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3,515,327

APPARATUS FOR STORING A VARIABLE LENGTH OF STRIP

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4 Sheets-Sheet 2

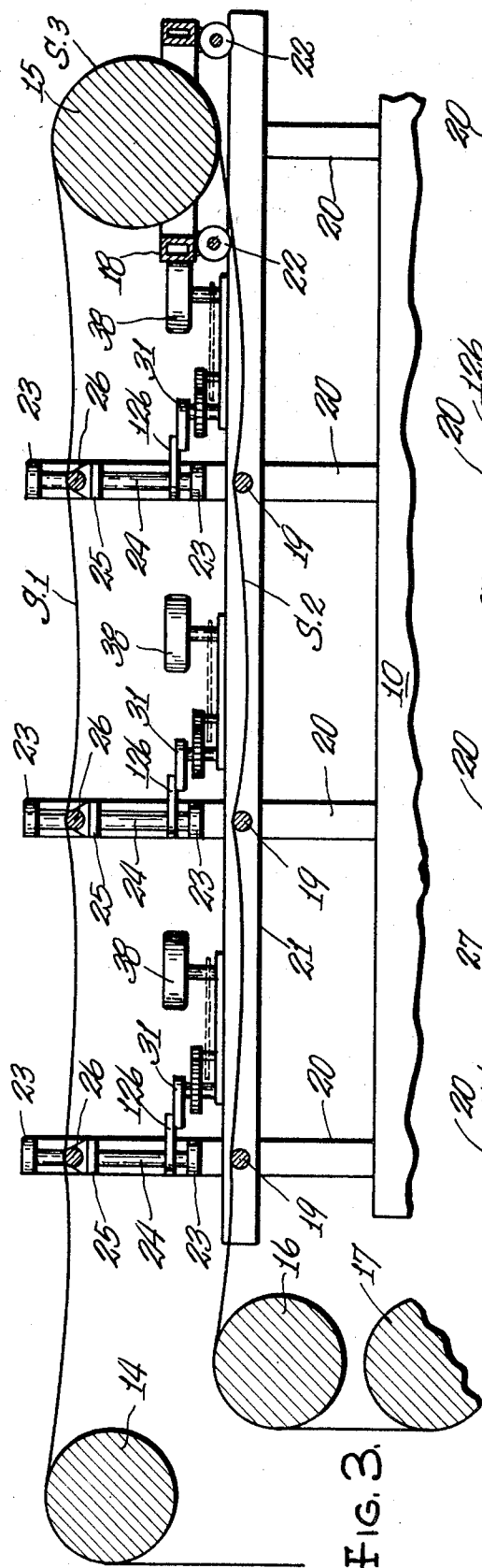


FIG. 3

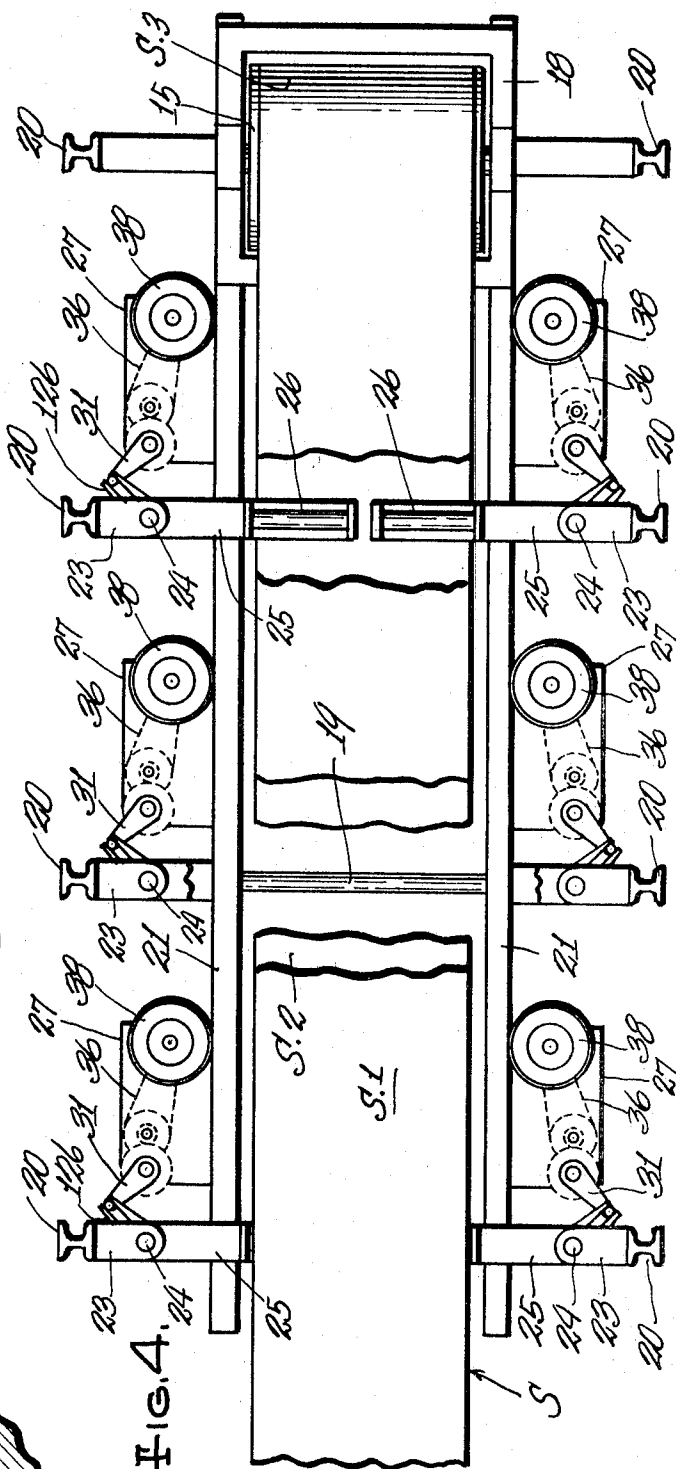


FIG. 4

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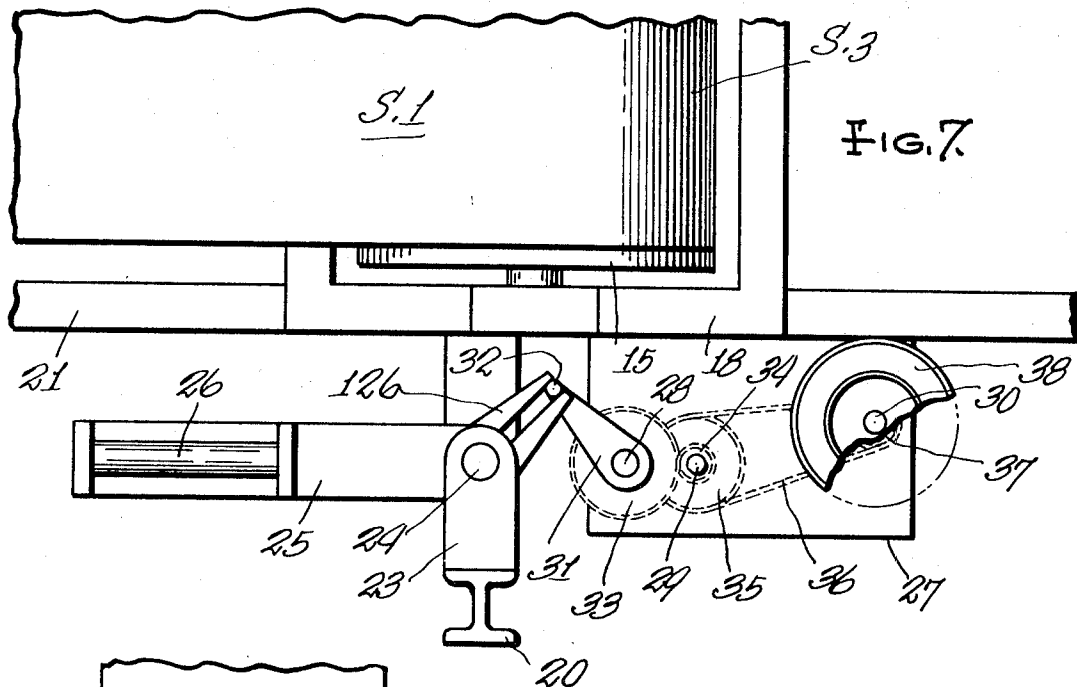
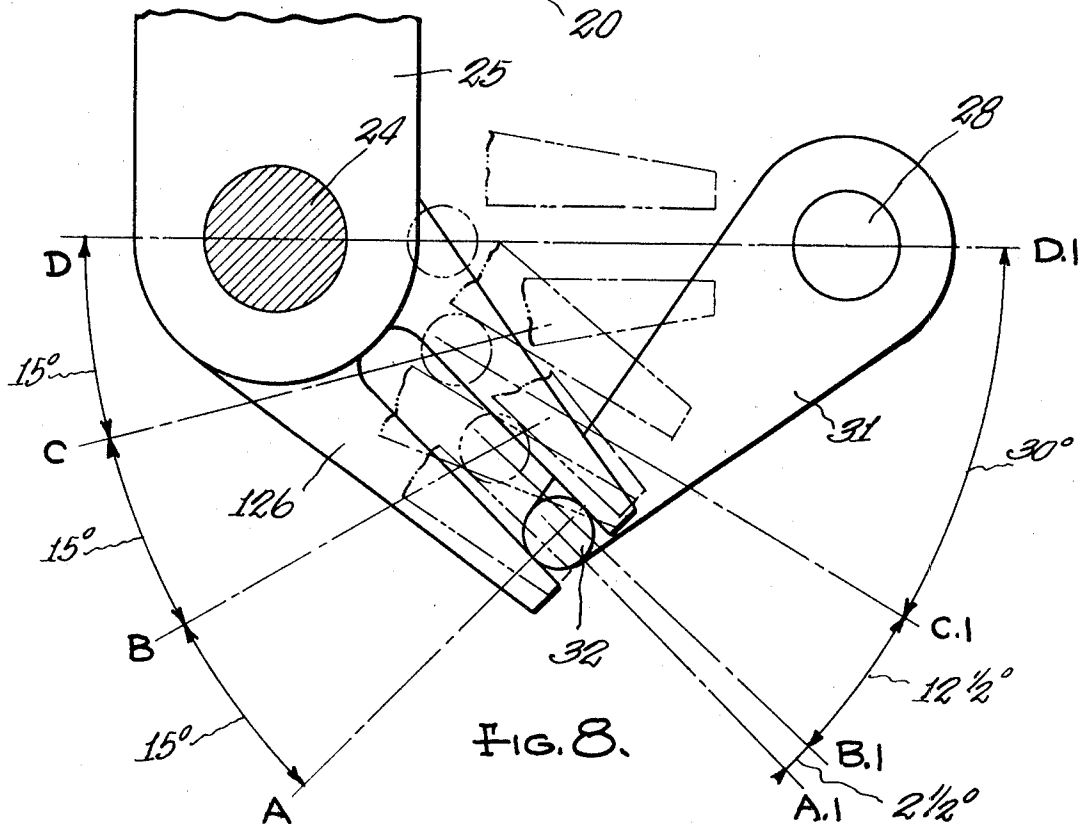
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1

2

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APPARATUS FOR STORING A VARIABLE LENGTH OF STRIP

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9 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus providing support rollers for underlying and supporting a generally horizontally extending portion of strip which may vary in length and such rollers being movable about respective pivot axes away from strip underlying positions during a decrease in length of the strip portion and movable to strip underlying positions during an increase in length of the strip portion. To minimize shock in initiating and terminating support roller movement toward and away from strip-supporting positions, such movement is effectuated by drive means having a variable drive ratio which gradually accelerates and gradually decelerates the support rollers toward and away from the positions aforesaid.

PREAMBLE

In many strip processing operations, it has been common practise to provide an accumulator, or strip storage device, in which a considerable length of strip may be stored and from which it may be released as required. Such devices are necessary in strip lines having one portion through which the strip moves continuously and another portion through which the strip moves intermittently. For example, many strip lines have portions through which strip must be fed continuously in an unbroken length. However, since strip is available only in coils of finite length, it is necessary to momentarily interrupt movement of a trailing strip end while the leading end of a new coil of strip is secured thereto. It is the function of a strip accumulator to feed strip to the continuously operating portion of the line, during the period when the trailing strip end is secured to the leading strip end.

In prior art strip accumulators, it has been common practise to support the strip in one or more loops which are variable in size to vary the length of strip stored and, because of the great length of such loops, they have been arranged horizontally to avoid high supporting towers with their attendant problems. When however, strip is stored in a horizontal loop, it is necessary to underlie each loop reach with rollers or the like to prevent excess sagging which may subject the strip to damaging stresses.

While support of a lower loop reach is quite simple, the support of an upper loop reach presents a problem in that the reach-supporting rollers must be shiftable from their normal reach-supporting positions as the loop is decreased in size and the loop upper reach becomes shorter to prevent interfering engagement with the looper roll positioned in the bight of the loop. Similarly, during an increase in loop size, the upper reach-supporting rollers must be shifted to reach-supporting positions as the loop upper reach increases in length.

Although prior art apparatus has employed shiftable rollers for supporting the upper reach of a loop of strip in an accumulator, such prior art apparatus has not been entirely satisfactory because of the shock imparted to various parts when movement of such rollers was initiated and terminated.

SUMMARY

The present invention provides strip accumulator apparatus for storing a variable length of strip in a horizontal loop having upper and lower reach portions connected by a bight portion. A looping roll is disposed in the loop bight portion and is displaceable longitudinally of the loop during changes in the size of thereof. Support rollers underlie and support the upper reach of the strip loop against sagging and such rollers are successively pivotable away from positions underlying the loop upper reach during looping roll movement resulting from a decrease in loop size and are pivotable toward such reach-underlying positions during an increase in loop size. To minimize shock in initiating and terminating support roller movement between said positions, such movement is effectuated by drive means which gradually accelerates and gradually decelerates such support rollers. Other advantages will readily become apparent from a study of the following description and from the drawings appended hereto.

DRAWING DESCRIPTION

In the drawings accompanying this specification and forming a part of this application there is shown, for purpose of illustration, an embodiment, which the invention may assume, and in these drawings:

FIG. 1 is a generally diagrammatic, side elevational view of apparatus with which the present invention may advantageously be used,

FIG. 2 is a view similar to FIG. 1 but with certain parts in another position,

FIG. 3 is a fragmentary view similar to FIG. 1 but in longitudinal section and to a larger scale and embodying structure of the present invention,

FIG. 4 is a top plan view of the apparatus seen in FIG. 3 but with certain parts on the near side broken away to illustrate the underlying structure,

FIG. 5 is a fragmentary top plan view of structure seen in FIG. 4 but to a larger scale,

FIGS. 6 and 7 are views similar to FIG. 5 but showing certain parts in other operating positions,

FIG. 8 is a greatly enlarged, fragmentary plan view of certain parts seen in FIG. 5 and such parts being shown in the position of the last-named view in full lines and in other positions in phantom lines, and

FIG. 9 is a graph illustrating rotation of certain operating parts of the invention.

DETAILED DESCRIPTION

With reference to FIG. 1, there is diagrammatically shown a strip processing line having a portion 10 which requires the unbroken feeding of strip S thereto. Upstream of line portion 10 is a welder mechanism 11 which functions to weld the trailing of a strip passing through the line to the leading end of another strip to be passed therethrough, thus forming an unbroken strip length.

Since strip movement at the welder must be stopped for a short period of time while the strips ends are secured together, a strip accumulator 12 is employed to provide for uninterrupted movement of strip into the line portion 10.

As herein disclosed, strip S passes from the welder 11 beneath a roll 13 and over a roll 14. From the roll 14, the strip extends in a horizontal reach S.1 about a looping roll 15 and returns beneath reach S.1 in a horizontal reach S.2 to pass over a roll 16 and under a roll 17 for passage into the line portion 10. While the rolls, 13, 14, 16 and 17 are fixed in position, the looping roll 15 is mounted on a carriage 18 for horizontal movement whereby the strip loop formed by strip reaches S.1

3

and S.2, which are joined by a bight portion S.3 which passes about the looping roll, may be varied in size to vary the amount of stored strip.

With the parts positioned as seen in FIG. 1, it will be noted that a relatively large loop of strip is stored in the accumulator and this is the normal status immediately prior to interruption of strip movement for welding the strip ends together as previously mentioned. If strip movement is now interrupted at the welder 11, the strip may still be continuously drawn into the line portion 10 from the loop of strip stored in the accumulator. During interruption of strip movement at the welder and continued strip movement into the line portion 10, the strip loop will decrease in size and the looping roll 15 will move to the left toward the position of FIG. 2. Although not shown, any suitable means may be employed to yieldably bias the looping roll to the right so as to maintain the stored strip loop under a certain amount of tension.

When the welder 11 has completed its function of welding the trailing strip end to the leading strip end, strip movement into the accumulator will be resumed but at a speed greater than that at which it is being drawn into the line portion 10. With strip moving into the accumulator faster than it is being withdrawn therefrom, the strip loop will increase in size and the looping roll 15 will once again move toward its position of FIG. 1 in preparation for the next-strip-joining cycle of operation.

While the structure thus far disclosed is sound in principle, in actual practice deficiencies arise. As illustrated in FIG. 1, it will be noted that the horizontal strip reaches S.1, S.2 tend to sag when the strip loop is large and since the loop may in actual practice be several hundred feet in length, the amount of sag becomes intolerable unless the loop reaches are maintained under prohibitively high tensions.

To prevent excess sagging of the lower strip loop reach S.2 is a relatively simple matter and may readily be accomplished by rotatably mounting supporting rollers 19 at spaced intervals therealong as seen in FIG. 3. The support of the upper loop reach S.1, however, is more difficult since any support rollers must be disposed within the strip loop and unless movable, such rollers would interfere with loop size reduction. Accordingly, and with reference to FIGS. 3 and 4, the following additional structure is preferably employed.

Disposed on opposite sides of the strip line portion 10 are a plurality of upright columns 20 in suitably spaced relation. By any suitable structure, columns 20 support respective tracks 21 in spaced, side-by-side relation and which are spanned by the previously mentioned rollers 19. Looping roll carriage 18 mounts flanged wheels 22 by means of which the looping roll 15 is movable along the tracks 21 during an increase or decrease in the size of the strip loop.

Mounted on each of the columns 20, with the exception of the right-most columns and by means of brackets 23, are respective upright pivot shafts 24 mounting respective arms 25. In the position of parts seen in FIGS. 3 and 4, arms 25 project toward the center of the upper strip reach S.1 from opposite sides thereof and are disposed therebeneath. For reasons to appear, the free ends of opposed arms 25 terminate short of each other and rotatably mounted on the upper side of each arm 25 is a strip-engaging roller 26. Rollers 26, of course, function in the same manner as do rollers 19 to support, in this case, the upper loop reach S.1 against excess sagging.

Means are provided for rotating the arms 25 about their pivots 24 from the positions seen in FIG. 4 to positions paralleling the tracks 21 and for this purpose, each shaft 24 has a longitudinally slotted arm 126 affixed thereto. Attention is directed to FIG. 5 wherein a single column 20 and associated adjoining structure is shown to a larger scale than FIG. 4 and, while only the structure of FIG. 5 will be described in detail, it will be understood that

4

such structure is duplicated at the columns aforesaid as clearly seen in FIG. 4.

Mounted on the adjoining track 21 is a housing 27 rotatably supporting upright shafts 28, 29 and 30. Affixed to the shaft 28 is a crank arm 31 having at its free end a roller 32 closely fitting within the slot of arm 126. Affixed to the shaft 28 beneath the crank arm 31 is a gear 33 in driving engagement with a gear 34 affixed to the shaft 29. Also affixed to the shaft 29 is a sprocket 35 and a chain 36 connects sprocket 35 and a chain 36 connects sprocket 35 to a sprocket 37 on the shaft 30. Affixed to the shaft 30 is a rubber tired wheel 38 positioned for engagement with the adjacent side of the looping roll carriage 18.

With the parts positioned as seen in FIG. 5, the support roller arm 25 underlies the upper loop reach S.1 so that the roller 26 may support such loop reach. When, however, the strip loop decreases in size, the looping roll carriage will move to the left to engagement with the wheel 38 and continued movement of the carriage to the left will, through the previously described gears, sprockets, crank arm, and slotted arm, first shift the support roller arm 25 to the position of FIG. 6 and finally to the position of FIG. 7.

In the position of parts of FIG. 7, it will be noted that the support roller arm is to one side of the strip upper reach S.1 so as not to interfere with free passage of the looping roll 15. Support roller arm 25 will remain in the position of FIG. 7 until the looper roll carriage 18 once again moves to the right to engagement with the wheel 38. Continued movement of the carriage to the right will return the arm 25 to the position of FIG. 5 wherein the support roller 26 is in position to underlie and support the upper reach of the strip loop.

It is an important feature of the invention that the support roller arm 25 is shifted between its positions of FIGS. 5 and 7 by a gradually accelerated and gradually decelerated motion. With reference to FIG. 8 wherein the slotted arm 126 and the crank arm 31 are seen in full lines in the same position as FIG. 5, crank arm 31 is shown in successive positions A, B, C and D spaced 15 degrees apart. Similarly, slotted arm 126 is shown in positions A.1, B.1, C.1, and D.1 corresponding to respective crank arm positions aforesaid.

When the crank arm 31 is rotated 15 degrees from its initial full line position A to its position B, it will in turn rotate the slotted arm 126 from its full line position A.1 to its position B.1. This initial 15 degree rotation of the crank arm will effect rotation of the slotted arm through an angle of approximately $2\frac{1}{2}$ degrees. Rotation of the crank arm another 15 degrees from position B to position C will in turn rotate the slotted arm from position B.1 to position C.1 through a further angle of approximately $12\frac{1}{2}$ degrees. Thus, during the first 30 degree of rotation of the crank arm, the slotted arm has been rotated approximately 15 degrees and mostly during the latter stages of rotation of the crank arm. Finally, rotation of crank arm 31 another 15 degrees from position C to position D, will rotate slotted arm 126 from position C.1 to position D.1 through an additional angle of approximately 30 degrees. With arm 31, 126 in positions D, D.1 respectively, the parts will be positioned at mid-point or as seen in FIG. 6.

Continued clockwise rotation of crank arm 31 from position D will carry with it the slotted arm 126 until the position seen in FIG. 7 is reached; however, in such further clockwise rotation of the crank arm, the slotted arm will progressively be rotated a lesser amount, in inverse ratio to the previously described movement.

From a study of FIG. 9, it will be seen that the slotted arm 126 is moved between its positions of FIGS. 5 and 7 with a harmonic movement which, because of gradual acceleration and deceleration of such arm, eliminates damaging stresses on the arm-moving mechanism which would otherwise be caused. Although not described in

detail, it will be understood that the identical harmonic movement is imparted to the slotted arm during movement thereof from the position of FIG. 7 to the position of FIG. 5.

It will be understood that while the drive mechanism for only one of the support rollers arms 25 has been described in detail, all of such mechanisms are similar and function in a similar manner. Furthermore, while not shown, a suitable detent mechanism may be provided to yieldably retain each of the support roller arms 25 in their respective positions of FIGS. 5 and 7.

I claim:

1. Apparatus for storing a variable length of strip in a generally horizontally disposed elongated loop having upper and lower reach portions connected by an intervening bight portion, a looping roll disposed in the bight portion of said strip loop and displaceable longitudinally of said loop during a change in size thereof and a consequent increase or decrease in the length of said loop reaches, the improvement comprising:

support means spaced longitudinally of said loop upper reach for supporting the latter against sagging and such means being successively movable from respective first positions underlying said loop upper reach to respective second positions spaced from beneath said loop upper reach upon displacement of said looping roll in one direction during a decrease in length of said loop upper reach and being successively movable from respective second positions aforesaid to respective first positions aforesaid upon displacement of said looping roll in the opposite direction during an increase in length of said loop upper reach, and

means actuated by looping roll displacement aforesaid and effecting support means movement between said positions with a gradually accelerated and gradually decelerated motion which minimizes shock.

2. The construction of claim 1 wherein drive means effects movement of said support means between said positions and wherein said drive means provides a variable drive ratio for gradually accelerating said support means during initial stages of support means movement away from one of said positions and for gradually decelerating said support means during subsequent stages of support means movement toward the other of said positions.

3. The construction of claim 2 wherein said drive means comprises a crank.

4. The construction of claim 3 wherein said drive means further comprises a pivotally mounted lever arm

connected to said crank and moved by rotation thereof, said arm having a relatively long effective length when said support means is in either position aforesaid and said arm having a relatively short effective length when said support means is intermediate respective positions.

5. The construction of claim 4 wherein said crank arm and said lever arm are so arranged that when said support means is in either position aforesaid, the portion of said crank arm engaged with said lever arm momentarily moves in a direction parallel to the longitudinal axis of the latter.

6. The construction of claim 4 wherein displacement of said looping roll effects rotation of said crank and wherein rotation of said crank effects pivotal movement of said lever arm and consequent movement of said support means between said positions.

7. The construction of claim 5 wherein said crank is engaged with said lever arm at various distances from said arm pivot thereby varying the effective length of said arm.

8. The construction of claim 2 wherein said looping roll is rotatably mounted on a carriage which is displaceable longitudinally of said loop,

wherein said drive means provides a friction roll, and wherein said carriage has a portion movable therewith to engagement with said friction roll and such carriage portion effecting rotation of said engaged friction roll and consequent operation of said drive means during carriage movement.

9. The construction of claims 5 wherein said looping roll is rotatably mounted on a carriage which is displaceable longitudinally of said loop,

wherein said drive means provides a friction roll, wherein said carriage has a portion movable therewith to engagement with said friction roll and such carriage portion effecting rotation of said engaged friction roll during carriage movement, and wherein rotation of said friction roll effects rotation of said crank.

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U.S. Cl. X.R.

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