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## [54] SPREADER FOR SLIT WEB MATERIAL


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[51] **Int. Cl.** .....**B65h 23/32**

[58] **Field of Search** .....226/109, 110, 199; 83/439, 83/448, 105, 107; 242/56.1, 56.4, 56.5



[56] **References Cited**

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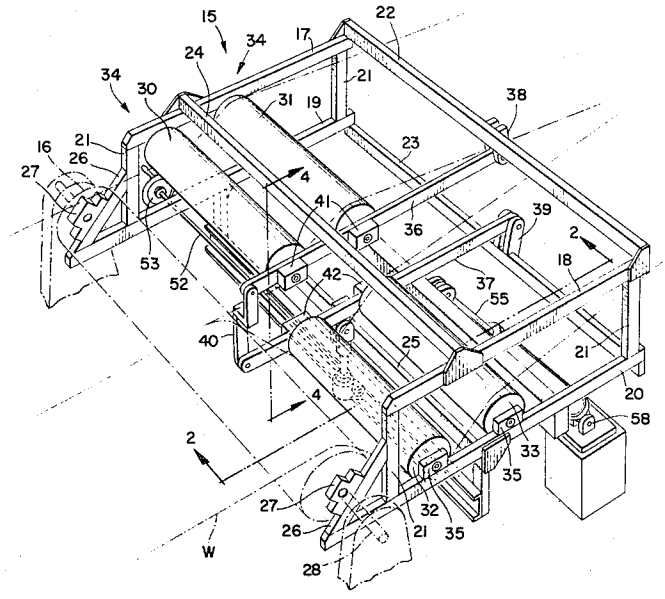
[57] **ABSTRACT**

A web spreader assembly having two pairs of web spreader rolls and associated with a predetermined pass line roll, by means of which the slit webs are maintained in predetermined orientation relative to the first of each of the pairs of spreader rolls, and in which the spreader rolls are mounted on a movable frame work which is swingable upwardly and downwardly so as to align the same in any desired positional relationship with relation to the rewind mandrel. The pairs of spreader rolls are preferably mounted within such a swingable framework with their outboard ends fastened to portions of the framework, and with a movable central framework, the inboard ends of the pairs of rolls being fastened to the movable inner framework, and means being provided whereby the movable inner framework can be swung upwardly and downwardly relative to the main framework so as to swing such pairs of rolls into any desired angular relationship relative to the plane of the web.


**7 Claims, 4 Drawing Figures**



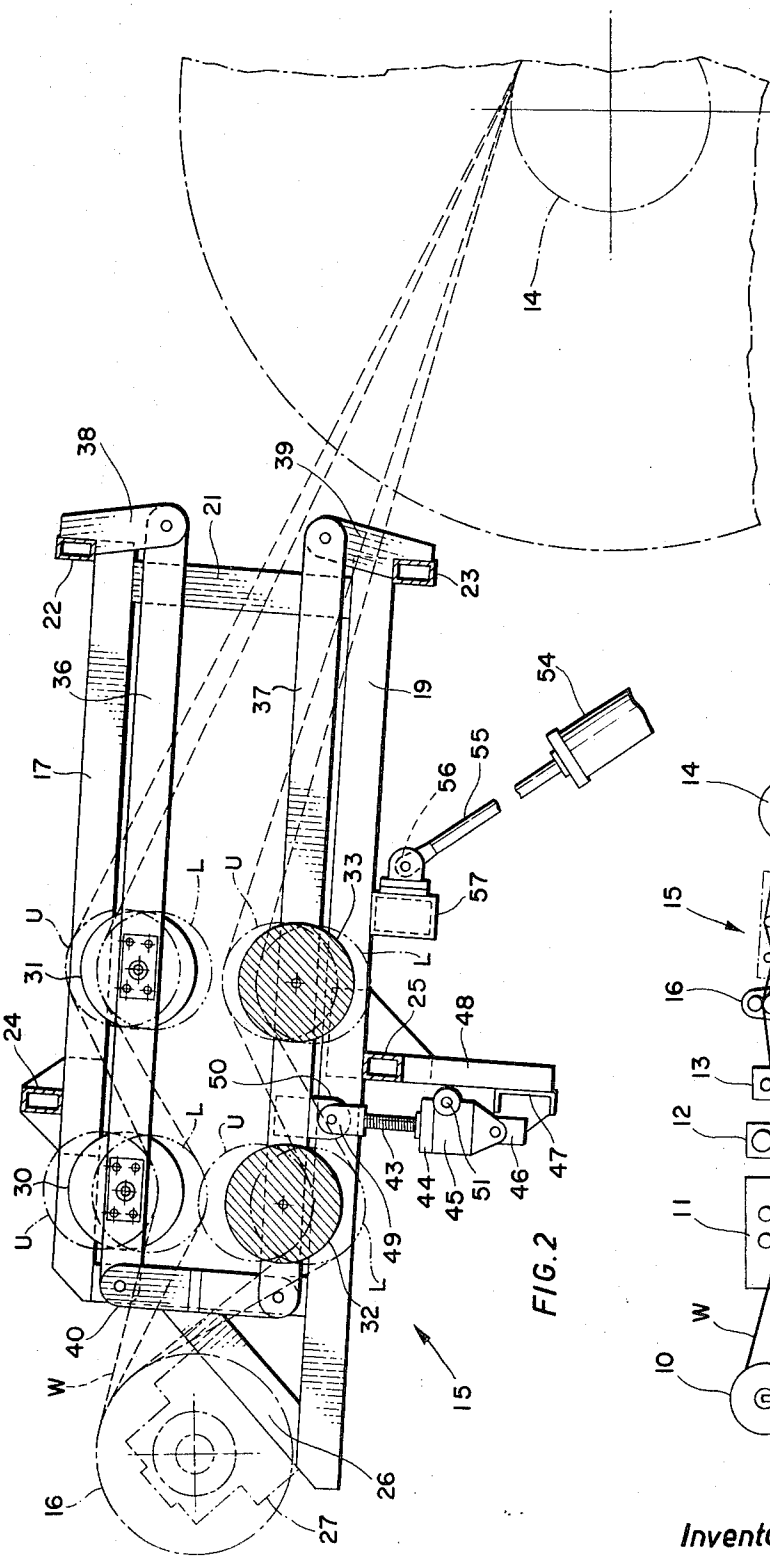



FIG. 2




FIG. 1

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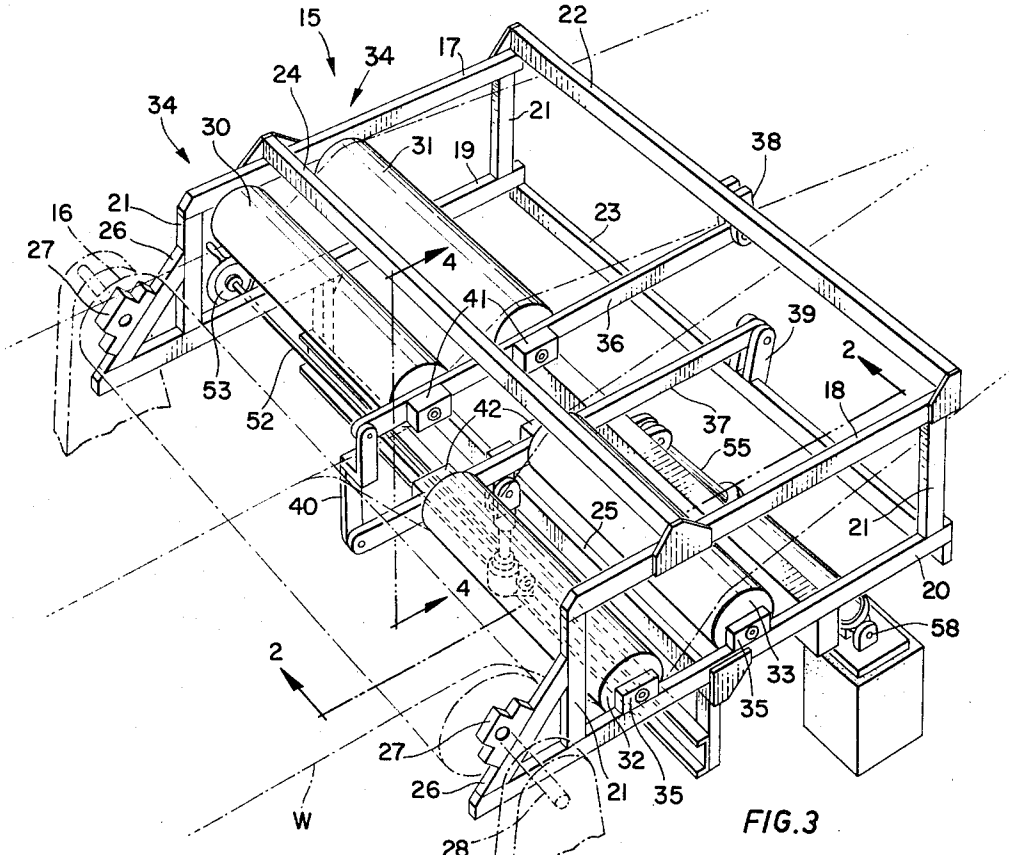


FIG.3

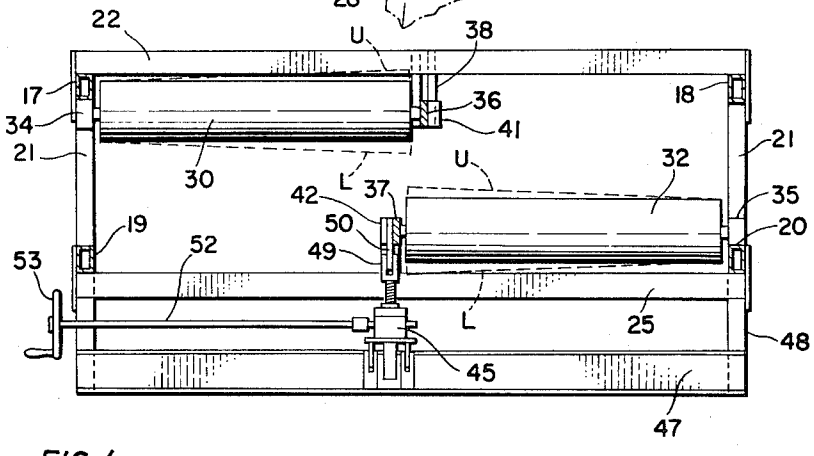


FIG.4

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# SPREADER FOR SLIT WEB MATERIAL

## BACKGROUND OF THE INVENTION

In the handling of web material such as sheet metal and the like, it is frequently necessary to slit a wide web into two or in some cases three narrower webs. Such slitting is a conventional operation and is carried on by means of rotary slitter knives which are well known in the art, afterwhich the two or three webs are then wound up on a rewind mandrel. It is found however that due to imperfections in the rolled strip such as "-camber" and the like, the edges of the slit web tend to converge towards the center line of the mandrel and overlap and interleave with one another and damage is caused. In order to avoid this, in the past, it has been customary to provide thin annular separator discs mounted on the rewind mandrel itself and in some cases mounted on an overarm separator. However, both of these methods tend to damage the strip edges. Obviously, in the slitting operation itself no material is removed. Thus if it is attempted to interpose in such slits even relatively thin annular discs, without prior separation of the strips, the edges on the strip material are bound to be damaged to some extent. In certain cases of heavy gauge relatively stiff material such damage is negligible. However, it is found that with wider strip material, the effects of camber and other rolling mill defects are greater, than in narrower strip, and in addition, where the web is of softer material the damage is greater. Thus it follows that the greatest damage occurs when slitting one very wide web into two webs, and the tendency for damage to occur decreases progressively when slitting is into a higher multiple of narrower webs.

Thus, it is desirable to separate the two webs without contracting their edges at all. In some cases in the past, it has been proposed to separate two such webs by running then over pairs of angled rolls, that is to say, rolls which are angled either upwardly or downwardly with relation to the plane of the web itself. A relatively crude form of such device is shown in U.S. letters Pat. No. 3,072,353, Jan. 8, 1963, Web Slitting and Winding Machines, H.W. Moser. The principal of passing a web over an angled roll so as to modify its axis of movement is not itself new. Thus in the art of belts drives, it has been well known for many years that a belt could be deflected from its path by passing it over an angled roll, typically a conical roll or pulley. Similarly, it has been well known that a belt running upon a pulley having a convex driving surface will always tend to seek the highest point of such driving surface, i.e., in the middle of the pulley.

However, when this principle is applied to the specific problem of separating slit webs on a very large production line, certain problems are found to arise. Thus a web slitting line of this type will frequently incorporate some means of web levelling or straightening rolls, and also web tensioners, located between the slitting roll and the rewind mandrel. Obviously, it is desirable to provide such additional strip treatment rolls before the separation of the webs, since otherwise the webs might tend to converge once more by the time they reach the rewind mandrel. Thus the separator rolls will preferably be placed as close as possible to the rewind mandrel. However, it is found that when the separator rolls are placed in this position, certain other problems occur. Thus at the beginning of the slitting and rewinding operation the diameter of the rewind mandrel is at a minimum, and it will expand gradually as the diameter of the rolls of rewound web on the mandrel become greater. In the case of a relatively short run, this will not present too much of a problem. The pairs of separator rolls may be mounted in a fixed location, and the angle at which the split webs leave the separator roll, will not suffer any substantial change. However, on longer production runs where the change in diameter is greater the angle of wrap of the slit webs, over the second set of separator rolls can change quite significantly, and such a change in angle will affect the orientation of the axes of the two webs. As a result, the rewound coils or rolls of web material will tend to become slightly irregular or telescoped on the coil.

In addition, it is found that the use of two pairs of spreader rolls, tends to produce a rotational stress in the assembly which under certain circumstances can still further aggravate the misalignment of the rewound rolls on the mandrel.

In addition, in order that any one web handling production line facility may be employed for a variety of purposes, it is desirable that the web spreading rolls should be removable so that they may be moved into an inoperative position, if for example the web handling facilities are to be used for multiple web slitting, or some other purpose.

## BRIEF SUMMARY OF INVENTION

In general terms, the invention provides an assembly of web spreader rolls arranged and adapted for use in association with a preliminary pass line roll, by means of which the slit webs are maintained in predetermined orientation relative to the first of each of the pairs of spreader rolls, and in which the spreader rolls are mounted on a movable frame work which is swingable upwardly and downwardly so as to align the same in any desired potential relationship with relation to the rewind mandrel. The pairs of spreader rolls are preferably mounted within such a swingable framework with their outboard ends fastened to portions of the framework, and with a movable central framework, the inboard ends of the pairs of rolls being fastened to the movable inner framework, and means being provided whereby the movable inner framework can be swung upwardly and downwardly relative to the main framework so as to swing such pairs of rolls into any desired angular relationship relative to the plane of the web.

The foregoing and other and related objectives and advantages will become apparent from the following description of a preferred embodiment of the invention which is given here by way of example only with reference to the following drawings in which like reference devices refer to like parts thereof throughout the various views and diagrams and in which;

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic side elevational view of a web slitting and recoiling line incorporating a web spreader according to the invention;

FIG. 2 is a side elevational view partially in section along the line 2—2 of FIG. 3, and

FIG. 3 is an upper perspective illustration of the web separator rolls according to the invention, showing the webs therein in phantom, and,

FIG. 4 is an end elevational view of the spreader according to the invention partly in section along the line 4—4 of FIG. 3.

## DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIG. 1, it will be seen that this illustrates in purely schematic terms a typical web slitting line, and will be seen to comprise an unwind mandrel 10, a set of flattening rolls 11, a rotating slitter knife station 12, a set of tensioner rolls 13, and a rewind mandrel 14. It will be understood that the foregoing components are essentially well known in the art, subject to variation between one maker and another, this in any event not forming part of this specific invention. In accordance with the practice of the invention, the web spreader assembly is referenced generally as 15, and will be seen to be placed as close as possible to the mandrel 14, in order to provide maximum control over the alignment of the webs as they are being rewound. For the sake of illustration, the web material is shown referenced by the letter W. It will of course be understood that the invention is not to be limited to a combination with these specific series of stages, but will be applicable to any situation where it is required to separate two or perhaps three relatively wide webs either during a slitting and rewinding operation or otherwise.

With further reference to FIG. 1, it will be noted that the web spreader assembly 15 is shown mounted in association with a pair of so-called "pass-line" rolls 16, which are found to greatly assist in the effective operation of the spreader assembly 15 and to avoid affecting the operation of previous processes. In addition, the pass-line rolls 16 are of importance in order to maintain the slit webs W horizontal as they exit from the slitter throughout the coil build up on the rewind mandrel 14.

With further reference to FIGS. 2, 3 and 4, it will be seen that the web spreader assembly generally referenced as 15 according to this preferred embodiment, comprises a generally rectangular box-like framework having left and right hand upper side members 17 and 18, and left and right hand lower side members 19 and 20, arranged and supported in spaced parallel relation by means of the upright corner supports 21. Upper and lower end frame cross members 22 and 23 extend between the ends of the side members 17, 18, 19 and 20, the upper member being attached to the upper edge of the upper side members 17 and 18, and the lower end member 23 being attached to the lower surfaces of the lower side members 19 and 20, whereby to define a predetermined maximum spacing between the end members 22 and 23. An upper median bracer member 24 extends between the upper side members 17 and 18, and a lower median bracer member 25 extends between the lower side members 19 and 20, the bracer members 24 and 25 again being attached respectively to the upper surfaces of the upper side members 17 and 18 and the lower surfaces of the lower side members 19 and 20 respectively. The lower side members 19 and 20 will be seen to be somewhat longer than the upper side members 17 and 18, and an angled mounting bracket 26 extends between the endwise extension of the lower side members 19 and 20, and the corner members 21. Bearing means 27 are fastened to the angled support members 26, and ride on pivots 28 running through the lower pass roll 16 (which is shown only in phantom form in FIG. 2) thereby supporting the entire spreader assembly 15 in a swingable manner, pivoting about the center of the lowermost of the pass line rolls 16.

Mounted and supported within the box-like frame assembly, are two pairs of spreader rolls, namely the left hand first and second spreader rolls 30 and 31 and the right hand first and second spreader rolls 32 and 33. The outer ends of the left hand spreader rolls 30 and 31 are mounted in outer end bearings 34 (see FIG. 4), and the outer ends of the right hand spreader rolls 32 and 33 are mounted in outer end bearings 35. Bearings 34 and 35 are so constructed and arranged as to permit the left and right hand rolls 30, 31, 32 and 33 to swing upwardly and downwardly in relation thereto through a limited arc between upper positions U and lower position L as shown in phantom in FIG. 4. The details of such bearings are omitted for the sake of clarity.

For the purpose of mounting the inner ends of the spreader rolls 30, 31, 32 and 33, a movable inner framework is provided which will be seen to comprise the upper and lower swing arms 36 and 37, the upper arm 36 being swingably mounted between the mounting plates 38 fastened to the upper end cross member 22, and the lower swing arm 37 being swingably mounted between the mounting plates 39 fastened to the lower end cross member 23. The free ends of the swing arms 36 and 37 are linked by an offset end link member 40, which is pivotally attached both to the upper and lower swing arms 36 and 37, thereby permitting the upper and lower swing arms 36 and 37 to be swung upwardly and downwardly through a limited arc relative to the frame side members 17, 18, 19 and 20.

The inner or inboard ends of the spreader rolls 30, 31, 32 and 33 are mounted on the inner end bearing means 41 and 42, which are so designed and constructed as to permit a limited degree of upwardly and downward swinging movement of the inboard ends of the spreader rolls 30, 31, 32 and 33, in response to upward and downward swinging movement of the swing arms 36 and 37. It will of course be understood that the details of the bearings 34, 35 and 41 and 42 are not specifically described, it being sufficient for the purposes of this specification that they permit the limited degree of upward and downward swinging movement as described above. Preferably, the spreader rolls 30, 31, 32 and 33 will be so constructed that they are provided with a central spindle (not shown) which is non-rotatable, such central spindle being held in the bearings 34, 35, 41 and 42 to permit limited swinging movement thereof as described above. Preferably, the spreader rolls themselves will be rotatably mounted on such spindles for example by means of self aligning bearings (not shown) in a manner well known in the art, the details of which are omitted for the sake of clarity.

Preferably, the construction and arrangement of the upper and lower swing arms 36 and 37 is such as to permit a certain degree of overlapping at least of the inboard bearings 41 and 42, so as to bring the inner ends

of the spreader rolls 30, 31, 32 and 33 into vertical alignment, or preferably overlapping relationship. For this purpose, it is necessary to provide the link 40 with two right angle bends more or less in its center, so as to offset the upper swing arm 36 with respect to the lower swing arm 37, and the location of the mounting brackets 38 and 39 on cross members 22 and 23 is similarly offset.

As noted above, the upper and lower swing arms 36 and 37 are movable up and down in unison so as to swing the inboard overlapping ends of the rolls 30, 31, 32 and 33 either upwardly, or downwardly with respect to their outer ends. In order to control such movement, is provided a central control shaft 43, which is exteriorly threaded, and is received in a worm driven wheel 44 mounted on the hub 45. The hub 45 is pivotally mounted on the mounting bracket 46 which is itself fastened to the lower cross beam 47. Cross beam 47 is mounted a suitable distance spaced below the lower side members 19 and 20, on the vertical supports 48 at either end thereof, the upper ends of supports 48 being connected both to the side members 19 and 20, and also to the median bracer 25.

The upper end of the threaded shaft 43 is provided with the attachment flanges 49, pivotally connected to the mounting brackets 50, connected to the underside of the lower swing arm 37. In order to rotate the drive wheel 44, and thereby extend or retract the threaded shaft 43, a worm drive unit 51 is mounted on one side of the hub 45, and a drive rod 52 (see FIG. 2) extends outwardly to the left hand side of the machine, and is operated by means of the hand wheel 53.

In order to swing the entire assembly 15 upwardly and downwardly, an elevating member, in this case an hydraulic or pneumatic cylinder 54 is provided, having a drive rod 55 pivotally connected to the mounting brackets 56. Mounting brackets 56 are themselves fastened to the lower cross beam 57 attached to the underside of the lower side members 19 and 20. The other end of the cylinder 54 may be fastened in any suitable location, on mounting brackets 58, which may be fastened to the floor, or fixed and supported in any other suitable manner. Obviously, the cylinder 54 is only one of various forms of raising and lowering mechanisms that would be applicable.

In operation, the web material W is continuously slit at the slitter station 12 more or less along a median line, into two web portions, and after passing over the lower pass line roll 16, the slit web is then separated, with the right hand web portion passing downwardly underneath the first right hand spreader roll 32, and then upwardly and over the second right hand spreader roll 33, after which it passes between the upper and lower end cross members 22 and 23 for rewinding on the mandrel.

The left hand portion of the slit web passes under the left hand first spreader roll 30, and is then raised upwardly over the second left hand roll 31 and then passes between the upper and lower end cross members 22 and 23 for rewinding on the mandrel. So long as the two pairs of left and right hand spreader rolls remain horizontal, i.e., in parallel but vertically spaced apart planes as shown in solid lines in FIG. 4, then the left and right hand portions of the slit web, when they leave the spreader 15 will be in exactly the same edgewise relationship, as they were when they entered the spreader 15, and of course it is not intended that the invention shall be operated in this manner.

In order to effect a spreading of the two portions of the split web material, the inboard ends of the spreader rolls are elevated into their upper angled positions, shown by the reference U in FIGS. 2 and 4. This is effected by simply rotating the hand wheel 53 so as to cause elevation of the shaft 43, thereby forcing the swing arms 37 and 36 upwardly, and raising the inboard bearings 41 and 42. When the spreader rolls are in this angled relationship, it will of course be understood that the inboard ends of the first spreader rolls 30 and 32 will be displaced upwardly somewhat more than the inboard ends of the second spreader rolls 31 and 33. The reason for this is obvious. Since the swing arms 36 and 37 must pivot about fixed points located by the mounting brackets 38 and 39, the free ends of the swing arms 36 and 37, will describe an arc, which is obviously at its greatest extent at such free ends and will progressively decrease along the length of the spreader arms 36 and 37. Since the first rolls 30 and 32 are mounted further away from the mounting brackets 38 and 39 than are the inboard ends of the second rolls 31 and 33, it is clear that the first rolls 30 and 32 will be displaced to a greater extent than the second rolls 31 and 33. The difference is such displacement is not of course great, but will correspond in scale more or less to the difference in the phantom positions shown in FIG. 2 as between the first roll 30 and the second roll 31 and the first roll 32 and the second roll 33.

As the two portions of the split web W pass underneath the first rolls 30 and 32, the axes of such portions will diverge slightly from one another, procuring a certain degree of separation or spreading. If such diversion was left uncorrected, then of course the two portions of the slit web would continue to diverge on separate axes and they could not be wound on the mandrel 14. For this reason, they pass over the second rolls 31 and 33, where the divergence of such axes is corrected, and they leave such second rolls on substantially parallel axes.

The degree of divergence and correction is of course dependent upon the degree of angular displacement of the rolls. The more they are angularly displaced, the more acute will the divergence become, although only a limited degree of such angular displacement is possible when operating with web material such as sheet metal as a practical matter. In addition, it is found that the degree of correction required to be imparted by the second rolls 31 and 33 is somewhat less than the original degree of divergence imparted by the first rolls 30 and 32, and thus the apparatus is specifically designed so that the angular displacement of the second rolls 31 and 33 shall be, as noted above, somewhat less than the angular displacement of the first rolls 30 and 32.

It will be understood that the divergence and correction of the slit web, in the specific example shown, will be achieved only when the rolls are moved into their upper position, in the particular example of the invention as illustrated. While for the sake of adaptability the invention has been illustrated as providing for both upper and lower position, in fact, in the particular form as illustrated, if the rolls where moved into their lower

position, they would in fact work in the opposite manner, that is to say, they would cause the two portions of the web to converge. It will be understood that in the description of this embodiment of the invention, the possibility that both positions may be of utility in some form of web processing, cannot be altogether excluded, and accordingly both upper and lower positions are illustrated.

The reason why only the upper position is of utility in the specific embodiment as shown is that the web material is shown as passing under the first rolls **30** and **32** and over the second rolls **31** and **33**. When the inboard ends of the first roll **30** and **32** are raised, then with respect to the web material, which is passing underneath those rolls, the angling of such rolls will cause the web material to continuously seek the "highest" part of the roll, i.e., the outboard ends of the rolls **30** and **32**. In this respect, the word "highest" would indicate the end of the roll which causes the greatest deflection or "wrap" of the web material, and it will be apparent that when the web material is passing under the rolls **30** and **32** that the greatest displacement of the web material will be at the outer ends of the rolls. Conversely, since the web material is passing over the second rolls **31** and **33**, the effect is reversed. Thus the "highest" part of the roll **31** and **33**, with regard to the web material, will be the inboard end of those rolls, thereby causing the web material to seek such inboard ends. Clearly, however, if for some reason it was desirable to pass the web material over the first set of rolls **30** and **32** and under the second set of rolls **31** and **33**, then the angular displacement of the rolls would have to be reversed and they would be moved into their lower position, in order to achieve the same degree of web spreading.

If the web slitting facilities are being employed for multiple web slitting, where the problem of controlling the individual portions of the slit web is not as great, and can be adequately handled by means of an overarm separator and spacer discs on the mandrel, then the spreader assembly **15** can simply be swung out of the way by lowering the elevating mechanism consisting of the cylinder **54**, and permitting the spreader **15** to swing downwardly. At this point, web material passing from the pass rolls **16** can then be wound directly onto the mandrel **14** without contacting any part of the spreader **15**.

In the event of handling a production run of exceptional length, in which the diameter of the recoiled slit material on the mandrel **14** will grow several times, then it may be found that when such coils reach a certain size that the degree of "wrap" of the web material around the second rolls **31** and **33** will be insufficient to produce adequate correction, and accordingly, the recoiled material may be recoiled in an irregular or telescoped manner. In order to avoid this, the elevating mechanism **54** can be operated from time to time throughout the run so as to gradually elevate the spreader **15** to ensure that the necessary "wrap" around the second rolls **31** and **33** is maintained at all times. Alternatively, by the use of a suitable servo mechanism (not shown) the elevating mechanism **54** can be continuously gradually operated in response to the gradual increase in the diameter of the recoiled material on the mandrel **14** automatically. Obviously, such a servo mechanism is not illustrated, but the details thereof could readily be constructed by persons skilled in the art and require no further explanation.

In certain circumstances, it may be desirable to employ the spreader **15** when a length of web material W is being split into three such webs. In this case, the two right and left hand slit portions of the web would pass over the pass line roll **16**, and through the spreader **15** as shown. However, the third central portion of the web would pass directly over the spreader **15** without any deflection whatever. For this purpose, an additional pass line roll (not shown) would be added, so as to provide sufficient clearance.

The foregoing is a description of a preferred embodiment of the invention which is given here by way of example only.

The invention is not to be taken as limited to any of the specific features as described, but comprehends all such variations thereof as come within the scope of the appended claims.

What I claim is:

**1.** Apparatus for spreading slit web material passing over pass line roll means on a predetermined axis and path of movement and comprising;

spreader frame means pivotally mounted for movement relative to said pass line roll means into and out of said predetermined path of said web material;

right and left hand pairs of parallel spaced apart spreader roll means supported by said frame means and movable therewith;

swingable bearing means on said frame means for supporting the outboard ends of said pairs of spreader roll means at different elevations on respective right and left hand sides of said frame means;

swingable support arm means swingably mounted on said frame means;

swingable bearing means on said support arm means for supporting the inboard ends of said pairs of spreader roll means;

arm control means connected to said support arm means for controllably swinging the same relative to said frame means, said swingable bearing means moving in unison therewith, and,

elevation control means connected to said frame means for moving and locating said frame means in a desired position relative to said pass line roll means.

**2.** The apparatus as claimed in claim **1** wherein said spreader frame means is of generally rectangular construction, and incorporating frame extension means at one end thereof, and bearing means on said frame extension means, attachable to said pass line roll means along the axis of rotation thereof, whereby said frame means is swingably movable relative thereto about the center of rotation of said pass line roll means.

**3.** Apparatus as claimed in claim **1** wherein said right and left hand pairs of spreader rolls are arranged on respective sides of said spreader frame means, in planes vertically spaced apart from one another.

**4.** The apparatus as claimed in claim **1** wherein said spreader frame means includes upper and lower right and left hand frame side members, and frame cross members extending therebetween, and wherein said

support arm means comprises upper and lower arm members swingably mounted to said cross members for swinging upwardly and downwardly intermediate said frame side members, in a substantially vertical path.

5. The apparatus as claimed in claim 4 including control means connected to said support arm means, and operable to swing said support arm means upwardly and downwardly and locate the same in a predetermined desired position.

6. The apparatus as claimed in claim 4 wherein said upper and lower support arm members are attached to said frame cross members in vertically offset relationship, and including link means pivotally connected between the free ends of said arm members, said link means being offset in said spaced apart vertical planes as aforesaid.

7. The apparatus as claimed in claim 1 wherein said elevation control means comprises a power cylinder member, means fixedly mounting a lower end of said cylinder, drive rod means extending from the upper end of said cylinder and means pivotally connecting the free end of said drive rod to said spreader frame means whereby to raise and lower the same.

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