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MATERIAL HANDLING APPARATUS

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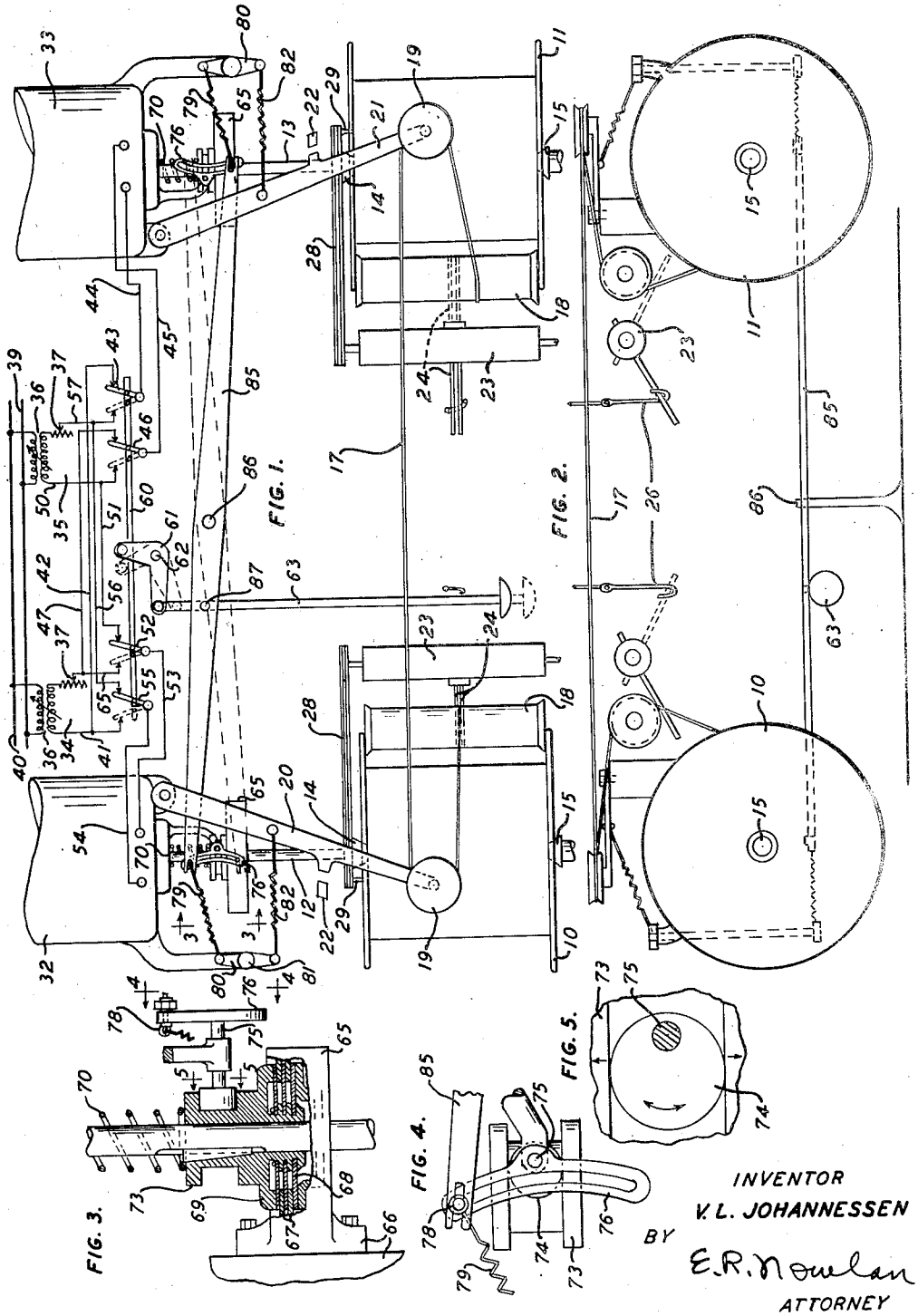


FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

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MATERIAL HANDLING APPARATUS

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17 Claims. (Cl. 242—45)

This invention relates to a material handling apparatus and more particularly to a reversible rewinding apparatus for handling material while being tested for possible defects.

In the manufacture of strand or sheet material it is often desirable to transfer such material from one reel or arbor to another, as, for example, when testing the material for possible defects. When the material is thus moved relative to a testing device means is sometimes employed to indicate any defects in the material, but in some cases before the advancement of the material in one direction can be stopped so that the operator may mend or remove the defective portion, that portion has moved an unknown distance beyond the point of indication and possibly upon the take-up reel. In such and other instances it is desirable to reverse the direction of movement of the material to locate the defective portion.

An object of the invention is to provide a simple, effective and practical material handling apparatus.

With this and other objects in view the invention comprises a pair of reels driven by separate electric motors energized by variable electrical circuits which may be transferred from one motor to the other to reverse the direction of rotation of the reels, the speed of the reels being controlled by units dependent upon the direction of rotation of the reels.

Other objects and advantages will be apparent from the following detailed description taken in conjunction with the accompanying drawing, wherein

Fig. 1 is a schematic plan view of the apparatus and the control circuits therefor;

Fig. 2 is a front elevational view of the structure shown in Fig. 1;

Fig. 3 is an enlarged fragmentary sectional view taken substantially along the line 3—3 of Fig. 1;

Fig. 4 is an enlarged fragmentary end elevational view taken along the line 4—4 of Fig. 3, and

Fig. 5 is an enlarged fragmentary sectional view taken along the line 5—5 of Fig. 3.

Referring now to the drawing, there are shown reels 10 and 11 removably secured to drive shafts 12 and 13, respectively, by any suitable means. In the present embodiment cone shaped elements 14 fixed to the shafts are receivable in the hubs of the reels at one side of the latter, and other cone shaped elements 15 positioned to engage the hubs at the opposite sides of the reels and adjustably movable by any suitable means (not shown) cause a gripping of the reels between the sets of cones 14 and 15. The reels may support any suitable material which is to be tested, or transferred from one reel to the other, in the present embodiment there being shown strand material indicated at 17 which may pass from one reel to the other over guide rollers 18 to sheaves 19 of control arms 20 and 21. Suitable stops 22 are positioned to limit the outward movement of the tension arms.

A distributing unit 23 is provided for each reel and consists of guide fingers 24 movable by the guide elements 18 to uniformly distribute the material upon whichever reel the material is being wound. Any conventional distributing means may be employed, it being important, however, that the guide fingers 24 be movable into and out of operative positions as illustrated in Fig. 2, there being shown hook members 26 to support the guide fingers when in operative positions. The distributing units are driven through chain and sprocket connections 28 from the drive shafts 12 and 13. Pins 29 carried by the shafts or the sprockets mounted upon the shafts are positioned to have their free ends receivable in apertures in the adjacent heads of the reels to assure positive driving connection between the drive shafts of the reels.

The drive shafts 12 and 13 are driven directly by means of electric motors 32 and 33 such as single phase, fully excited, reversible constant horse power motors. There are two electrical circuits, 34 and 35, either one of which may be electrically connected to either motor. Each circuit includes a variable transformer 36 and a rheostat or variable resistance 37. With the circuits 34 and 35 including the controlling means, namely the variable transformers and variable resistances, it is possible to control the motors so that they will be supplied with the desired variable electrical energy. This variation in the drive of the two motors is desirable to cause the take-up reel to rotate slightly in advance of the supply reels to maintain a suitable tension upon the material passing from one reel to the other. Therefore, one circuit, for example, circuit 34, may be adjusted and termed a supply reel circuit and the circuit 35 may be adjusted and termed a take-up reel circuit. The circuit 34 is connected electrically to the motor 33 and one part of this circuit may be traced from lead 39 of a supply circuit through the primary winding of the transformer 36 to the lead 40. Another part of circuit 34 is traced from

the secondary winding of the transformer through conductors 41 and 42, switch 43, conductor 44, through the motor 33, conductor 45, switch 46, conductor 47, and the variable resistance 37 to the secondary winding of the transformer. In a similar manner the circuit 35 is electrically connected to the motor 32. The primary winding of the transformer 36 of circuit 35 is connected to the leads 39 and 40. The other portion of circuit 35 is traced from the secondary winding of the transformer 36 through conductors 50 and 51, switch 52, conductor 53, through the motor 32, conductor 54, switch 55, conductors 56 and 57, through the variable resistance, back to the secondary winding of the transformer. The switches 43, 46, 52 and 55 are connected to an actuating bar 60 which is operatively connected to one end of a bell crank lever 61, pivoted at 62, the opposite end thereof being connected to a pull rod 63 to provide manual actuating means for moving the switches simultaneously from their solid line positions to the dotted line positions shown in Fig. 1. When the switches are thus moved the circuit 34 will be electrically connected to the motor 32 and the circuit 35 to the motor 33. The portion of circuit 34 may be traced from the secondary winding of the variable transformer, through conductor 41, switch 55, conductor 54, through the motor 32, conductor 53, switch 52, conductor 65 and variable resistance to the secondary winding of the transformer. The portion of circuit 35 with the switches 43 and 46 in the dotted line positions may be traced from the secondary winding of its transformer through conductor 50, switch 46, conductor 45, through the motor 33, conductor 44, switch 43, conductor 57, and through the variable resistance to the secondary winding of the transformer. The transferring of the circuits from one motor to the other causes reversal of the motors to drive the reels in opposite directions, thus converting a supply reel to a take-up reel and vice versa.

Means controlled by the tension of the material 17 for varying the speed of rotation of the drive shafts is illustrated in Figs. 1, 3, 4 and 5. This means consists of braking units having stationary housings 65 mounted upon suitable supports 66 and having hollow portions disposed concentrically with the drive shafts. Disposed in these hollow portions are friction plates 67 held against movement and interposed between movable friction plates 68 carried by and rotatable with their respective drive shaft. Keyed to each drive shaft so as to cause rotation thereof during rotation of the shafts to permit axial movement thereof relative to each shaft is a pressure head 69 to force the friction plates 67 and 68 into intimate engagement, resulting in a braking means for each shaft. A helical compression spring 70 mounted concentrically with each shaft manually urges its respective pressure head 69 toward the friction plates. A grooved collar 73 integral with or fixed to each pressure head 69 receives an eccentric cam 74, mounted rigidly upon one end of a shaft 75 which is journalled in a suitable support, the opposite end of the shaft having fixed thereto a slotted lever 76. Movably disposed in the slot of the lever 76 is a spring pin 78 to which one end of a spring 79 is secured, the opposite end of the spring being secured to one end of a toggle lever 80 pivoted at 81, the opposite end of the toggle lever being connected to the tension arm 20 or 21 through a spring 82. The braking means for each shaft is identical in construction, the only difference being in their actuation and control, one being controlled through the movement of the tension arm 20 and the other being controlled through the movement of the tension arm 21. The levers 76 and the slots therein are arcuate in general contour. The spring pins 78 movably carried by these levers 76 may be moved from one end thereof to the other and in so doing vary the resulting action of its respective control arm thereupon. As illustrated in Fig. 1, the spring pin 78 adjacent motor 32 is shown in its uppermost position, whereas the spring pin adjacent motor 33 is in its lowermost position, these positions being controlled by a lever 85 pivoted at 86 to any suitable support, operatively connected to the pull rod 63 at 87, and having its ends slotted to receive the outer ends of the pins 78 to move them from upper to lower positions relative to their levers 76 through the movement of the pull rod.

The apparatus as shown in Figs. 1 and 2 is conditioned to cause the reels to be rotated through the energization of the motors in clockwise directions (Fig. 2), the supply circuit 34 being electrically connected to the motor 33, the supply circuit 35 being electrically connected to the motor 32 and the distributing fingers 24 for the reel 11 being held in operative position. When the apparatus is thus set in operation the strand material 17 will be moved to the left from the reel 11 over the sheave 19 of the tension arm 21 around the sheave of the tension arm 20 downwardly around the roller 18 of the reel 10, where the strand will be distributed upon the reel 10 by means of the distributing fingers 24 in engagement therewith.

In the present embodiment of the invention it is desirable that both the speed of the strand and the tension thereof, while moving from one reel to the other, be constant. The desired tension on the strand is established by the tension arms 20 and 21 and their associated springs 79 and 82. This desired tension is maintained and the strand is caused to move at a constant speed by the constant H. P. (horse power) motors 32 and 33 and their associated controlling means, namely, the electrical circuits and the braking units. The motors are so designed that throughout their working range the product of the motor torque and the motor speed is constant. The result accomplished by the use of such motors is that the motor speed will decrease comparable to the increase in motor torque and the motor speed will increase comparable to the decrease in motor torque. The torque from each motor varies with variations in the fullness of each reel and the cause for such variations differs for each motor depending upon whether they are rotating a supply reel or a take-up reel. The torque of each motor is also affected by the braking means on the motor shafts.

Disregarding the braking means for the moment, consider, first, either one of the motors, for example motor 32, electrically connected to the take-up circuit 35 driving a take-up reel at the beginning of an operation with the reel empty and the strand fixed thereto to begin winding thereon. The torque of the motor 32 when driving this take-up reel is at its minimum, and, as the speed of the motor is controlled, depending upon the motor torque, the maximum motor speed exists at this point in the operation. As the layers of strand on the take-up reel increase, thus increasing the effective radii of the reel, the torque increases due to the increase in load

on the reel coupled with the increase in length of the lever arm or the distance from the motor axis to the point where the strand is taken on. The constant tension on the strand, coupled with the added load as the layers of strand build up on the reel during operation, causes an increase in the motor torque, thus causing a decrease in speed. The decrease in motor speed with the increase in reel diameter causes the strand speed to be constant.

Consider, now, the other motor 33 electrically connected to the supply circuit 34 at the beginning of the operation, with supply reel full of strand material, the take-up reel empty and the strand threaded around the rollers 18 and the sheaves 19 of the tension arms 20 and 21. At this position in the operation there exists a maximum motor torque and minimum motor speed at the supply end. In order to rotate the supply reel at a speed to allow the strand to advance toward the take-up reel at a predetermined constant speed and constant tension, an electrical current of lower potential than that supplied to the take-up motor is supplied to the supply motor. This is accomplished through the adjustment of the variable transformers 36 and variable resistances 37 in the circuits. As the strand is drawn off the supply reel the motor torque decreases and the motor speed increases.

It is, therefore, possible to control the motors so that both the speed and tension of the strand will be constant. During certain conditions, for example, when the apparatus is started with a slack strand, when slack convolutions appear on the supply reel, or with a greater tension than desired on the strand, it is desirable to bring about a more rapid adjustment than is possible with the motors. This is accomplished through the braking means and the tension means associated therewith to increase or decrease the motor torque. Through the braking means the motor torque may be increased far beyond the maximum torque resulting from the reel load and the strand tension and the torque may be sufficient to almost stop either one of the motors without affecting the motor physically. This makes it possible to slow down the take-up reel even to a stop to allow the motor to the supply to relieve the strand of excess tension. At the same time braking force on the supply motor is removed by the balancing of the springs 79 and 82 with spring 79 associated therewith.

If the tension on the strand 17 should increase beyond the predetermined normal tension the tension arms 20 and 21 will be swung about their pivots toward each other, increasing the tensional force of each spring 82 and transmitting this increased force or pull through the toggle levers 80 and the springs 79 to the levers 76. The force of the spring 79 affected by the movement of the tension arm 21 overcomes the force of the associated spring 79, and causes the movement of the associated lever 76 above its supporting axis in a counter-clockwise direction, causing its associated eccentric cam 74 to move its collar 73 with its pressure head 69 upwardly to relieve the shaft 13 of the braking force. In a similar manner, but with opposite results, the braking force to shaft 12 is increased due to the rocking of the associated lever 76 counter-clockwise through added force of the associated springs 79, 79 and 82, forcing its pressure head 69, through the action of the eccentric cam and collar associated therewith, to increase the frictional braking force of the friction plates and thus decrease the speed of rotation of the shaft 12. This action of the braking means for the shafts 12 and 13 brought about through the movement of the tension arms 20 and 21 due to an increase in tension of the strand 17 relieves the shaft 13 of whatever braking force has been applied thereto so as to allow the motor 33 to increase the speed of rotation of the reel 11 and at the same time the braking force to shaft 12 is increased, causing a decrease in the speed of rotation of the reel 10 until the tension on the strand is again normal, allowing the tension arms to resume their present or normal positions. Therefore, predetermined electrical energies are supplied to the motors, tending to drive them at predetermined variable speeds, and during the rotation of the reels the tension on the strand is maintained substantially constant through the controlling means, namely the motors and the braking means applied to each shaft.

If the operator chooses to reverse the direction of movement of the strand this may be accomplished by merely moving the rod 63 from its solid line position to its doted line position shown in Fig. 1. Actuation of this rod automatically transfers circuit 34 from motor 33 to motor 32 but in reverse formation so as to cause the motor 32 to move in a reverse direction. In a similar manner the circuit 35 is transferred from motor 32 to motor 33. The transfer of the circuits from one motor to the other makes it possible to condition the reel 11 as the take-up reel and the reel 10 as the supply reel, reversing their direction of rotation and causing a variation in their speed of rotation. Simultaneously with this transferring of the circuits the lever 85 is rocked about its pivot, moving the spring pins 78 to the opposite ends of their levers, for example, moving the spring pin at the left downwardly and the spring pin at the right upwardly, so that during the operation of the apparatus in the manner now described an increase in tension of strand 17 will cause a decrease in braking force to the shaft 12 and an increase in braking force to the shaft 13. Of course, with this arrangement the guide fingers 24 for the reel 11 are moved into operative position and the guide fingers for the reel 10 are moved into inoperative position.

During normal operation the tension arms 20 and 21 are positioned away from their stops 22. However, should the tension of the strand be below normal the arms will swing outwardly about their pivots, limited, of course, by the stops. Such movement of the arm 21, with the arrangement shown in Fig. 1, will relieve the force of the springs 79 and 82, associated with the supply motor 33, allowing the associated spring 79, through the friction discs, to apply braking force to the shaft 13 to decrease the speed of the supply reel 11. The outward movement of the arm 20 into engagement with its stop will cause sufficient tensional force to remain in the associated springs 79 and 82 to balance the force of the associated spring 79 to free the shaft 12 of any braking force and allow the speed of the motor 32 to increase the speed of the reel 10 until the strand tension is again normal.

The embodiments of the invention herein disclosed are illustrative only and may be modified and departed from in many ways without departing from the spirit and scope of the invention as pointed out in and limited solely by the appended claims.

What is claimed is:

1. In a material handling apparatus, a pair of rotatable elements for material, an electric motor operatively connected to each element, variable electrical circuits, and selective means to electrically connect the motors with certain of the circuits to cause each motor to rotate its respective element at a speed differing from the speed of the other element to advance the material from one element to the other and to exchange the circuits for the motors to cause the elements to reverse the direction of advancement of the material.

2. In a material handling apparatus, a pair of rotatable elements for material, an electric motor operatively connected to each element, variable electrical circuits, and selective means to electrically connect the motors with certain of the circuits to cause rotation of the elements to advance the material from one element to the other and to exchange the circuits for the motors to reverse the direction of advancement of the material, variable means associated with each motor to control the speed of rotation of the elements, and means operatively connected to the selective means to cause variation of the said variable means.

3. In a material handling apparatus, a pair of elements rotatable for transferring material from one element to the other, an electric motor for rotating each element, an electrical circuit to energize either motor to render either element a supply element, and a second electrical circuit to energize either motor to render either element a take-up element, the circuits being adjustable to vary the relative speed of the motors.

4. In a material handling apparatus, a pair of elements rotatable for transferring material from one element to the other, an electric motor for rotating each element, an electrical circuit to energize either motor to render either element a supply element, a second electrical circuit to energize either motor to render either element a take-up element, a speed control unit for each motor, shiftable means controlled by variations in the tension of the material to cause variations in the rotary speed of the elements, and means to transfer the circuits from one motor to the other and to shift the speed control means.

5. In a material handling apparatus, a pair of rotatable elements for material, an electric motor operatively connected to each element, electrical circuits conditioned to supply varying electrical forces to drive the motors, and means to connect the circuits to the motors to cause operation of the motors and elements at different speeds to cause advancement of the material under tension from one element to the other.

6. In a material handling apparatus, a pair of rotatable elements for material, an electric motor operatively connected to each element, electrical circuits conditioned to supply varying electrical forces to the motors, and means to selectively connect each circuit to either motor to cause operation of the motors and elements at different speeds to cause advancement of the material under tension from either element to the other.

7. In a material handling apparatus, a pair of rotatable elements for material, a constant horse power electric motor operatively connected to each element, electrical circuits conditioned to supply varying electrical forces to the motors, and means to connect the circuits to the motors to cause operation of the motors and elements at different speeds to cause advancement of the material under tension from one element to the other.

8. In a material handling apparatus, a pair of rotatable elements for material, a constant horse power electric motor operatively connected to each element, electrical circuits conditioned to supply varying electrical forces to the motors, means to connect the circuits to the motors to cause operation of the motors and elements at different speeds to cause advancement of the material under tension from one element to the other, brake means for each motor, and means controlled by variations in the tension of the material to actuate the brake means to vary the speed of the motors.

9. In a material handling apparatus, a pair of rotatable elements for material, an electric motor operatively connected to each element, electric circuits conditioned to supply varying electrical forces to the motors to cause operation of the motors at different speeds to cause advancement of the material under tension from one element to the other, a brake unit for each motor, and means conditioned to selectively cause actuation of the brake units to increase or decrease the braking force to their respective motors during an increase in tension of the material.

10. In a material handling apparatus, a pair of rotatable elements for material, an electric motor operatively connected to each element, electric circuits conditioned to supply varying electrical forces to the motors to cause operation of the motors at different speeds to cause advancement of the material under tension from one element to the other, and actuating means to electrically connect the circuits to the motors to cause operation of the motors and spindles to advance the material under tension in one direction and to transfer the connections of the circuits to opposite motors to cause operation of the motors and spindles to advance the material under tension in another direction.

11. In a material handling apparatus, a pair of elements for material, an electric motor operatively connected to each element, electric circuits conditioned to supply varying electrical forces to the motors to cause operation of the motors at different speeds to cause advancement of the material under tension from one element to the other, a brake unit for each motor, actuating means to electrically connect the circuits to the motors to cause operation of the motors and spindles to advance the material under tension in one direction and to transfer the connections of the circuits to opposite motors to cause operation of the motors and spindles to advance the material under tension in another direction, and means controlled by the actuating means to selectively cause actuation of the brake units to respectively increase and decrease the braking force of their respective motors during an increase in tension of the material dependent upon the direction of advancement of the material.

12. In a material handling apparatus, a pair of elements for material, a motor for each element, two electrical circuits having connections transferable from one motor to the other to selectively supply varying electrical forces to each motor but in reverse order to selectively cause the elements to advance the material in either direction under tension, a brake unit for each motor, shiftable controlling means associated with each brake unit to selectively cause increasing or decreasing force thereof to each motor with increase in tension of the material, and means to transfer the circuit connections to opposite motors and shift the brake controlling means.

13. In a material handling apparatus, a pair of elements rotatable for transferring material from one element to the other, an electric motor for rotating each element, an electrical circuit to energize either motor to render either element a supply element, and a second electrical circuit to energize either motor to render either element to take-up element and cause the material to travel under tension.

14. In a material handling apparatus, a pair of rotatable elements for transferring material under tension from one to the other, a reversible motor for rotating each element, two electrical circuits to supply varying electrical forces to the motors, means actuable to electrically connect one of the circuits singly to either motor to render either element a take-up element and to electrically connect the other circuit to either motor to render either element a supply element, a brake for each motor, a member for each brake movable to release or apply the brakes, and means controlled by variations in the tension of the material to actuate the brakes.

15. In a material handling apparatus, a pair of rotatable elements for transferring material under tension from one to the other, a reversible motor for rotating each element, two electrical circuits to supply varying electrical forces to the motors, means actuable to electrically connect one of the circuits singly to either motor to render either element a take-up element and to electrically connect the other circuit to either motor to render either element a supply element, a brake for each motor, a member for each brake movable to release or apply the brakes, and means actuable by the material during an increase in tension thereof to apply the brake associated with the take-up element and release the brake associated with the supply element.

16. In a material handling apparatus, a pair of rotatable elements for transferring material under tension from one to the other, a reversible motor for rotating each element, two electrical circuits to supply varying electrical forces to the motors, means actuable to electrically connect one of the circuits singly to either motor to render either element a take-up element and to electrically connect the other circuit to either motor to render either element a supply element, a brake for each motor, a member for each brake movable to release or apply the brakes, shiftable means controlled by variations in the tension of the material to move the said member to actuate the brakes, and means actuable with the means to connect the circuits to shift the said shiftable means.

17. In a material handling apparatus, a pair of rotatable elements for transferring material under tension from one to the other, a reversible motor for rotating each element, two electrical circuits to supply varying electrical forces to the motors, a brake for each motor, and means to selectively connect one of the circuits to either motor to render the element of the selected motor a take-up element and condition the brake of the selected motor to apply braking force upon an increase in tension of the material and simultaneously selectively electrically connect the other circuit to the other motor to render the element thereof a supply element and condition the brake thereof to release braking force upon its motor an increase in tension of the material.

VAUGHN L. JOHANNESSEN.

CERTIFICATE OF CORRECTION.

Patent No. 2,221,543. November 12, 1940.

VAUGHN L. JOHANNESSEN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, first column, line 7, claim 13, for "to" second occurrence, read --a--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 27th day of May, A. D. 1941.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.

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