United States Patent [19]

Bijasiewicz et al.

[11] **3,729,144**

[45] **Apr. 24, 1973**

[54] **DESIGN OF ROTARY STRIP ACCUMULATOR**

[75] Inventors: **Tadeusz M. Bijasiewicz; Robert A. Somerhalder,** both of Pittsburgh, Pa.

[73] Assignee: **Wean United, Inc.,** Pittsburgh, Pa.

[22] Filed: **Aug. 5, 1971**

[21] Appl. No.: **169,192**

[52] **U.S. Cl.** .....**242/55,** 242/55.19 R

[51] **Int. Cl.** **B65h 17/48**

[58] **Field of Search** .....242/55, 55.19 R, 242/55.18, 55.21, 78.1

[56] **References Cited**

UNITED STATES PATENTS

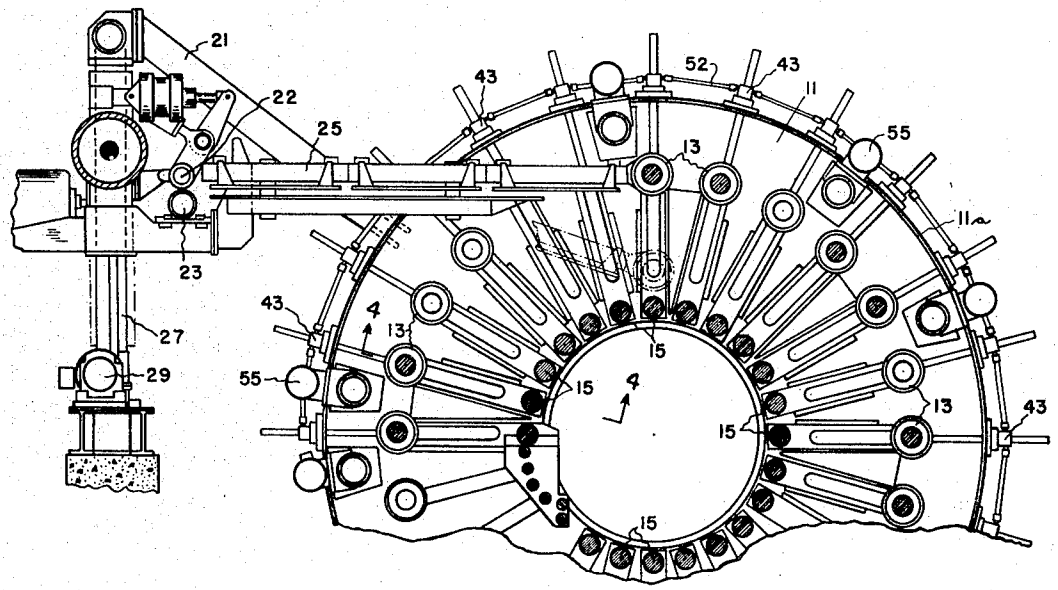
3,628,742	12/1971	Fritzsche	242/55
3,506,210	4/1970	La Tour	242/55
3,258,212	6/1966	La Tour	242/55

Primary Examiner—George F. Mautz
Assistant Examiner—Edward J. McCarthy
Attorney—Henry C. Westin

[57] **ABSTRACT**

The disclosure relates to a device for accumulating a continuous coil of strip, such as, carbon steel. The device comprises a support upon which the strip material is accumulated by being coiled into two substantially concentric sets of convolutions—an outer set and an inner set—connected by a free reverse loop which orbits between the sets of convolutions. The sets of convolutions are distinguished not only by their relative concentric positions, but by their reversed winding which results in the existence of a numerical balance between the convolutions of the respective sets during periods of strip input and/or output from the device. Accordingly, the rate of change in the number of convolutions in each set is the same; their number increasing as the quantity of the accumulated strip increases and decreasing as the quantity decreases. To accommodate such changes without undesirable collapsing and slippage of the strip, the sets of convolutions are formed against two expansible roller cages which support and guide the strip. The rollers of the cages are provided with interrelated bearing chock assemblies to which are connected mechanical jacks for radially displacing the cages independently. At least some of the rollers of the outer cage are driven by a gear-motor unit directly supportable by the journals of the rollers. The diameters of the rollers of the outer cage are considerably larger than the diameters of the rollers of the inner cage and several of the former are considerably shorter in body length for strip guiding purposes.

10 Claims, 9 Drawing Figures



Patented April 24, 1973 3,729,144

5 Sheets-Sheet 1

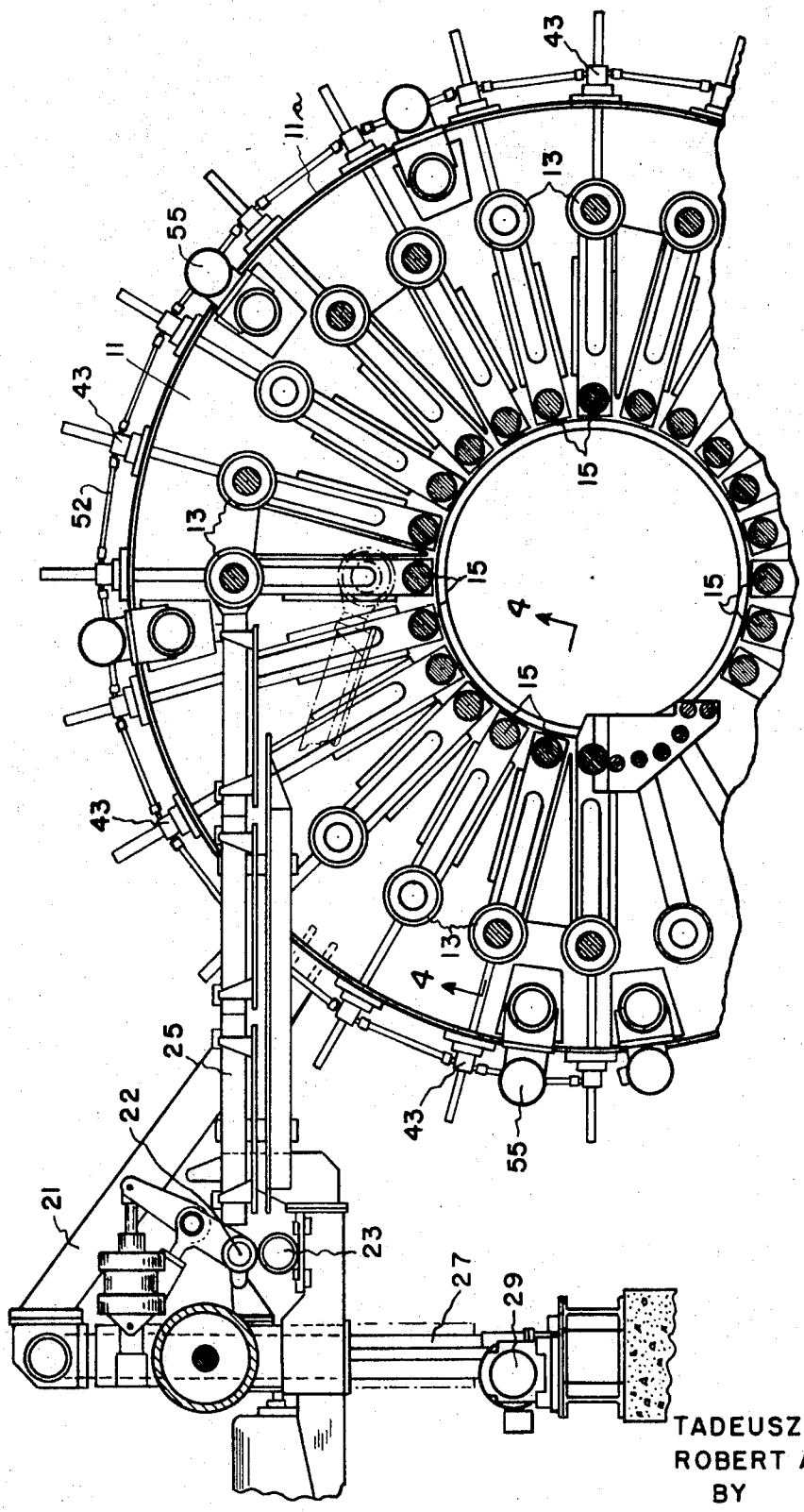


FIG. 1

INVENTORS
TADEUSZ M. BIJASIEWICZ
ROBERT A. SOMERHALDER
BY
HENRY C. WESTIN
ATTORNEY

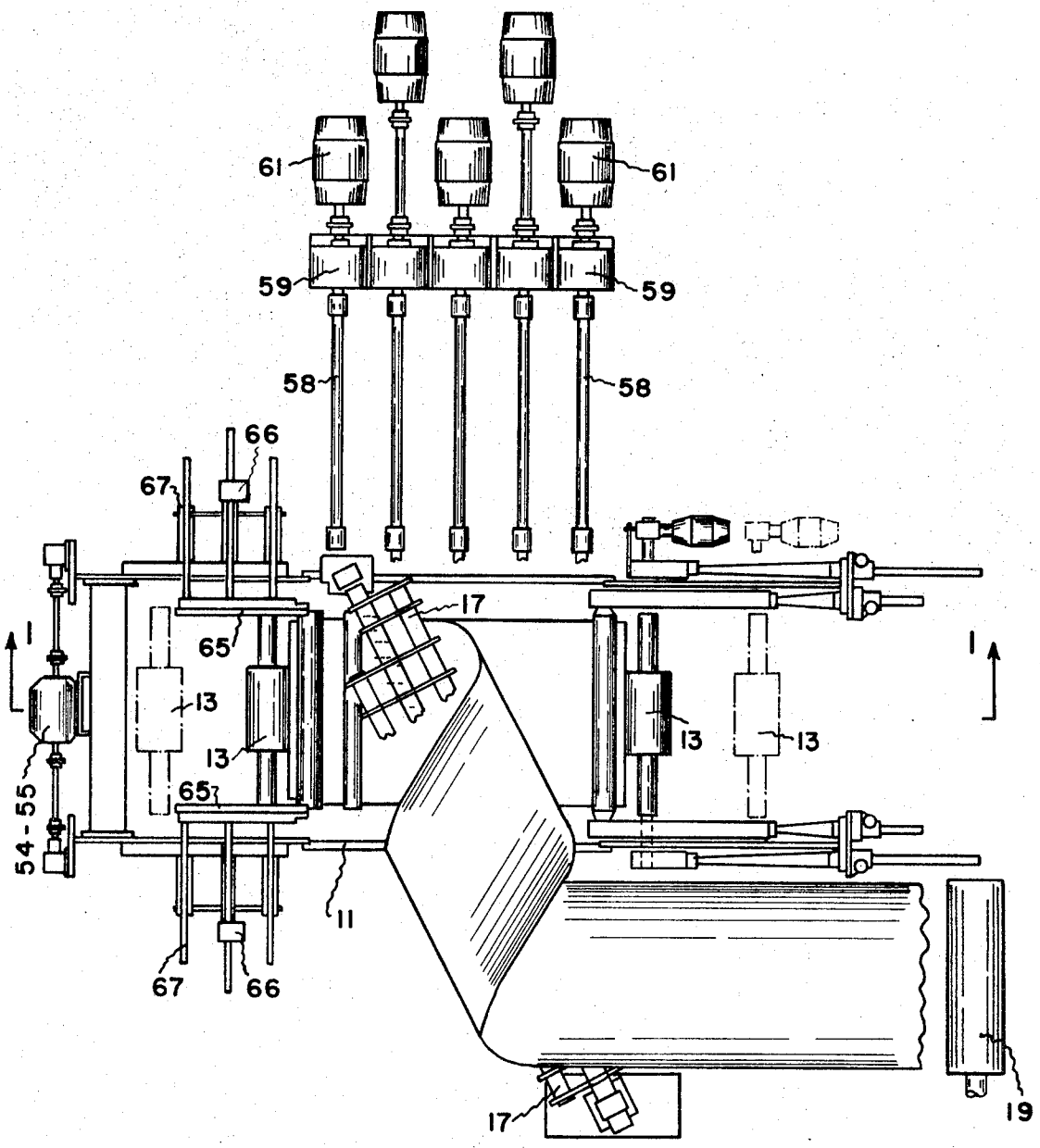


FIG. 2

INVENTORS
TADEUSZ M. BIJASIEWICZ
ROBERT A. SOMERHALDER
BY
HENRY C. WESTIN
ATTORNEY

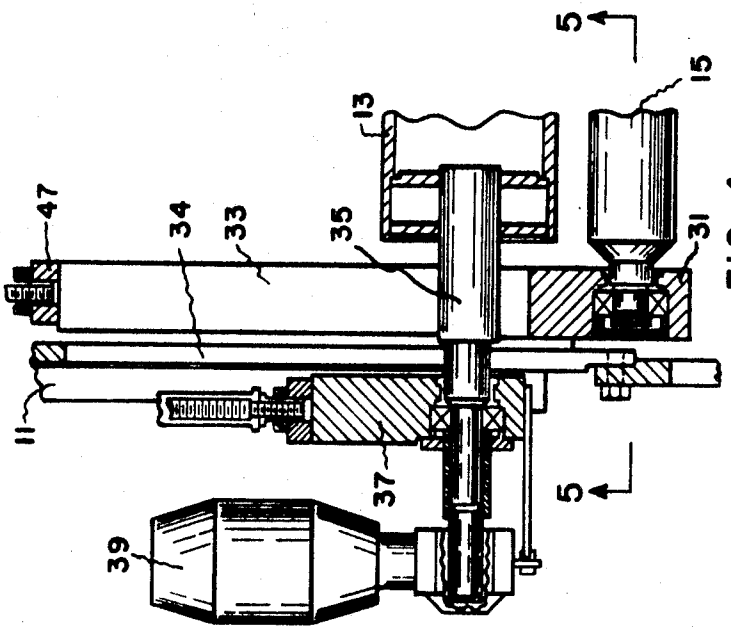


FIG. 4

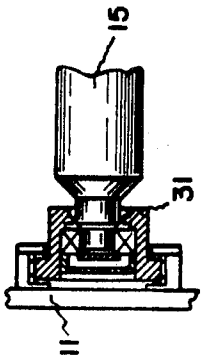


FIG. 5

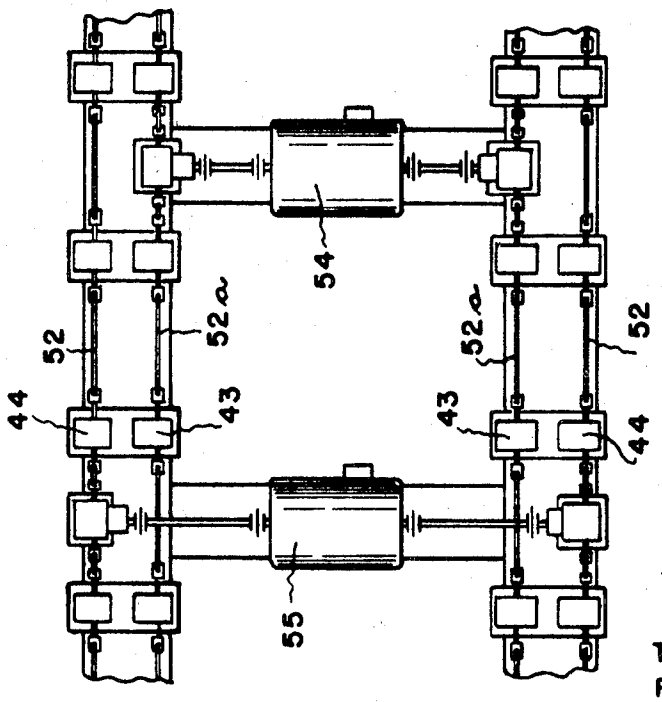


FIG. 3

INVENTORS
TADEUSZ M. BIJASIEWICZ
ROBERT A. SOMERHALDER
BY
HENRY C. WESTIN
ATTORNEY

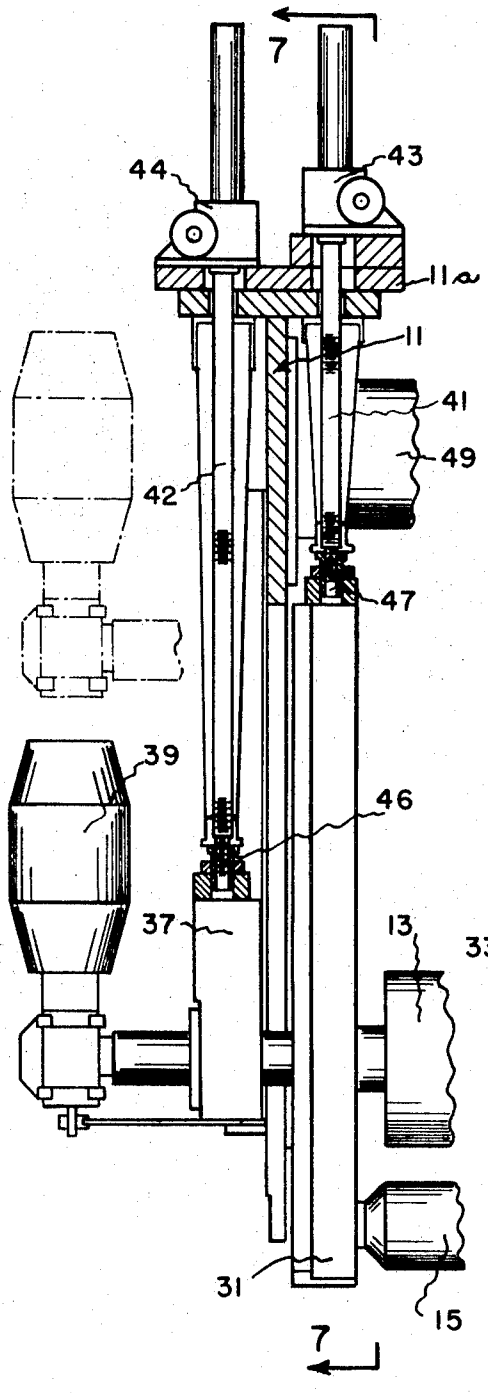


FIG. 6

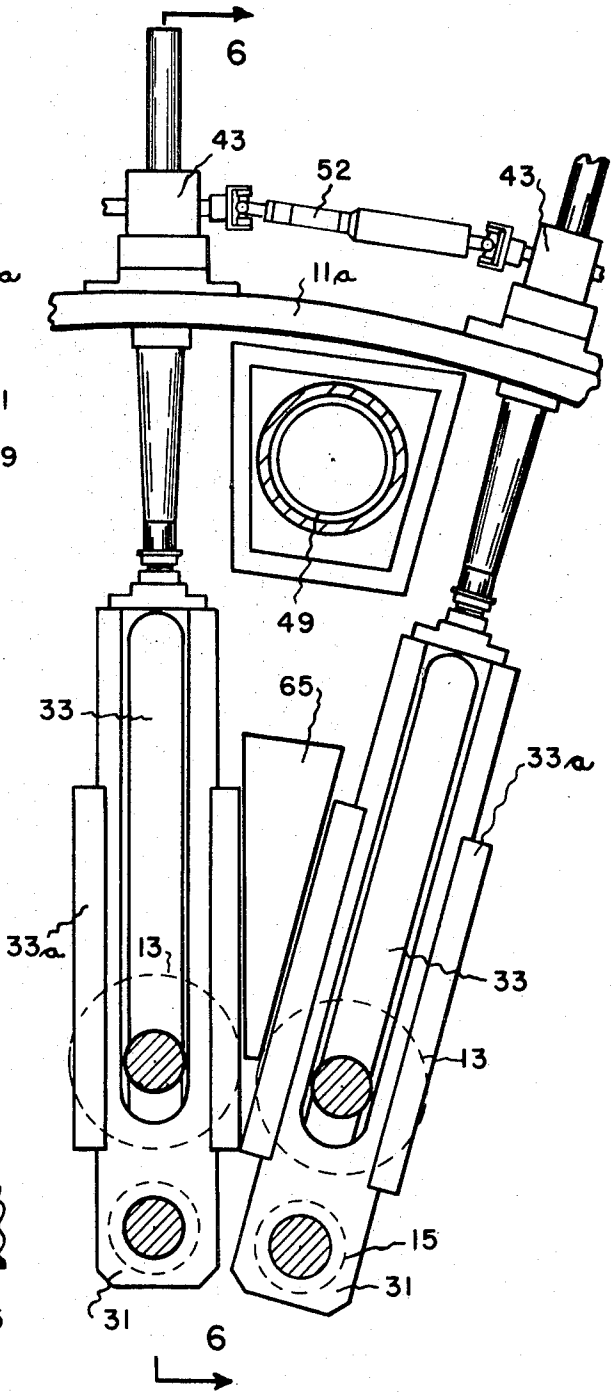


FIG. 7

INVENTORS
TADEUSZ M. BIJASIEWICZ
ROBERT A. SOMERHALDER
BY
HENRY C. WESTIN
ATTORNEY

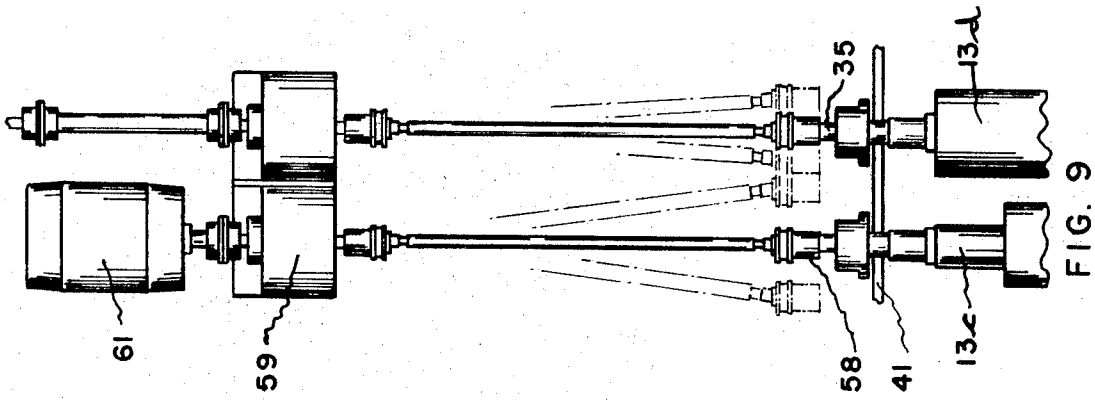


FIG. 9

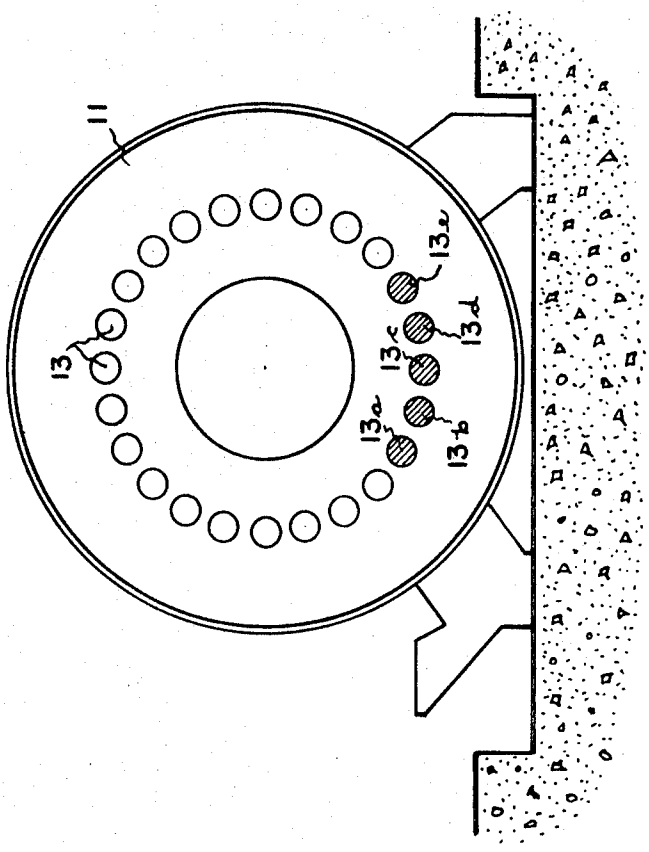


FIG. 8

INVENTORS
TADEUSZ M. BIJASIEWICZ
ROBERT A. SOMERHALDER
BY
HENRY C. WESTIN
ATTORNEY

DESIGN OF ROTARY STRIP ACCUMULATOR

The present invention relates to a strip accumulating device of the type illustrated in U. S. Pats. Nos. 3,258,212, 3,341,139 and 3,506,210. Particular attention is directed to the last-mentioned patent which contains a description of the general background of strip accumulators and also of the basic operating principle and construction of an accumulator of the type to which the present invention applies.

The present invention represents, in part, construction improvements to the strip accumulator illustrated in U. S. Pat. No. 3,506,210. When strip accumulators of the type illustrated in the aforesaid patent were attempted to be utilized for accumulating wide strip and heavy coils with a wide range of thickness and widths, considerable difficulty was experienced. This was due, principally, to the magnitude of the forces involved and the physical size of the inner and outer sets of convolutions. These problems were greatly intensified by the multiplying of interacting motions which had to be executed simultaneously by various elements of the accumulator, while still being confined to a relatively small space in order to realize the full advantage of the accumulator disclosed in the aforesaid U. S. Pat. No. 3,506,210.

Some of the more particular problems experienced had to do with the mounting of the cage rollers and their displacement when large coils were to be handled which were formed of relatively heavy and wide strip, in which the maximum thickness and width of the strips were substantially larger than previously processed. The new strip accumulators were also required to handle relatively narrow and light strips which greatly complicated the developing of a satisfactory device.

The manner employed in previous devices for driving the outer cage rollers, along with guiding the edges of the strip as it passed between the two cages, was found unacceptable. Previous accumulators had very elaborate guiding equipment which was employed to form and guide the free loop. When, however, it was contemplated to increase the size of the accumulators, these prior guiding apparatuses were found inordinately expensive both from an initial cost and a maintenance standpoint. Other limitations and disadvantages of the previous machines will become evident from the description of the present invention.

It is the object of the present invention to provide a strip accumulator not only capable of handling wide strip of heavy coil having substantial thickness in a most economical and troublefree manner, but one that will afford the opportunity of providing an accumulator that will service a wide range of widths and weights of coils.

More particularly, the present invention provides in a strip accumulating device of the type generally disclosed and described in the aforesaid U. S. Pat. No. 3,506,210, that the outer cage rollers be made considerably larger than the inner cage rollers and of narrower roll bodies, and wherein the inner rolls are rotatably received by slotted bearing chock assemblies similar to the slots formed in the frame of the accumulator and through which slots the journals of the rollers of the outer cage extend.

A further object of the present invention is to provide a motor unit mounted on one or both ends of the rollers of the outer cage for driving these rollers, and wherein the rollers of both cages are radially adjusted by separate jacks carried by the frame, which jacks are driven in a manner to provide separate end adjustments of the rollers of the two cages.

These and other features of the present invention will be better understood when the following description is read along with the accompanying drawings of which:

FIG. 1 is a sectional view taken on lines 1 — 1 of FIG. 2 of a strip accumulating device incorporating the features of the present invention;

FIG. 2 is a plan view of the strip accumulating device illustrated in FIG. 1;

FIG. 3 is a partial plan view of the drive for the mechanical jacks associated with the inner and outer cages illustrated in FIG. 1;

FIG. 4 is a sectional view taken on lines 4 — 4 of FIG. 1;

FIG. 5 is a sectional view taken on lines 5 — 5 of FIG. 4;

FIG. 6 is a sectional view taken on lines 6 — 6 of FIG. 7;

FIG. 7 is a sectional view taken on lines 7 — 7 of FIG. 6;

FIG. 8 is an end view, partially in section, of the outer cage rollers illustrated in FIG. 1; and

FIG. 9 is a plan view of two of the lowermost rolls illustrated in FIG. 8 showing the drive for these rolls.

As noted above, the principal construction and operation of the strip accumulating device is set forth in U. S. Pat. No. 3,506,210 so that only a brief statement thereof is deemed necessary with respect to the description of the present invention. The strip accumulator receives the leading end of a strip to be stored from a supporting device, such as a pinch roll, which also serves as a feeding device for the strip. Strip is fed to and between the inner and outer cages of the device and passed around a suitable inclined payoff roll which shifts the strip sideways so that it can be taken out from where it is fed to a delivery pinch roll or other tensioning means. The inner annular roller cage is positioned centrally with respect to the position the strip assumes as it is fed to the accumulating device; whereas, the outer annular roller cage surrounds the inner roller cage and lies in a spaced relationship thereto. The pinch roll feeds the strip into contact with the inner face of the outer roller cage, which cage is adapted to build up an outer set of convolutions; whereas, the inner cage is adapted to build up an inner set of convolutions. These two sets of convolutions lie in a spaced relationship to each other with the outermost convolutions of the inner set connected to the innermost convolutions of the outer set by a reverse loop formed by the strip which is freely movable in the space between the set of convolutions. The delivery pinch roll is adapted to withdraw strip from the inside of the inner set of convolutions around the inner roller cage and payoff roll. The entry pinch roll is driven independently of the delivery pinch roll at a variable rate of speed and the rate of speed at which the strip is withdrawn from the inner roller cage, so that the number of convolutions in both the inner and outer set of convolutions will be increased when the lineal rate of input strip speed exceeds the lineal rate of strip withdrawn and decreased when the lineal rate of strip input is less than the lineal rate of strip withdrawal.

As noted above, the present invention relates to certain mechanical improvements over the basic machine illustrated in the aforesaid patent, and reference in this connection is made to FIGS. 1 and 2 of the present invention. As shown in FIG. 1 particularly, there is provided a pair of spaced-apart upright frames, one of which is shown in FIG. 1 as 11, that receive and movably support radial equidistant rollers 13 that make up the outer cage of rollers. The frame also indirectly supports rollers 15, also radially equispaced, that make up the inner cage of the strip accumulating device. The rollers 13 of the outer cage are equally spaced with respect to each other and are adapted to move in a radial direction towards the rollers 15 of the inner cage as the rollers 15 of the inner cage are adapted to move in common planes towards and away from the rollers 13 of the outer cage. As shown in FIG. 1, a roller 13 and a roller 15 that fall in the same radial plane make up a cooperative set and their inter-relationship will be pointed out more clearly hereinafter in addition to describing the driving means for the various rollers.

In FIG. 2 there is better illustrated the spaced-apart construction of the two upright frames 11 along with illustrating the extent of movement of two of the rollers 13 of the outer cage, which are shown in phantom in their extreme outward position and in full line in their extreme inward position. FIG. 2 also shows, in part, the take-out spool 17 which is employed to support and convey the innermost convolution of the inner set of convolutions from the interior of the strip accumulating device in a spiral path to the outside of the device and, hence, to a delivery pinch roll which is shown diagrammatically at 19. FIG. 2 actually shows the interior support members of the spool 17, it being appreciated, however, that inwardly and centrally located in a spiral manner are a number of individual support rollers, not shown, that engage the inside surface of the strip as it is caused to pass from the rollers 15 of the inner cage to the pinch roll 19.

Before leaving FIG. 1, it will be noted towards the left that there is provided a feeding unit 21 in the form of a pinch roll unit having an upper roll 22 and a lower roll 23 between which the strip is fed. The rolls 22 and 23 are driven by a means, not shown, to urge the strip into a feed box or trough 25, which in FIG. 1 is shown in full line in a horizontal position, but which is adapted to assume an angular position as shown in the partial phantom position of the far end of the trough 25. Although the exact construction will be more clearly pointed out hereinafter, it is noted in FIG. 1 that the end of the trough 25 is carried by the uppermost rollers 13 of the outer cage and is movable with this roller as the roll moves radially relative to the center of the accumulating device.

The entire pinch roll unit 21 is adapted to be raised and lowered on a support 27 by means of a motor and jack unit 29. In this way the trough 25 can be caused to always assume the horizontal position shown in FIG. 1 as it moves with the associated roller 13 of the outer cage. On some, occasions, for example in handling very thick and wide strip, the horizontal position may be desirable; whereas, on others, the inclined position of the feeder box 25 may be sufficient to properly guide the leading end of the strip between the two cages.

Reference will now be made to FIGS. 4, 5, 6 and 7 which illustrate the interrelationship of each set of rollers 13 and 15 of the inner and outer cages. As previously noted, two of these rollers arranged in the same radial plane constitute a cooperative pair, in which it will be noted in the aforesaid figures that, inward of the upright frames 11, rollers 15 of the inner cage are adapted to be received at their opposite ends in bearing chock assemblies 31, only one end of which is shown in these drawings, it being understood that the opposite end construction at the other end is the same. Each bearing chock assembly 31 has a longitudinal slot 33 and, as shown in FIG. 5, is received in opposed U-shaped guides 33a of the frame 11. Directly behind the slot 33 is a similar slot 34 formed in the frame 11, which slots allow for the free passage of the journal 35 of the rollers 13 of the outer cage; this construction being particularly illustrated in FIG. 4. On the outside of the frame 11, a journal 35 is provided with a bearing chock assembly 37 which rotatably supports the roller 13 and which is guided in the frames 11 similar to the chock assemblies 31. It will be appreciated that the length of the slots 33 and 34 of the bearing assembly 31 and frame, respectively, are formed long enough to allow the maximum adjustment and displacement of the rollers 13 and 15 of the inner and outer cages. At the extreme end of only one of the journals 35 of each roller 13, there is provided a gear motor unit 39 which is mounted directly on the journal 35 and which furnishes the torque to drive the rollers 13, at least with respect to the rollers other than the lowermost rollers, the drive of which will be described later.

As shown in FIGS. 6 and 7, the weight of the rollers 13 and 15, together with their bearing chock assemblies and, with respect to the rollers 13, their motor drive unit 39, are supported by the frames 11 through the agency of, in the case of the rollers 15, rods 41 and, in the case of the rollers 13, rods 42, which rods are part of the jack assemblies 43 and 44, respectively; the housings of which are supported directly by the frames 11. In FIGS. 6 and 7 it is noted that the frames around their perimeters are joined by a circular plate 11a which serves as the support base for the jacks 43 and 44. It will be noted in FIG. 6 that at the ends of each of the rods 41 and 42 of the jack assemblies 43 and 44 there is provided a turnbuckle assembly 46 and 47 through which means the proper leveling of the ends of the rollers 13 and 15 can be secured. In still referring to FIG. 6 it will be noted that there is illustrated in phantom the uppermost position of the rollers 13 with respect to its journal 35 and its motor gear unit 39 which is carried on the journal. FIG. 6 also illustrates, as does FIG. 7, one of the several separators 49 that run between the two upright frames 11 and tie them together.

The outer and inner cages are adapted to be adjusted relative to each other in which the rollers of each cage move simultaneously in equal amounts and for which purpose the jacks 43 or 44 of each cage are interconnected, as shown in FIG. 7, through universal spindles 52 which also appear in a more composite view in FIG. 1. While these drawings do not illustrate the universal spindle for the jacks 44, it will be appreciated that these jacks which service the rollers 13 of the outer cage are also provided with such spindles. FIG. 3 actually illustrates the spindles for both of the jacks 43 and 44 in which the spindles for the jack 43 are identified as 52*a*,

in which regard it will be noted that for each separate series of jacks **43** and **44** there are provided separate electrical motors **54** and **55**, respectively. As shown in FIG. **1**, the network of the jacks, spindles and motors mounted on the outside of the frames **11** make a circular path around the entire accumulating device. A special drive is provided for the lower five rollers **13** of the outer cage.

With reference now to FIGS. **2**, **8** and **9**, because of the fact that the lower rollers **13** of the outer cage are subject to the greater part of the weight of the set of outer convolutions requiring substantially larger driving capacity than the upper rollers **13**, there is provided a special drive for these rollers. Accordingly, in place of the motor gear unit **39** for the rollers **13***a*, *b*, *c* and *e*, as identified in FIG. **8**, the journals **35** extend through one of the frames **11** in a manner previously described, at which end there is connected an universal spindle coupling drive shaft **58**, the opposite end being associated with a gear drive **59** which is driven by an electrical motor **61**. As FIG. **2** illustrates, each roller has its own electrical motor **61** in which the drive assemblies are mounted on the opposite side of the strip with respect to the location of the delivery pinch roll **19**.

The present invention provides for the elimination of any expensive and cumbersome mechanism for guiding the free loop between the inner and outer cages. Instead, it provides that the rollers **13** of the outer cage be made of considerably larger diameter than the rollers **15** of the inner cage. The extent of the diameters of the rollers **13** is such that, when in their innermost positions, they are brought as closely together as possible without touching each other, as illustrated in FIG. **7**. In this manner the gaps between the outer cage rollers are reduced to a very minimum and, since both the strip and the periphery of the rollers move at the same speed, the bulging free transfer loop will ride on more or less a wavy, but continuously moving surface, which will greatly reduce any danger of cobbling. The size of the gaps between the outer cage rollers at the end of the cycle when the free loop reverses its rotation depends mainly on the strip thickness as does the free loop diameter. Because of this, the larger the gaps, the larger the free loop diameter. This means that the free loop diameter to roller gap ratio, which determined the capabilities of guiding the free loop at the end of the cycle, remains substantially constant throughout the whole range of strip thicknesses.

The present invention provides an improved manner of guiding the edges of the strip, as illustrated best in FIGS. **2** and **7**. Although not provided for each adjacent pair of rollers **13** for a selected number, there are provided between the rollers **13** a triangular shaped guide **65** which is adapted to be adjusted transversely of the two upright frames **11** by a motor driven jack screw **66**, the guides having on either side of the jack screw guide rods **67**, as shown in FIG. **2**. The two opposed jack screws are mechanically tied together to synchronize their motions. FIG. **2** also shows that in order to accommodate the guides **65** the roll bodies of the rollers **13** of the particular adjacent pair with which the guides are associated have a reduced body length that enables the guide to be moved transversely towards the center of the strip accumulating device in order to accommodate the narrowest strip received by the accumulating device.

In accordance with the provisions of the patent statutes, we have explained the principle and operation of our invention and have illustrated and described what we consider to represent the best embodiment thereof.

We claim:

1. In a strip accumulating device, an inner annular roller cage composed of a plurality of freely rotatable guide rollers,

an outer annular roller cage surrounding said inner roller cage and lying in spaced relation thereto,

said outer roller cage comprising a plurality of freely rotatable guide rollers,

feed means positioned to feed strip into contact with the inner surface of said outer roller cage,

said outer roller cage being adapted to build up an outer set of convolutions and said inner roller cage being adapted to build up an inner set of convolutions; the inner and outer sets of convolutions lying in spaced relation to each other with the outermost convolution of the inner set connected to the innermost convolution of the outer set by a reverse loop of said strip which is freely movable in the space between said sets of convolutions,

separate means mounting said guide rollers for radial movement during operation to vary the diameter of the roller cages defined thereby,

strip delivery means mounted to withdraw strip from the inside of the inner set of convolutions around said inner roller cage,

means for driving said feed means at an independent rate of speed from the rate of speed at which strip is withdrawn from said inner roller cage, whereby the number of convolutions in both the inner and outer sets of convolutions will be increased when the lineal rate of strip feed exceeds the lineal rate of strip withdrawal and decreased when the lineal rate of strip feed is less than the lineal rate of strip withdrawal,

the improvement comprising an upright frame for supporting said rollers of said inner and outer cages,

said means for mounting said guide rollers including bearing chock assemblies mounted on the opposite ends of said inner cage rollers and inside said frame,

a radial slot formed in each bearing chock assembly radially outward of said rollers of said inner cage,

radial slots formed in said frame equal in number to said first slots and arranged in planes containing said first slots in which one each of said first and second slots form a set,

extended journals formed on said opposite ends of the rollers of the outer cage passing through one of the sets of said first and second slots,

said means for mounting said guide rollers also including bearing chock assemblies arranged on the outside of said frame on the opposite ends of the outer cage rollers, and

means connected to said bearing chock assemblies for radially moving said guide rollers.

2. In a strip accumulating device according to claim **1**, wherein said means for radially moving said guide rollers includes separate mechanical jacks connected to each bearing chock assembly,

means for securing said jacks to said frame, and

separate power means for driving the jacks of said inner and outer cage rollers.

3. In a strip accumulating device according to claim 1, wherein at least some of said extending journals on at least one side of said rollers of said outer cage have further extensions, and

means for connecting to said further extensions a power means in which said power means is carried by said further extensions.

4. In a strip accumulating device according to claim 3, wherein said power means comprises a gear-motor unit.

5. In a strip accumulating device according to claim 1, wherein the major axes of said convolutions lie in a horizontal plane and wherein at least some of the bottom-most guide rollers of said outer cage assume a weight-supporting relationship with the outer set of convolutions,

separate drive means for at least one of said bottom rollers of said outer cage, and

means for supporting said drive means divorced from said frame.

6. In a strip accumulating device according to claim 1, wherein at least an adjacent pair of rollers of said outer cage has strip contacting portions substantially shorter than the strip contacting portions of the rollers of said inner cage,

a pair of opposed adjustable guides arranged between said adjacent pairs of said outer cage rollers adapted to engage the opposite edges of said strip, and

means mounting said guides on said frame for movement towards and away from each other.

7. In a strip accumulating device according to claim 6, wherein the length of the strip contacting portions of said adjacent pair of outer cage rollers define the inner extent of movement of said pair of guides.

8. In a strip accumulating device according to claim 1, wherein said rollers of said outer cage are substantially larger in diameter than the rollers of said inner cage,

the diameters of the rollers of said outer cage being such that in their innermost radial positions they form a substantially continuous closed circle.

9. In a strip accumulating device according to claim 2, including adjustable means arranged between said associated bearing chock assemblies and said jacks of at least one end of each of said rollers of said inner and outer cages.

10. In a strip accumulating device according to claim 1, wherein said feed means includes a pinch roll unit and a feed box for guiding a strip from said pinch roll unit to said inner and outer cages, and

means for connecting one end of said feed box to said outer cage for movement therewith, but relative to said pinch roll unit.

* * * * *