetrically spaced with respect to said work rolls and being in contact with the latter, at least one backing roll positioned between adjacent supporting rolls, the longitudinal axis of said backing roll being positioned between the plane common to the longitudinal axes of said supporting rolls and the plane common to the lines of contact of said supporting rolls with said work rolls, said supporting rolls and said backing rolls combine in their action to maintain their associated work rolls against undesired horizontal as well as vertical deflection.

7. A supporting roll arrangement for the work rolls of roller levelers comprising in combination with said work rolls between which the work-material is to pass, supporting means of relatively larger diameter than said work rolls symmetrically positioned with respect to at least two of said work rolls and revolubly contacting those flanks of said work rolls which are turned away from each other, rotatable elements associated with each of said supporting means and having the same axes of rotation as said supporting means, backing means positioned between two adjacent supporting means and revolubly engaging said rotatable elements as well as the adjacent flanks of said work rolls for the support of said work rolls against undesired horizontal and vertical deflection.

8. A supporting roll arrangement for the straightening rolls of roller levelers comprising in combination with said straightening rolls, supporting rolls of substantially larger diameter than said straightening rolls spaced to rotatably engage subsequent pairs of straightening rolls, independently rotatable elements having the same axes of rotation as said supporting rolls, relatively smaller backing rolls positioned between subsequent supporting rolls, said backing rolls being in contact with said straightening rolls and with said rotatable elements to support said straightening rolls against undesired vertical and horizontal deflection.

9. A supporting roll arrangement for roller levelers comprising straightening rolls between which the work material is to pass, relatively large diameter supporting roll units contacting subsequent pairs of said straightening rolls, sleeves rotatably mounted on said supporting roll units for the independent rotation of said sleeves and of said supporting roll units, backing rolls positioned between subsequent pairs of said straightening rolls, said backing rolls being revolubly in contact with said straightening rolls and with said sleeves to cause said sleeves and said straightening rolls to rotate in identical directions and to cause their associated supporting rolls and backing rolls to rotate in respective opposite directions thereto.

10. A supporting roll arrangement for a train of straightening rolls comprising supporting rolls of relatively large diameter located in staggered relation to subsequent pairs of said straightening rolls, backing rolls of relatively smaller diameter spaced between adjacent supporting rolls, said supporting rolls and said backing rolls being in revoluble engagement with respective opposite flanks of their associated straightening rolls for the support of said straightening rolls against undesired vertical and horizontal deflection under load.

11. In combination with a series of equally spaced and closely arranged small diameter straightening rolls in a sheet straightening machine of the class described, of backings disposed between adjacent rolls of greater diameter than the rolls, said backings including portions engaging the flanks of the rolls in supporting the rolls against undesired vertical and horizontal deflection when under load, and means eliminating excessive frictional engagement between the rolls and backing.

12. In mechanisms of the character described, a plurality of closely spaced straightening rolls for engagement with one surface of the work material to be flattened, a train of supporting rolls of relatively larger diameter than said straightening rolls spaced relative to the latter in such a way that one of said supporting rolls at one end of said train reinforces one straightening roll while the remaining supporting rolls each reinforce adjacent flanks of two of said straightening rolls, freely rotatable, sleeve-like elements associated with each of said supporting rolls, and backing rolls of relatively smaller diameter than said supporting rolls spaced between adjacent supporting rolls and resting against said elements while at the same time backing-up those flanks of said straightening rolls unsupported by said supporting rolls.

13. A roll structure comprising a plurality of straightening rolls, a multiplicity of supporting sections located along said straightening rolls, each of said supporting sections comprising supporting rolls of relatively larger diameter than said straightening rolls in contact with and spaced between successive pairs of said straightening rolls, independently rotatable elements associated with said supporting rolls, and backing rolls interposed between adjacent supporting rolls and in engagement with said elements and said straightening rolls, said supporting rolls and said backing rolls effecting in combination a rigid reinforcement of said straightening rolls against undesired deflection under load.

14. A supporting roll structure for a train of substantially evenly spaced work engaging rolls comprising supporting rolls of relatively large diameter in contact with and spaced between successive pairs of work engaging rolls, auxiliary backing rolls interposed between two adjacent supporting rolls and revolubly engaging the flanks of their associated work engaging rolls at higher levels than their associated supporting rolls, said supporting rolls and said backing rolls combining in their action to maintain said associated work engaging rolls against undesired deflection.

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