June 6, 1939. M. MORGAN 2,161,076

METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

Filed April 29, 1936 9 Sheets-Sheet 1

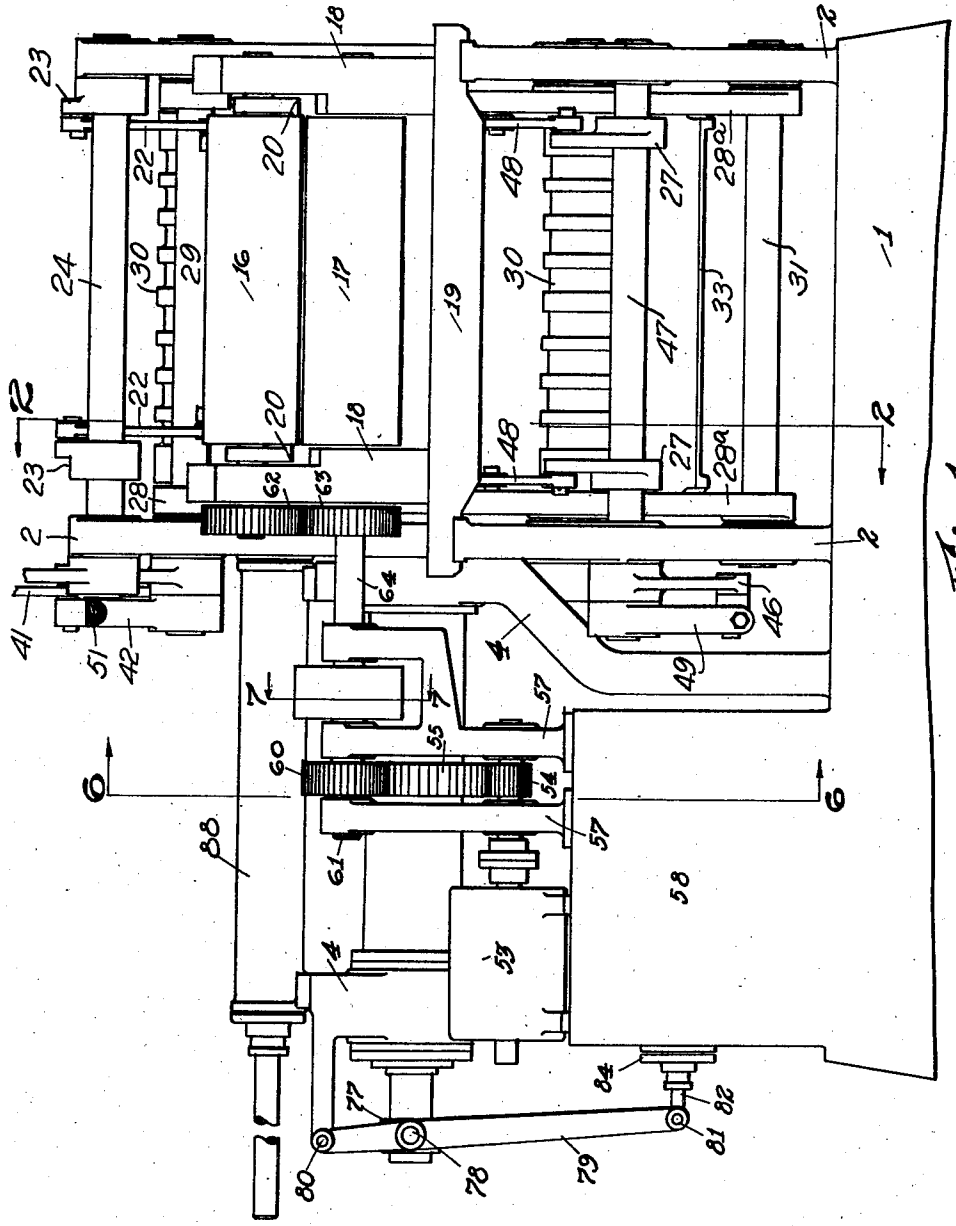


Fig. 1.

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METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

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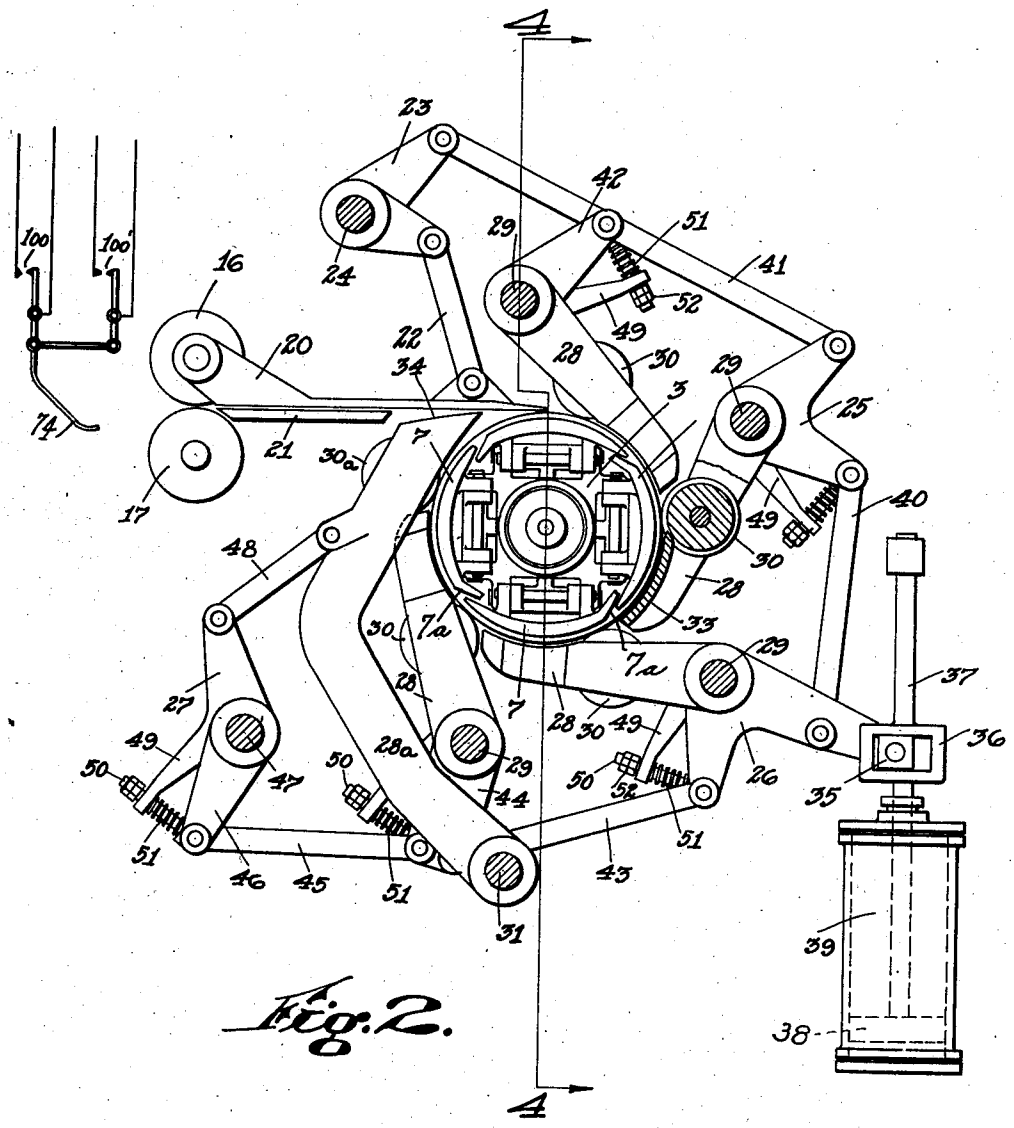



Fig. 2.

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METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

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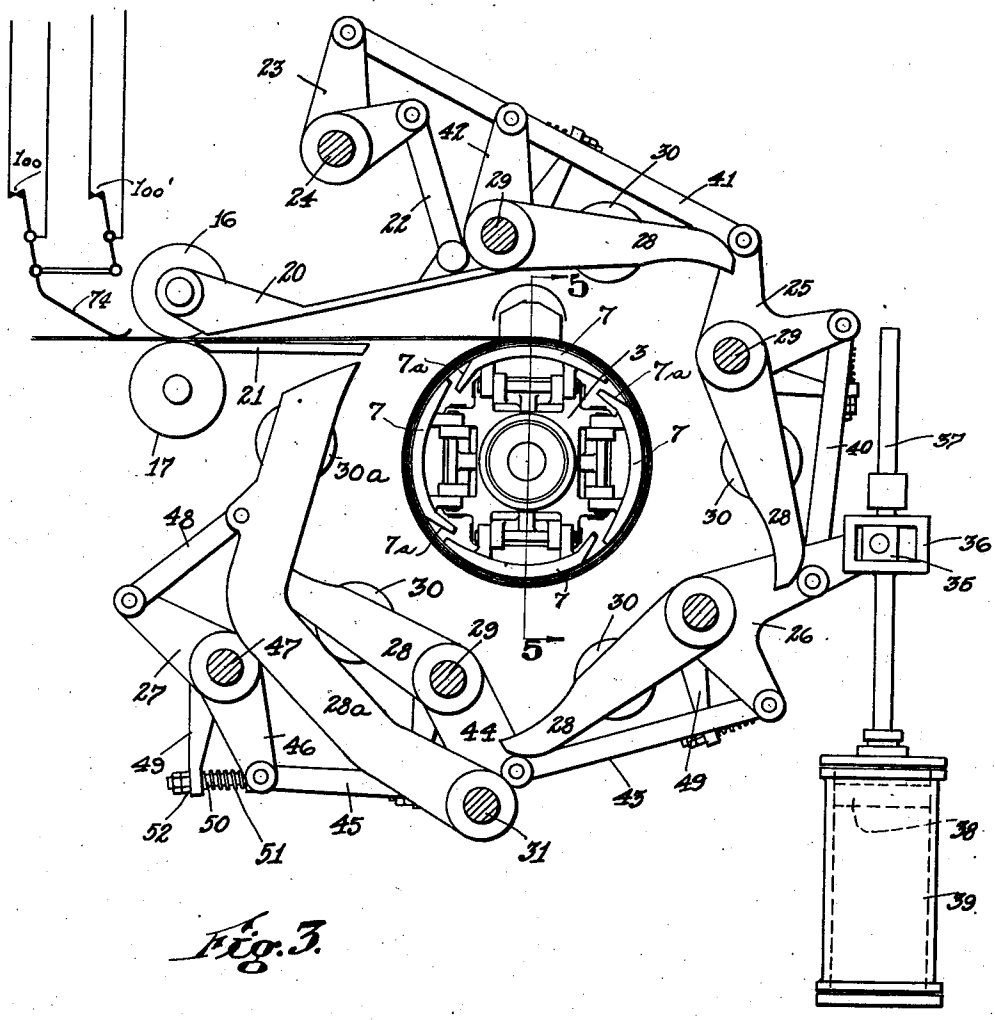



Fig. 3.

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June 6, 1939. M. MORGAN 2,161,076

METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

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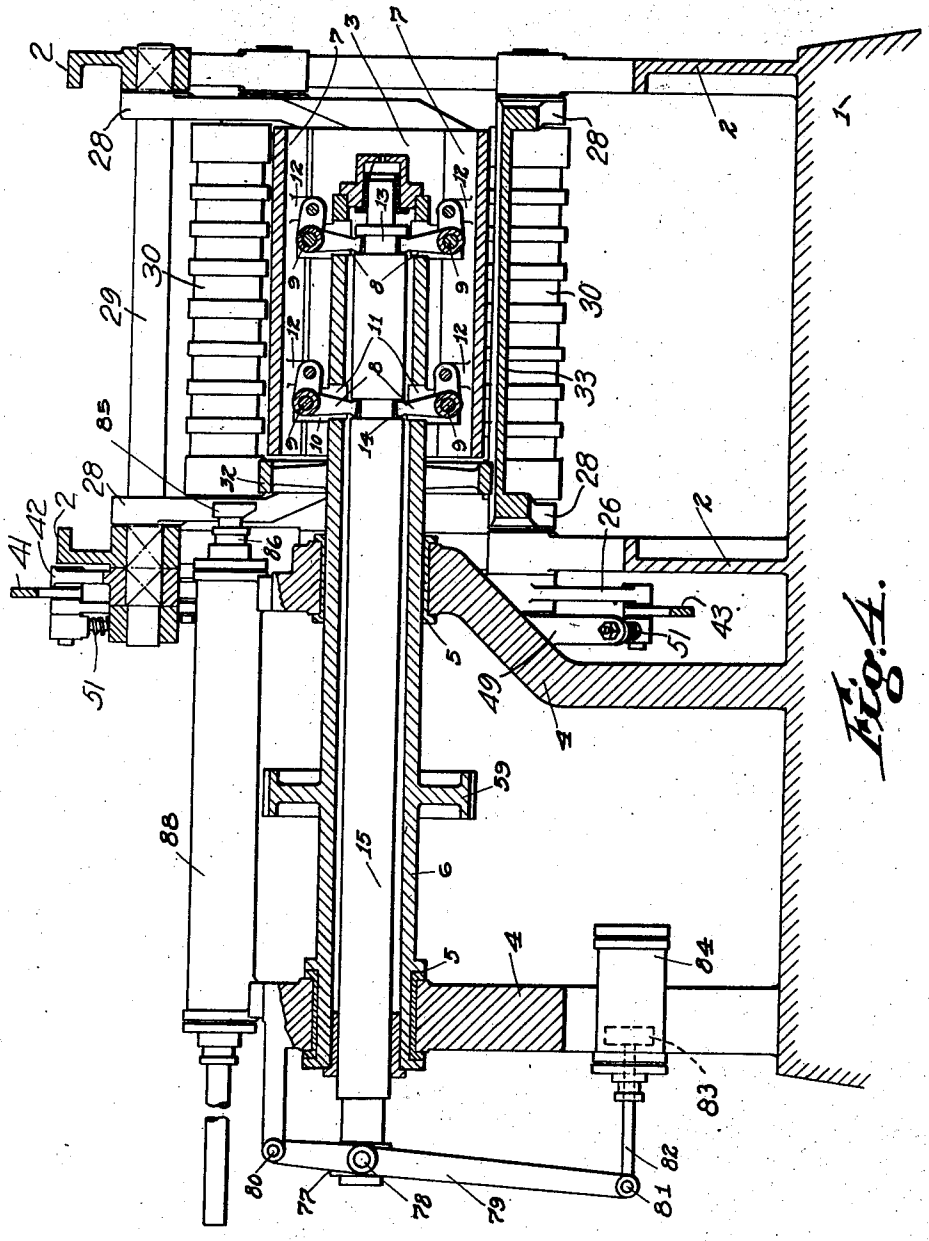


Fig. 4.

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June 6, 1939. M. MORGAN 2,161,076

METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

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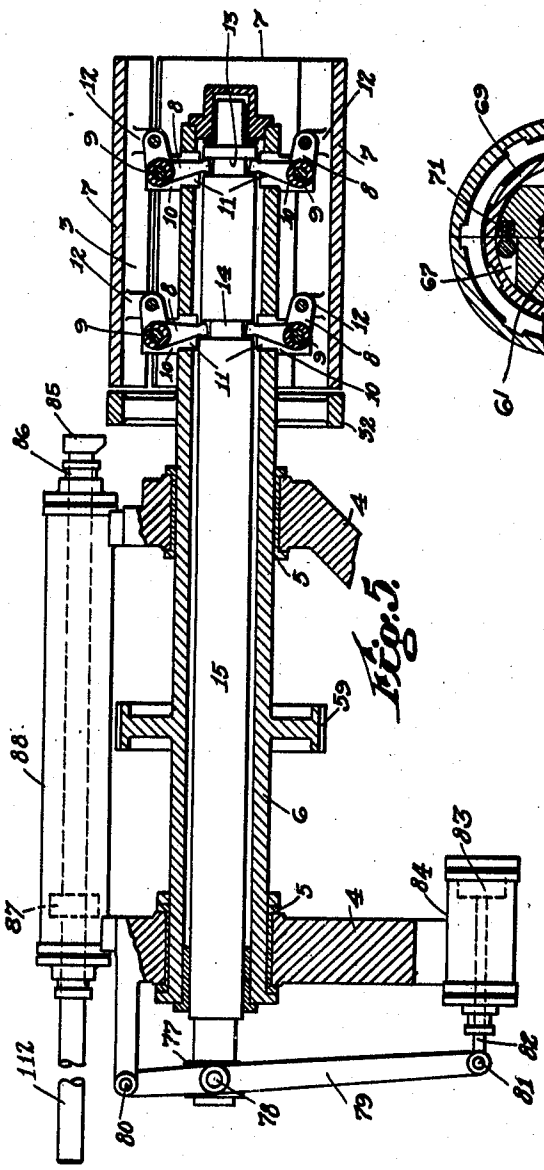


Fig. 5.

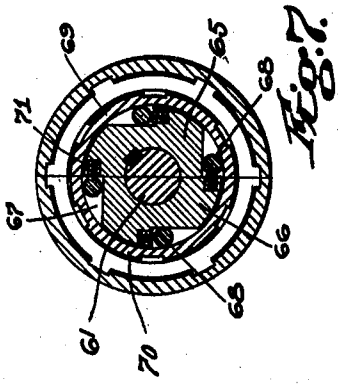


Fig. 7.

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METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

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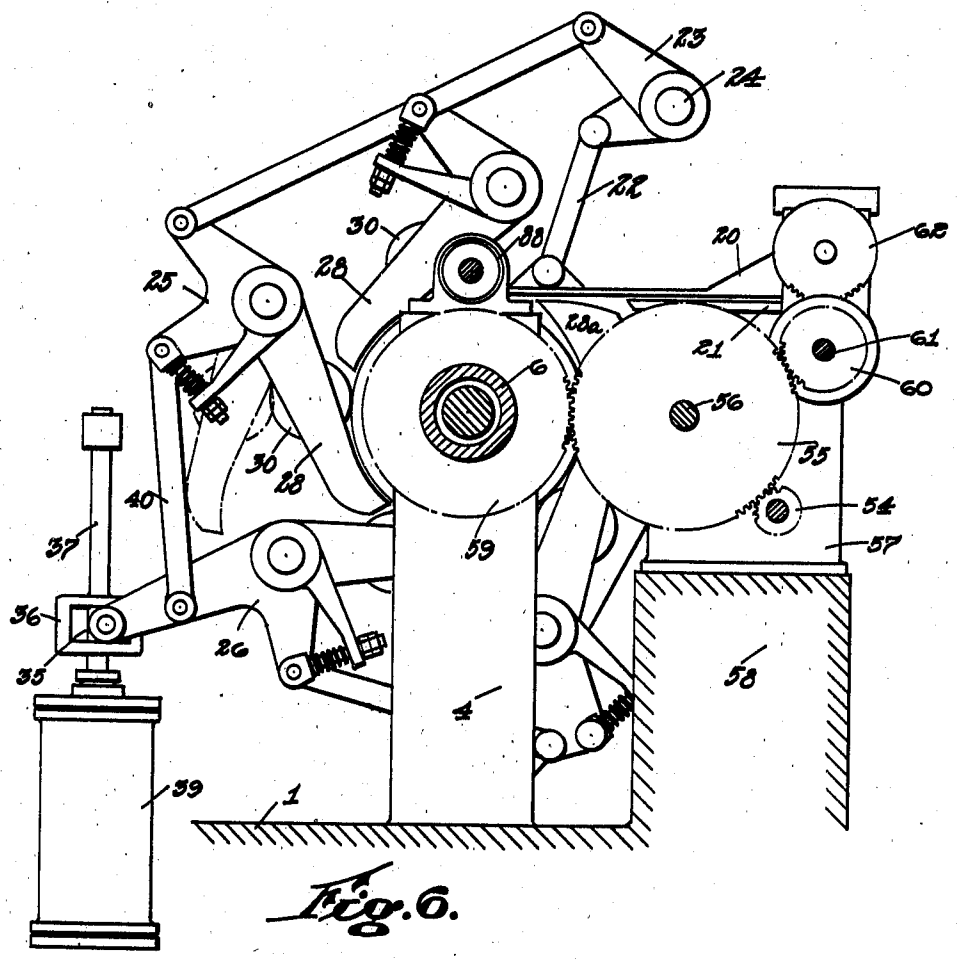



Fig. 6.

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METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

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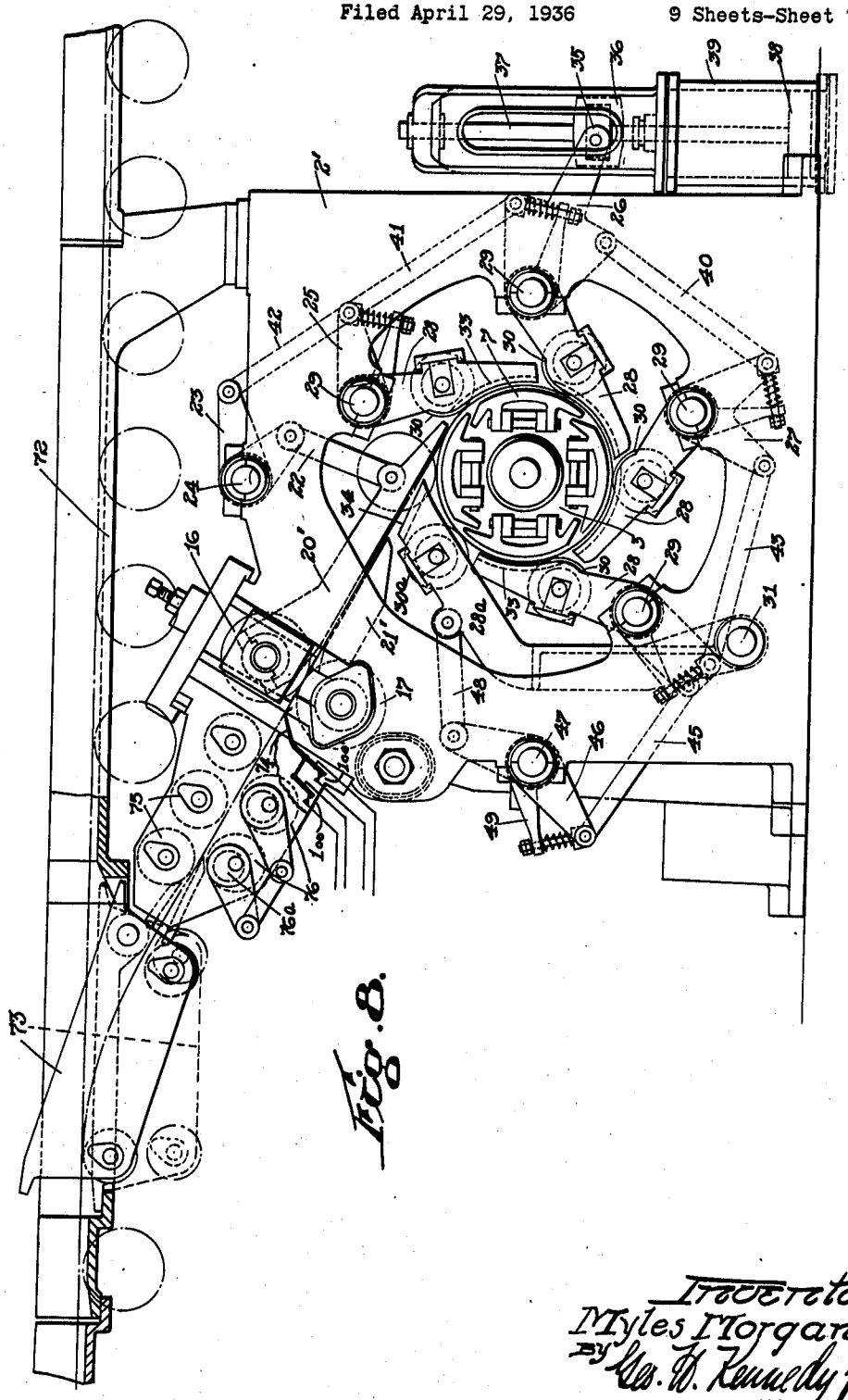


Fig. 8.

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METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

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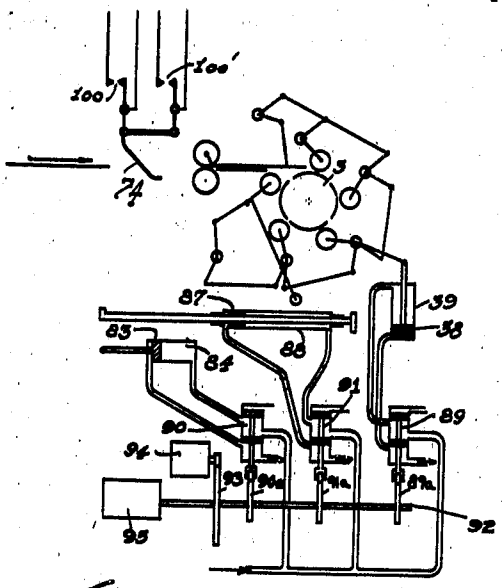



Fig. 9.

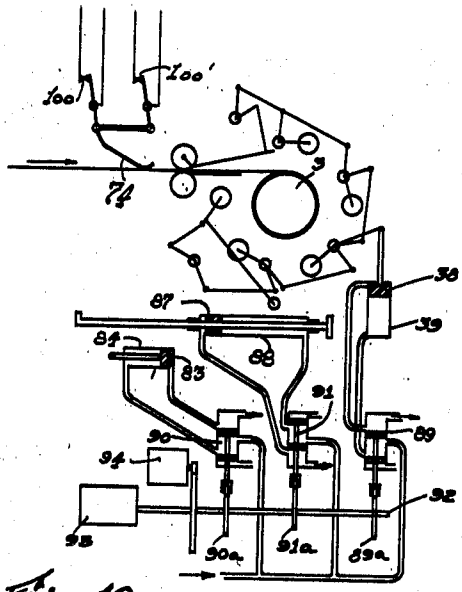



Fig. 10.

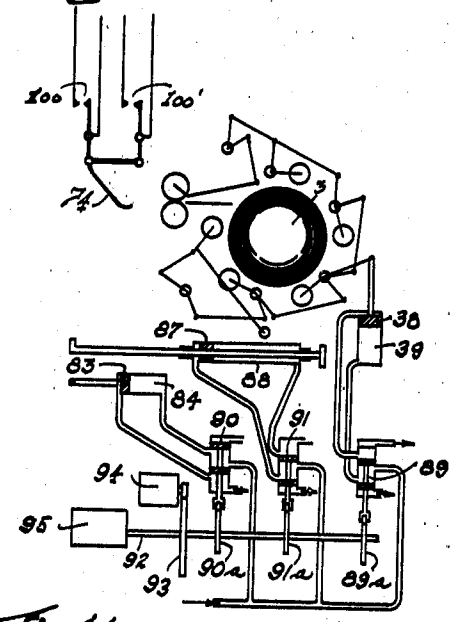



Fig. 11.

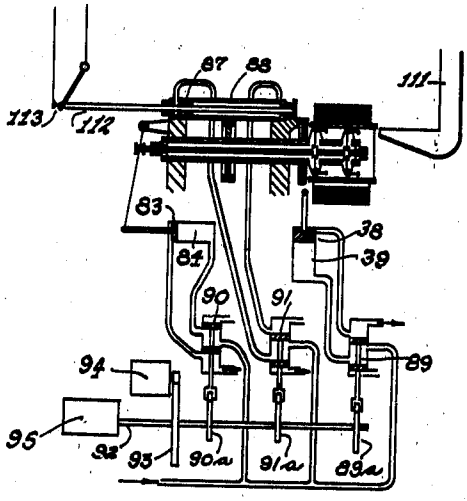



Fig. 12.

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METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

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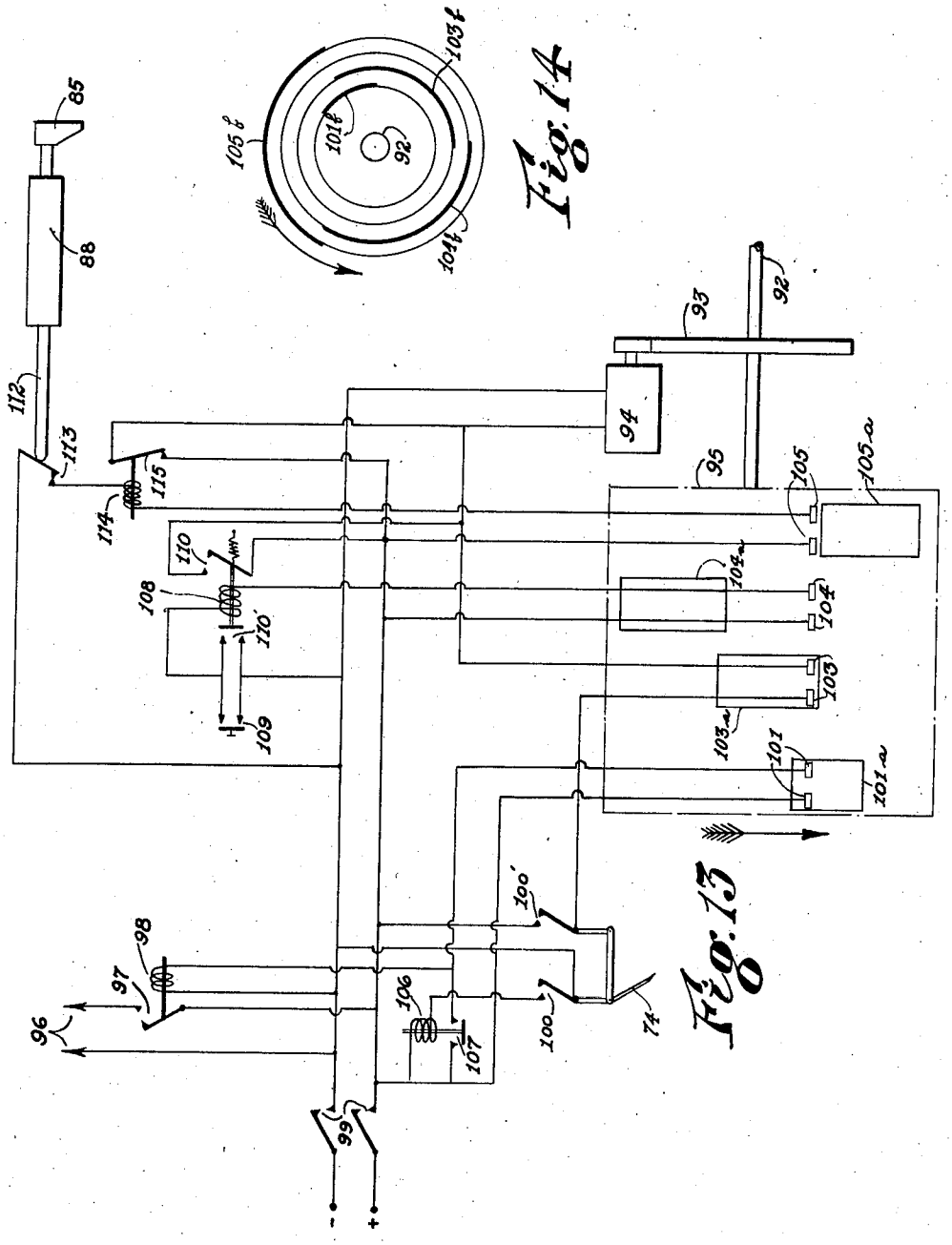



Fig. 13




Fig. 14

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Patented June 6, 1939 2,161,076

# UNITED STATES PATENT OFFICE

2,161,076

## METHOD OF AND APPARATUS FOR REELING STRIP MATERIAL

Myles Morgan, Worcester, Mass., assignor to Morgan Construction Company, Worcester, Mass., a corporation of Massachusetts

Application April 29, 1936, Serial No. 77,003

32 Claims. (Cl. 242—78)

The present invention relates to the reeling of strip material, particularly relatively thin metal strip as delivered at high speed from the finishing rolls of a strip-rolling mill.

The invention contemplates, for the handling of such stock, a reeling method and apparatus of fully automatic character, that enables the reeling operation on each elongated piece of stock to start and to be carried through to completion with practically no need for intervention by an operator, and without any interruption or curtailment of the high speed delivery of such stock from the mill.

According to the invention, the reeling apparatus includes an expansible and contractible rotary core, and a surrounding set of guide devices which are brought into play only for the purpose of causing the first end of a piece of stock to make a few wraps around the rotating collapsed core; thereupon, with the expansion of said rotating core to produce a clutching engagement internally with said few initial wraps, the aforesaid wrap-producing devices shift to an inoperative position, wholly removed from any contact with the stock that is being reeled; such stock in consequence is reeled up, layer upon layer, on the rotating core, (functioning in effect as a traction reel) in the entire absence of any contact of the stock surfaces with guides or other elements tending to scratch or mar said surfaces,—which scratching or marring, from the presence of stock-contacting guides or like elements, has heretofore been unavoidable in automatic reeling operations.

Other and further objects and advantages of the invention will appear from the following detailed description thereof, taken in connection with the accompanying drawings, in which—

Fig. 1 is a view in end elevation of apparatus in accordance with my invention, as viewed from the left hand side in Figs. 2 and 3.

Figs. 2 and 3 are fragmentary views in side elevation, partly diagrammatic and sectional, showing the core and the wrap-producing devices in different positions,—the plane of the section being indicated generally by the line 2—2, Fig. 1.

Fig. 4 is a sectional view at right angles to Figs. 2 and 3, the plane of the section being indicated generally by the line 4—4 of Fig. 2.

Fig. 5 is a fragmentary sectional view, similar to Fig. 4, showing the parts in a different position.

Fig. 6 is a sectional view on the line 6—6 of Fig. 1.

Fig. 7 is a sectional view on the line 7—7 of Fig. 1.

Fig. 8 is a side elevational view, on a somewhat smaller scale than Figs. 2 and 3, showing my invention in its preferred environment.

Figs. 9, 10 and 11 are diagrammatic views, illustrating successive positions assumed by the control mechanism of the apparatus in different stages of the reeling operation.

Fig. 12 is a diagrammatic view, illustrating the removal or stripping of the reeled material from the core, at the completion of the reeling operation.

Fig. 13 is a wiring diagram.

Fig. 14 is a schematic view, illustrating the angular extent of the several contact-bridging members provided by a rotary switching mechanism shown in the lower part of Fig. 13.

Like reference characters refer to like parts in the different figures.

As shown in Fig. 1, the reeling apparatus proper may be mounted on a suitable base 1, the latter at one side providing spaced uprights 2, 2 which serve as a supporting frame for the movable wrap-producing devices, best shown in Figs. 2, 3 and 8, which surround the rotary expansible core, designated as a whole by the numeral 3. Other upright frame members 4, 4 provide suitable bearings 5, 5 for the hollow shaft 6, Figs. 4 and 5, which carries the expansible core structure, the latter consisting of a plurality of curved shoes 7, 7 (here shown as four in number) arranged about the shaft 6 to present conjointly an approximately cylindrical outer surface. For the support of each shoe 7, the shaft 6 carries a pair of bell cranks 8, 8, the latter pivoted at 9, 9 on lugs 10, 10 formed exteriorly on said shaft 6 adjacent to openings 11, 11, through each of which loosely extends one arm of each bell crank 8. The other arm of each bell crank 8 is pivotally attached to a lug 12 provided interiorly by the associated shoe 7, and thus each shoe by its pair of bell cranks is supported and carried by the shaft 6 in parallel spaced relation thereto. The several bell crank arms that project through the openings 11, 11 of shaft 6 engage at their ends in grooves 13 and 14, respectively, of a rod 15 which occupies the interior of the hollow shaft 6, and which is axially slidable within said shaft for the purpose of rocking the several bell cranks 8, 8 in unison, either to expand or to contract the cylindrical structure constituted by the several shoes 7, 7. That is to say, when the rod 15 occupies the position shown in Fig. 4, having been moved to

the left, the shoes 7, 7 are drawn in toward the shaft 6 by the bell cranks 8, 8,—this being the contracted core condition illustrated in Fig. 2, made possible by the bevelling at 7a of each shoe along one of its longitudinal edges to permit of overlapping the same by the adjacent shoe. When the rod 15 is shifted to the right into the position shown by Fig. 5, the consequent rocking of the several bell cranks 8, 8 throws the shoes 7 outwardly to expand the core 3 into the condition shown by Fig. 3.

According to my invention, the rotating core 3, after receiving in its contracted condition (Fig. 2) a few wraps of the strip material, is expanded as described above, and by such expansion establishes so firm a grip between itself and the initial wraps that its ensuing operation is substantially that of a traction reel. I will now describe the means herein shown for directing the advancing front end of the piece of strip stock as delivered by the mill (not shown) around the rotating contracted core 3, and for producing such initial few wraps or turns, preparatory to the core's expansion.

The strip material on its way from the rolling mill to the reeling apparatus is directed between a pair of pinch rolls 16, 17, which, as shown in Fig. 1, may be journalled in frame members 18, 18 carried by a horizontal frame portion 19; or, as shown in Fig. 8, said pinch rolls 16, 17 may be journalled in the main frame members 2'. In either case, said pinch rolls are driven, as hereinafter described, in such a way as to avoid any slippage between the same and the stock, while the latter is being collected on core 3 by the traction reel operation of said core. Beyond the pinch rolls 16, 17 are arranged upper and lower guide plates, marked 20 and 21 respectively in Figs. 2 and 3, and marked 20' and 21' respectively in Fig. 8,—the lower plate in each instance being stationary, and the upper plate, in its operative position shown in Figs. 2 and 8, cooperating with the lower plate to confine the stock, in its passage from the pinch rolls to the reeling devices proper, to a path substantially tangential to the contracted periphery of core 3. The stock is relieved of confinement by or contact with said guide plates as soon as a small number of wraps of said stock around the contracted rotating core 3 have been established; to this end, the upper plate 20 or 20' is made movable to the inoperative position shown in Fig. 3, said plate being here shown as pivoted on an axis provided by the shaft of pinch roll 16, and its movement being effected by a link connection 22 to a bell crank 23 which is turnable on a pivot 24 provided by the frame members. Said bell crank 23 is operatively associated, as shown in Figs. 2, 3 and 8, with a plurality of similarly pivoted members 25, 26 and 27 that obtain, by their actuation in unison, the movements of the wrap-producing instrumentalities into and out of operative position. Such wrap-producing instrumentalities, effective around the periphery of the contracted core 3, take the form of a succession or series of arms 28, 28 arranged in pairs, (there being four of such pairs shown herein), with each pair of arms secured to a rock shaft 29 that is suitably journalled at its ends in the spaced frame members 2, 2. Extending between each pair of arms 28, 28 and journalled suitably therein is a roller 30; in addition to the succession of the four rollers 30, 30 provided by the pairs of arms 28, 28, the apparatus also includes a final roller 30a extending between and journalled in a pair of elongated bent arms 28a, 28a, which are secured to a rock shaft 31.

In the operative position of the wrap-producing instrumentalities shown by Figs. 2 and 8, the several arms 28, 28 and 28a have been moved simultaneously inward to engage all the rollers 30, 30 and 30a with a rotating wheel 32 (see Fig. 4), which is formed on or secured to the hollow shaft 6 immediately adjacent the expansible core structure 3. Said wheel 32 has a diameter slightly in excess of the contracted core diameter, thereby to maintain the rollers 30, 30 and 30a, which derive rotation frictionally from said wheel 32, in positions slightly spaced from said contracted core. Each pair of arms 28, 28, beyond its roller 30, is spanned by a curved guide plate 33, the concave surface of which, in the position of the parts shown by Figs. 2 and 8, substantially bridges the gap in each case between adjacent rollers 30, 30 and 30a, said plates 33 having substantially the same spacing from the contracted periphery of the core 3 as said rollers, due to the latter's engagement with the wheel 32. Thus, as shown in Figs. 2 and 8, around the contracted periphery of core 3 is established, by means of the rollers 30, 30 and 30a and the plates 33 alternating with said rollers, a substantially continuous surrounding surface, between which and the core periphery is left a slight annular space for the reception and guidance of the advancing front end of each piece of stock that is projected by the pinch rolls 16, 17 through the tangential extension of said space which is provided by the guide plates 20, 21 or 20', 21'. In this connection, it is to be noted that the free ends of the final pair of arms 28a, 28a, beyond the roller 30a, are formed to provide a guide surface 34, constituting in effect an extension of the lower stationary guide plate 21 or 21', thus completing such tangential guide passage and insuring the stock's entry to such annular space.

The inner wall of said space is the periphery of the rotating contracted core structure 3, said periphery preferably having a surface speed slightly exceeding the speed of the entering stock, and the outer wall of said space being constituted in part by the rollers 30, 30 and 30a which, from their frictional contact with the wheel 32, derive surface speeds substantially the same as the stock speed. Thus, notwithstanding such stock's guidance through and close confinement in said annular space, the tendency for its surface to be scratched by contact with the stationary guide elements, is reduced to a minimum; furthermore, and of the greatest importance, even this minimized scratching tendency is wholly eliminated almost as soon as the reeling operation has been started, because the narrow annular space aforesaid is maintained only long enough to allow a few initial wraps of the stock to be made around the rotating contracted core 3; thereupon, with the expansion of said core, (by shifting of rod 15 as hereinafter described), to seize or clutch internally the encircling stock, the entire stock-confining structure that constitutes the outer wall of said annular space and also the tangential admission passage thereto is immediately shifted to a position (see Fig. 3) wholly removed from any possibility of contact with the stock being reeled, so that for the duration practically of the entire reeling operation no contact with the stock of guiding or like elements tending to scratch or mar the same is ever permitted. The movement of the stock-confining parts from the operative position of Fig. 2 to the inoperative position of Fig. 3 is effected as follows:—

As shown in Figs. 2, 3 and 8, the bell crank 26 is journalled on the rock shaft 29 that carries the third pair of arms 28 of the stock-confining structure, one arm of said bell crank having pivoted on its free end a block 35 which is slidably received in a yoke or cross head 36 that is carried by a sliding rod 37, the latter being attached, as here shown, to a piston 38 adapted to operate within a hydraulic cylinder 39. The motions of bell crank 26, under the influence of piston 38, are communicated to the several rock shafts 24, 29, 29 and 31, for shifting the parts from the Fig. 2 position to the Fig. 3 position and vice versa, by a system of connecting links and arms; that is to say, a link 40 connects the bell crank 26 with the bell crank 25, the latter being journalled on the shaft 29 of the second pair of arms 28, 28, and a link 41 connects the bell crank 25 with the bell crank 23, the latter having its other arm connected by link 22 to the guide plate 20; said link 41 at an intermediate point has a pivotal connection with an arm 42 journalled on the shaft 29 of the first pair of arms 28, 28. Also, a link 43 connects the bell crank 26 with an arm 44 journalled on the shaft 29 of the fourth stock-confining pair of arms 28, 28, and from this arm 44 there is a link connection 45 with an arm 46 that is journalled on the shaft 47, to which is secured the bell crank 27 that operates, through link 48, the pair of arms 28*a*, 28*a*, which carry the final roller 30*a*.

The several linked-together and jointly-movable elements 42, 25, 26, 44 and 46 above described, which are pivoted, respectively, on shafts 29, 29, 29, 29 and 47 impart their movements to said shafts, in each case preferably through resilient or yieldable connections; as here shown, each such shaft has secured thereto an arm 49, through the end of which loosely passes a rod or pin 50 projecting from the associated actuating element that is pivoted on said shaft,—there being a coil spring 51 on each pin, confined between the actuating element and the arm 49, to hold said parts in spaced relation. When the connected actuated elements 42, 25, 26, 44 and 46 are shifted counterclockwise, from the positions shown in Figs. 2 and 8 to those shown in Fig. 3, the several shafts 29, 29 and 47 are correspondingly rocked through the engagement with their arms 49, 49 of nuts 52 on the ends of the rods or pins 50,—thus procuring, as shown in Fig. 3, the opening or dilation in substantially iris fashion, of the wrap-producing instrumentalities. On the reverse or closing movement, obtained when the actuating elements 42, 25, 26, 44 and 46 are shifted clockwise, the forces for rocking the shafts 29, 29 and 47 are transmitted through the springs 51, 51 and thus the arrival of the rollers 30, 30 and 30*a* in contact with the rotating wheel 32 may occur before the end of the down stroke of piston 38; additional movement of said piston serves simply to compress said springs, each of the latter thus providing for its associated roller an independent source of pressure for the friction drive of said roller by the wheel 32.

Rotation is constantly imparted to the core 3 by an electric motor 53, Fig. 1, said motor being preferably of the well known adjustable speed type, and provided with some one of several well known arrangements of accessory control arranged to maintain any desired constant tension in the stock being reeled; that is to say, the control provides a gradually increasing torque as the speed decreases, thus maintaining a substantially constant tension in the stock in spite of the gradual increase in the diameter of the stock bundle as it accumulates during the reeling operation. The shaft of said motor 53 carries a pinion 54, Fig. 6, which meshes with a gear 55 on a countershaft 56, the latter being suitably journalled in spaced uprights 57, 57 rising from a pedestal 58 of the base 1, which supports said motor. A gear 59, formed on or carried by the hollow shaft 6 and meshing with the gear 55, obtains the drive of the core 3 by the motor 53; also in mesh with said gear 55 is a gear 60 carried by another countershaft 61 also journalled in the uprights 57, 57 and through which, in the manner now to be described, is obtained the drive of the pinch rolls 16, 17 from said motor 53.

As shown in Figs. 1 and 6, the shafts of the pinch rolls 16 and 17 carry intermeshing gears 62 and 63, respectively,—one of said shafts providing an extension 64, Fig. 1, which alines substantially with the countershaft 61 that, through the gearing above described, rotates constantly in synchronism with the core 3. This rotation of countershaft 61 is transmitted to the alined shaft extension 64, for the constant drive of the pinch rolls 16, 17 by a clutching mechanism of the so-called free-wheeling type, Fig. 7, that transmits the rotation of countershaft 61 to the alined shaft extension 64, and also permits the latter to overrun, in response to stock travel at a higher speed, due, for example, to the progressively increasing diameter of the material accumulating on said core as the reeling proceeds; in this way, any slippage between the stock and the pinch rolls, such as might cause marring or scratching of said stock, is wholly avoided.

Referring now to Fig. 7, the countershaft 61, for the purpose above described, has secured to its end an annular driving member 65, the hub 66 of which is appropriately recessed, as shown at 67, for the reception of rollers 68, 68 which are confined in said recesses by an encircling flange 69 of a driven member 70 secured to the end of shaft extension 64. The springs 71, 71, carried by the hub 66, press the rollers 68, 68 rearwardly, in relation to the clockwise direction of rotation of said hub, the rollers thereby normally wedging between flange 69 and the opposed surfaces of recesses 67 to impart to member 70 and shaft extension 64 the same speed of rotation as that of countershaft 61, thus to give the pinch rolls 16, 17 a positive drive that is in step with the drive of the contracted circumference of core 3. Nevertheless, the pinch rolls 16, 17, by this arrangement, are left free to partake of rotation at a speed commensurate with that of the stock,—as when the above described drive of said pinch rolls may drop behind the actual running speed thereof as imparted by said stock.

Any suitable means may be employed, in conjunction with the pinch rolls, for imposing on the stock, particularly after its last end has run out from the mill, a braking action or drag, to hold the stock taut during the final stages of the reeling operation. See in this connection Fig. 8, which depicts the preferred environment and arrangement of the reeling apparatus proper which is shown more or less diagrammatically in Figs. 2 and 3. Fig. 8 shows a mill runout in the form of a roller table 72, arranged to deliver the stock to one or the other of a plurality of the reeling instrumentalities of my invention,—only one of the same being shown. Incorporated in this roller table 72 is a movable switch 73 which, in its full line position, deflects the stock to the illustrated reeling apparatus; when said switch 73 occupies

its broken line position, the stock continues over the roller table 72 to the next reeling apparatus, not shown. As shown in Fig. 8, preceding the pinch rolls 16 and 17, there may be provided any suitable braking device, here shown as a plurality of upper rollers 75, in combination with staggered lower rollers 76, the latter having eccentric mountings 76a, by means of which to raise and lower the same. During most of each reeling operation, while the stock is under the influence of the finishing rolls of the mill, the rolls 75 and 76 are kept separated, so that they impose no restraint on the stock in its passage between the same. But when the last end of a piece of stock emerges from the mill, the eccentric supports 76a of the lower rolls 76 are shifted, so as to elevate said lower rolls somewhat above the normal stock path, this action forcing the stock to travel a zigzag path in its passage between the rollers 75 and 76, with the result that a suitable drag is imposed thereon during the final stages of the reeling operation when the last end of a piece of stock would otherwise be free.

Referring now to Figs. 1, 4 and 5, the rod 15, at the end thereof which projects beyond the hollow shaft 6, carries a sleeve or collar 77, the latter having a pivotal connection at 78 with a lever 79, fulcrumed at 80 to a bracket projecting from frame member 4. The other end of lever 79 has a pivotal connection 81 with a slidable rod 82, which derives its motion from a piston 83 that operates with a hydraulic cylinder 84,—the opposite movements of said piston, produced by the admission of fluid under pressure to one end or the other of said cylinder, procuring the contraction and expansion of core 3. Figs. 4 and 5 show also in proximity to core 3 a pusher head 85, which is adapted, at the completion of a reeling operation, to be moved against the end of the reeled-up accumulation of stock on core 3 (the latter then being contracted) to sweep said bundle off the core; said pusher head 85 is carried by a rod 86 which extends from a piston 87 adapted to work in a hydraulic cylinder 88,—the opposite movements of said piston, produced by the admission of fluid under pressure to one end or the other of said cylinder, procuring the pushing and retractile movements of the head 85.

The three hydraulic cylinder and piston units 38, 39 for the wrap-producing devices, 83, 84 for the core, and 87, 88 for the pusher, are shown in the diagrams of Figs. 9, 10 and 11 in association with suitable valve devices 89, 90 and 91, respectively, that govern the admission and discharge of the pressure fluid to and from the cylinders 39, 84 and 88. These three valve devices, shown diagrammatically in Figs. 9, 10 and 11, are arranged to be operated in the proper sequence by cams 89a, 90a and 91a, respectively, carried by a shaft 92 whose actuation is obtained through gearing 93 from a suitable electric motor 94; said shaft 92 also carries the rotating contact elements, hereinafter described, of certain limit switching devices, designated as a whole by the numeral 95, which are employed in establishing the several electrical circuits that contribute to the automatic operation of the reeling apparatus,—reference being had in this connection to the wiring diagram of Fig. 13, which includes a developed representation of the limit switch mechanism 95.

Said wiring diagram of Fig. 13 indicates at 96 the circuit of the motor 53 that drives the core 3 and pinch rolls 16, 17; this circuit 96 includes an automatic switch 97 of conventional type that is normally held open by a spring or the like, but which is shifted to closed position for completing the motor circuit 96 by the flow of electric current through a coil 98, the latter being included in certain holding circuits, now to be described, that, through limit switching mechanism 95, are established with the manual closing of the main switch 99 of the apparatus, and are maintained by the stock's engagement with a trigger 74 (see Figs. 2, 3, 8, 9, 10, 11 and 13) which closes a pair of switches 100 and 100'. That is to say, when the switch 99 is thrown by the operator into closed position, thereby making available the current of the supply line (shown by the + and — feed bars at the extreme left in Fig. 13), the first thing that occurs is a flow of current through coil 98 by way of a pair of contacts marked 101 which, in the stopped position of limit switch mechanism 95, are bridged by a member 101a carried by the then-stationary shaft 92 of said limit switch mechanism; the latter also provides, in different angular and radial relations, the pairs of contacts marked 103, 104 and 105, and the rotatable bridging members for said pairs marked respectively 103a, 104a and 105a, the latter being carried by the shaft 92 and becoming successively operative in the ensuing single revolution of said shaft, as will hereinafter appear. Fig. 13, being diagrammatic in character, does not adequately illustrate the angular extent and the relative angular positions of the several contact-bridging members 101a, 103a, 104a and 105a; such showing is supplied approximately, for purposes of illustration, by Fig. 14 wherein the four heavy-line arcs are numbered correspondingly, using, however, the subscript "b" instead of the subscript "a".

The flow of current through the circuit that includes the coil 98 and the bridged pair of contacts 101, 101 energizes said coil and thereby closes the switch 97, whereupon current flows through circuit 96 to start and drive the motor 53. At this time, the parts are in the positions shown diagrammatically by Fig. 9, the core 3 being contracted, the wrap-producing devices being in their operative positions close to the core, and the pusher head 85 being retracted,—all of these conditions having been established by the stoppage of shaft 92 in such an angular position that the cams 89a, 90a and 91a thereon have disposed their associate valve devices 89, 90 and 91, respectively, in the positions shown by Fig. 9, thus to maintain the piston 38 at the bottom of its stroke, and to maintain the pistons 83 and 87 at the limits of their left hand movements. Though the contracted core 3 and the pinch rolls 16, 17 are in rotation (from the closing, as above described, of switches 99 and 97), there is as yet no movement of any of the other parts from the position shown in Fig. 9, since the motor 94 has not yet been started up from its rest position where, as previously stated, the member 101a is disposed in bridging relation to the pair of contacts 101 of the limit switch mechanism. It should be noted that motor 53, when up to speed, drives the core 3 at a surface speed exceeding the delivery speed imparted to the material by the mill.

The first end of a piece of material emerging from the mill, on its way to the rotating core and pinch rolls, engages the trigger 74, the effect of such engagement being to close the switches 100 and 100' and to hold the same closed

during the passage of the entire length of said piece. The closing of the switch **100** completes a circuit that includes (see Fig. 13) a coil **106** that is associated with an automatic switch **107**. This energization of coil **106** closes the switch **107**, and the latter thereby short circuits and replaces the limit switch contacts **101** in the circuit for the coil **98**, this being required by the fact that the starting of motor **94** (through closure of switch **100'**) causes the commencement of a revolution by shaft **92**; therefore the member **101***a* on shaft **92**, starting from the position shown in Fig. 13, will very shortly pass beyond the pair of contacts **101**,—the duration of contact in this instance corresponding to a portion only of the short arc **101***b* (Fig. 14), representing the initial stage of this single revolution of shaft **92**. The closing of the switch **100'** completes a circuit that includes the motor **94** and the pair of spaced contacts **103** which are bridged by member **103***a*. The motor **94**, having been started by the closing of the switch **100'**, continues to run for the duration of the somewhat longer arc of contact **103***b* (Fig. 14) that supersedes the arc **101***b*, soon after the start of the single revolution of shaft **92**. The advancing first end of the stock having closed the electric switch **100'** and started the motor **94**, is received between the pinch rolls **16**, **17** and is directed into the narrow annular space (Figs. 2 and 8) between the rotating contracted core **3** and the surrounding then-undilated wrap-producing structure that includes the rotating rolls **30**, **30**. As soon as a small number of wraps of stock around the contracted core **3** have been made, the shaft **92** reaches that point in its rotation (near the end of arc **103***b*) where its cams **90***a* and **89***a* act either simultaneously or in close succession to shift the valve devices **90** and **89**, respectively, procuring thereby, as shown in Fig. 10, the admission of pressure fluid to the left hand end of cylinder **84** and to the bottom of cylinder **39**, whereby to move the pistons **83** and **38**, respectively. These piston movements procure the expansion of core **3** into gripping engagement with the initial encircling wraps of stock thereon, and simultaneously or practically so, the dilation, as shown in Figs. 3 and 10, of the wrap-producing structure into an inoperative position, wholly removed from any possibility of contact with or scratching of the stock. Said stock is reeled up, wrap upon wrap, by the continued rotation of the expanded core **3**, the latter thus operating, for practically the entire duration of the reeling operation, as a traction reel.

Referring again to Figs. 13 and 14, shortly after the cams **90***a* and **89***a* have operated as above described to establish the reeling conditions shown in Fig. 10, the shaft **92** is brought to rest by the temporary stoppage of motor **94**,—this occurring with the shaft's completion of the arc of movement **103***b* that terminates the engagement of member **103***a* with the contacts **103**, thus breaking the circuit of motor **94**. The motor **53** continues to drive the expanded core **3** for the traction reeling of the stock emerging from the mill until finally the last end of the stock is drawn past the trigger **14**. This allows the electric switches **100** and **100'** to open, thereby breaking the circuit that includes the coil **106**; the deenergization of coil **106** opens the switch **107** and this in turn breaks the circuit that includes the coil **98**, whereupon switch **97** opens to stop the motor **53**.

When the motor **53** stops, the expanded core **3** comes to rest in the condition illustrated by Fig. 11, the entire length of the piece of stock having been reeled thereon. Referring again to Figs. 13 and 14, it is to be noted that the previous stoppage of motor **94**, at the end of the arc of contact **103***b* has left the shaft **92** in an angular position where a pair of contacts **104** are bridged by a member **104***a* on said shaft, these contacts **104** being in a circuit that includes a coil **108** and a normally open push button switch **109**. The coil **108** is so arranged that, when energized, it will procure the closing of a switch **110**, the latter contained in a circuit that includes the motor **94**. When the operator desires to procure stripping of the completed reeled-up bundle of stock from the core **3**, he presses closed the push button switch **109**, thereby energizing the coil **108**, which in turn closes the switch **110** and this restarts the motor **94** and shaft **92**. The operator's release of push button switch **109** is without effect on the restarted motor **94**, since the energization of coil **108** for the closure of switch **110** also automatically closes a supplementary switch **110'** that short circuits the push button switch **109** and maintains the circuit through coil **108** notwithstanding removal of the operator's finger pressure from push button switch **109**. The first effect of this resumption of rotation by shaft **92** is to cause cam **90***a* to move valve **90** into the position shown by Fig. 11, thereby directing the pressure fluid into the right hand end of cylinder **84**, so as to shift piston **83** to the left, causing the expanded core **3** to collapse within the bundle carried thereon, thus releasing the grip of said core on said bundle. The next ensuing result of the restarting of motor **94** and shaft **92** is the movement by cam **91***a* of the valve **91**, this causing the pressure fluid to be admitted to the left hand end of cylinder **88**, to drive the piston **87** to the right, so that the pusher head **85** is thrust against the end of the released bundle on core **3**. Such piston movement sweeps the head **85** across the core, pushing the bundle ahead of it onto any suitable receiving device, such as the hook **111**, Fig. 12.

The rod **86** of the pusher head or stripper **85** has an extension **112** which, in the normal retracted position of said stripper, holds closed a switch **113**, the latter being in a circuit which includes a coil **114** and also includes a pair of spaced contacts **105** of the limit switch mechanism **95**, said contacts **105** adapted to be bridged by a member **105***a* on the shaft **92**. The coil **114** when energized effects closure of a switch **115** that is in the circuit of motor **94**; since the switch **113** remains closed in the retracted position of stripper **85**, said coil **114** is energized when the engagement of member **104***a* with contacts **104**, **104** is superseded by the engagement of member **105***a* with contacts **105**, **105**. Thus, in the operation of restarted motor **94** and switch **95**, after such engagement of member **105***a* with contacts **105**, **105** occurs, there would take place no further interruption of said motor's operation except for the fact that, as stated above, the cam **91***a*, during the arc of contact **104***b*, has become operative to admit pressure fluid to the left hand end of cylinder **88**, for the actuation of stripper **85**; this stripper movement allows the normally closed switch **113** to open, which deenergizes the coil **114** and thereby opens the normally closed switch **115** in the circuit of motor **94**, so that said motor may again temporarily come to a stop during the operation of stripper **85**. But auto-

matic resumption of said motor's running at the end of the stripping operation is assured because before the engagement of member 104a with contacts 104, 104 is broken, the cam 91a, after shifting valve 91 into the position shown by Fig. 11, for the working stroke of stripper 85, will move far enough to return said valve 91 to its normal position (Fig. 9); the resultant admission of pressure fluid to the right hand end of cylinder 86 drives the piston 87 to the left and causes, ultimately, the reclosing of switch 113 by extension 112. As a result, the motor 94, if it has in the meantime again come temporarily to rest at the commencement of the arc of contact 105b, is started up again because this closure of switch 113 energizes the coil 114 and thereby closes switch 115 in the circuit of said motor.

This third stage of operation of motor 94 is terminated by the completion of a full revolution by shaft 92,—the motor 94 coming to rest at the end of the arc of contact 105b, which breaks the circuit through coil 114 and thereby opens at switch 115 the circuit of motor 94. This return of shaft 92 to the same angular position that it occupied when the motor 94 was first started by the closure of the switch 100', is accompanied by the restoration of the same conditions as those depicted in Fig. 9; that is to say, before the shaft 92 finally comes to rest at the end of contact arc 105b, the cam 89a thereon will move valve 89 back to the position shown in Fig. 9, thereby admitting pressure fluid to the upper end of cylinder 39 and causing the piston 38 to move downwardly, for the return to operative position of the wrap-producing instrumentalities. It will be recalled that a movement of piston 83, earlier in the cycle, has already effected the contraction of core 3. Also, just before the shaft 92 comes to rest, the pairs of contacts 101 are bridged by the member 101a; in consequence, the coil 98 becomes energized to close switch 97, thereby restarting the main or reel-driving motor 53 and the pinch rolls 16, 17, since the main switch 99 has been left closed. Thus the entire apparatus is automatically restored to a condition of readiness for the reception of the next piece of stock emerging from the mill,—the contact of the first end of said next piece with trigger 74 procuring a repetition of the above-described automatic reeling operation.

I claim:

1. In the art of reeling strip or like metal stock, the improvement which consists in subjecting the advancing front end of each piece to the action of guiding and confining devices, arranged to produce a few turns or wraps of the stock around a rotating drum or core, causing the expansion of said drum or core into clutching engagement, internally, with said initial wraps or turns, and causing withdrawal from said initial turns or wraps of said guiding and confining devices, whereby the reeling thereafter of said piece is performed by said drum or core alone, functioning in effect as a "traction" reel.

2. In the art of reeling strip or like metal stock, the improvement which consists in causing each piece emerging from the mill, by engagement of its advancing front end with guiding and confining instrumentalities, to make a few turns or wraps around a rotating drum or core, then causing said drum or core to clutch internally with said initial wraps or turns, and thereupon relieving the piece of the influence of said guiding and confining instrumentalities, to permit the reeling thereafter of said piece to be performed by said drum or core alone, functioning in effect as a "traction" reel.

3. In the art of reeling strip or like metal stock, the improvement which consists in engaging the advancing front end of each piece with guiding and confining devices, so as to form a few turns or wraps of same around a rotating drum or core, then expanding said drum or core to clutch internally with said initial wraps or turns and simultaneously causing removal of said guiding and confining devices, whereby the reeling thereafter of said piece is performed by said drum or core alone, functioning in effect as a "traction" reel, and finally contracting said drum or core, to permit removal of the reeled-up piece therefrom.

4. In the operation of an "automatic" reel for strip or like material, the improvement which consists in so confining and directing the advancing first end of the moving material as to form a few wraps of same around a rotating core, and then expanding said rotating core into internal gripping engagement with said initial wraps, whereby for the subsequent reeling-up of each piece of material said core functions as a "traction" reel.

5. In the reeling of strip or like material as it emerges at high speed from a rolling mill, the improvement which consists in projecting the advancing first end of the material into the annular space between a rotating drum and a surrounding wrap-producing structure, expanding said drum, after the collection in said space of a few initial wraps of the material, into gripping engagement therewith, and thereupon shifting said wrap-producing structure into inoperative position, whereby the subsequent reeling-up of the material is obtained in the absence of any contact with guiding or confining elements.

6. The herein described method of reeling strip or like metal stock, which consists in collecting the advancing first end of the stock in a few coils or wraps between confining means disposed both internally and externally of such coil, and then causing the internal means to clutch with the inner surface of the coil, at the same time withdrawing from contact with the stock the external means.

7. An "automatic" reel for strip or like metal stock, comprising internal and external elements, means for contracting and expanding the internal element, said two elements when the internal element is contracted defining an annular space into which is projected the advancing first end of the moving stock, and characterized by the fact that, upon the accumulation in said space of a few wraps or turns of said stock in surrounding relation to the internal element, said means is operated to expand said internal element, thereby to clutch same internally with said initial wraps or turns for operation thereafter as a "traction" reel, on the remainder of the length of said piece of stock.

8. In "automatic" reeling apparatus of the class described, a rotating inner member, means for procuring its expansion and contraction, means surrounding said inner member and cooperating with same when contracted to guide thereon a few wraps or turns of the advancing first end of the material to be reeled, and means operative upon said inner member's expansion into clutching engagement internally with said initial wraps or turns for shifting said surrounding means to a position out of contact with said material,

thereby to obtain subsequent reeling-up of said material by said inner member alone, functioning in effect as a "traction" reel.

9. In "automatic" reeling apparatus of the class described, a rotating inner member, means surrounding said inner member and cooperating therewith to form thereon a few wraps or turns of the advancing first end of the material to be reeled, means for expanding said inner member into clutching engagement internally with said initial wraps or turns, and for procuring substantially simultaneously with such expansion the movement of said surrounding means to a position out of contact with said material.

10. In "automatic" reeling apparatus of the class described, a rotating inner member, means surrounding said inner member and cooperating therewith to form thereon a few wraps or turns of the advancing first end of the material to be reeled, means for expanding said inner member into clutch engagement internally with said initial wraps or turns, and for procuring substantially simultaneously with such expansion the movement of said surrounding means to a position out of contact with said material, and means for subsequently contracting said inner member, to permit removal therefrom of the material reeled thereon.

11. In an "automatic" reel, a positively driven expansible core, a plurality of guide rolls arranged around said core, means responsive to the rotation of said core for driving said rolls at approximately the surface speed of the material being reeled, and means operating in timed relation to the expansion of said core for rendering said rolls inoperative as guiding and confining means for the material being reeled.

12. In an "automatic" reel, a positively driven expansible core, a plurality of guide rolls arranged around said core, a ring coaxial with the core and engaging said rolls for procuring the rotation of said rolls at surface speeds approximately the same as the surface speed of the core and means operable after the expansion of said core into internal clutching engagement with the material being reeled for shifting said rolls into inoperative position relative to said material.

13. In an "automatic" reel, a positively driven expansible core, a plurality of guide rolls arranged around said core, means for supporting said rolls a predetermined distance away from the periphery of the core when said rolls are in operative position to provide a space between said core and the rolls to receive the front end of the material being reeled, means for expanding said core into internal clutching engagement with such front end of the material, and means for thereupon disposing said rolls in inoperative position.

14. In a reel for strip or like material, a rotating drum, means surrounding and cooperating with said drum for causing the advancing front end of the material to wrap itself about said drum, means for effecting a clutching engagement of said drum with the interior of such initially-received wraps of material, and means for shifting said surrounding means to an inoperative position when the material is so clutched by said drum.

15. In reeling apparatus of the class described, a rotary inner member, means surrounding and cooperating with said inner member to cause the advancing first end of the moving material to form a plurality of wraps around said member, and means for expanding said inner member and said surrounding means substantially simultaneously, the former thereby clutching internally with said initially-formed wraps, and the latter thereby withdrawing from contact with said moving material.

16. In reeling apparatus of the class described, a rotary expansible inner member, wrap-producing devices arranged around said inner member and movable into and out of operative position, and control means, responsive to wrapping of a predetermined length of the advancing first end of the material around said inner member, for procuring clutching engagement of said inner member with said initial wraps and the movement of said wrap-producing devices to inoperative position.

17. In reeling apparatus of the class described, a rotary expansible inner member, wrap-producing devices arranged around said inner member and movable into and out of operative position, means, responsive to wrapping of a predetermined length of the advancing first end of the material around said inner member, for procuring clutching engagement of said inner member with said initial wraps and the movement of said wrap-producing devices to inoperative position, and means responsive to arrival of the material's last end at the reeling apparatus for stopping rotation of the inner member and for releasing its clutching engagement with said initial wraps.

18. In reeling apparatus of the class described, a rotary expansible inner member, wrap-producing devices arranged around said inner member and movable into and out of operative position, a stripper operable for the discharge of reeled-up material from said apparatus, and control means associated with said inner member, said wrap-producing devices and said stripper for effecting, in response to initial wraps around said inner member of the material's advancing first end, the clutching of said inner member with said initial wraps and the movement of said wrap-producing devices to inoperative position, and for effecting, in response to arrival of the material's tail end at the reeling apparatus, the cessation of said inner member's rotation, the release of said inner member's clutching engagement with said material, and the operation of said stripper.

19. In reeling apparatus of the class described, a rotary expansible inner member, wrap-producing devices arranged around said inner member and movable into and out of operative position, a stripper operable for the discharge of reeled-up material from said apparatus, control means associated with said inner member, said wrap-producing devices and said stripper for effecting, in response to initial wraps around said inner member of the material's advancing first end, the clutching of said inner member with said initial wraps and the movement of said wrap-producing devices to inoperative position, and for effecting, in response to arrival of the material's tail end at the reeling apparatus, the cessation of said inner member's rotation, the release of said inner member's clutching engagement with said material, and the operation of said stripper, and means brought into action by return movement of said stripper for restoring said wrap-producing devices to operative position and for restarting the rotation of said inner member.

20. In an "automatic" reel, a rotary inner member adapted to be contracted and expanded, a surrounding wrap-producing means comprising a plurality of rolls, means for rotating said rolls, and for spacing their surfaces a predetermined

distance from the contracted periphery of said inner member to establish an annular space for the reception and confinement of a few turns or wraps made by the advancing first end of the material being reeled, and means operating in timed relation to the accumulation in said space of such few turns or wraps for expanding said inner member into internal clutching engagement therewith.

21. In an "automatic" reel, a rotary inner member adapted to be contracted and expanded, a surrounding wrap-producing means comprising a plurality of rolls, means comprising a rotary element concentric with said inner member for frictionally driving said rolls, said element having a diameter greater than that of said inner member in its contracted condition, whereby to establish an annular space between said inner contracted member and said wrap-producing means for the reception of the advancing first end of the material being reeled and means operating in timed relation to the accumulation in said space of a few turns or wraps of said material for expanding said inner member into internal clutching engagement therewith.

22. In an "automatic" reel, an inner member rotating at a surface speed substantially the same as the stock delivery speed, a pair of pinch rolls feeding the stock to said member and driven therefrom, means permitting the pinch rolls to overrun their drive when the stock speed increases, and braking means adapted to hold the stock taut after the tail end of a piece of same has passed beyond the mill.

23. In an "automatic" reel, a rotary inner member, means for contracting and expanding said member, devices operative at the start of a reeling operation, when the inner member is contracted, to direct and confine around the latter a few wraps or turns of the moving stock, and means for procuring, in timed relation to the operation of said means to expand said inner member into clutching engagement with said initial wraps, the removal of said directing and confining devices from contact with the stock.

24. In an "automatic" reel, a rotary inner member, means for contracting and expanding said member, a set of devices cooperating with said member at the start of a reeling operation when said member is contracted, to provide a surrounding restricted annular space to receive and guide the advancing first end of the stock, a second set of devices providing a stock passage substantially tangential to said annular space, and means for procuring, in timed relation to the operation of said means to expand said inner member into clutching engagement with the first few wraps or turns of stock confined in said annular space, the movement of both sets of said devices into positions out of contact with the stock thereafter reeled up on said inner member by the latter's rotation.

25. In a reel of the class described, a rotary inner member subject to expansion and contraction, wrap-producing means adapted to cooperate with said member in its contracted condition, and means operable in delayed response to the arrival at said reel of the advancing first end of the stock to be reeled, for clutching said rotary inner member with stock directed around same by said wrap-producing means and for thereupon shifting said wrap-producing means to a position where it is uncontacted by the piece of stock during the subsequent reeling-up of same on said rotary inner member.

26. In a reel of the class described, a rotary inner member subject to expansion and contraction, wrap-producing means adapted to cooperate with said member in its contracted condition, means operable in delayed response to the arrival at said reel of the advancing first end of the stock to be reeled, for clutching said rotary inner member with stock directed around same by said wrap-producing means and for thereupon shifting said wrap-producing means to a position where it is uncontacted by the piece of stock during the subsequent reeling-up of same on said rotary inner member, and means operable in response to arrival at said reel of the last end of said piece of stock for stopping the rotation of said inner member.

27. In a reel of the class described, a rotary inner member subject to expansion and contraction, wrap-producing means adapted to cooperate with said member in its contracted condition, means operable in delayed response to the arrival at said reel of the advancing first end of the stock to be reeled, for clutching said rotary inner member with stock directed around same by said wrap-producing means and for thereupon shifting said wrap-producing means to a position where it is uncontacted by the piece of stock during the subsequent reeling-up of same on said rotary inner member, means operable in response to arrival at said reel of the last end of said piece of stock for stopping the rotation of said inner member and for procuring its contraction, to release the bundle of reeled-up stock thereon, a stripper operable to discharge said bundle from said inner member, and means responsive to operation of said stripper for re-starting rotation of said inner member and for returning said wrap-producing means to stock-contacting position.

28. The method of reeling strip or like metal stock, which consists in so confining and guiding the advancing front end of each piece as to accumulate a few wraps of same around a rotating drum or core, and thereupon expanding such drum or core into internal clutching engagement with said initial wraps and withdrawing the guiding and confining devices, to permit operation of said drum or core as a "traction" reel on the remainder of the length of said piece.

29. In apparatus for reeling strip or like material, the combination with feeding means for the stock, of concentrically arranged internal and external devices cooperating to form wraps or turns of the advancing first end of the stock, means for expanding said internal device into clutching engagement with said initial wraps or turns, and means for thereupon rendering said external device inoperative on the remainder of the length of said piece.

30. In apparatus for reeling strip or like material, the combination with feeding means for the stock, of a pair of devices arranged for contact, respectively, with the opposite surfaces of the advancing first end of the stock to form said end into a few wraps or turns surrounding one of said devices, and means for expanding the so-surrounded device into clutching engagement with said initial wraps or turns.

31. In apparatus for reeling strip or the like material, the combination with feeding means for the stock, of a pair of devices arranged for contact, respectively, with the opposite surfaces of the advancing first end of the stock to form said end into a few wraps or turns surrounding one of said devices, means for expanding the so-surrounded device into clutching engagement

with said initial wraps or turns and for thereupon removing the other device to a position out of contact with the stock.

32. In apparatus for reeling strip or like material, the combination with feeding means for the stock, of a rotating core, means cooperating with said rotating core at the commencement of the reeling operation to form a few core-surrounding wraps or turns of the advancing front end of the stock, and means for thereupon expanding said rotating core into internal clutching engagement with said initial wraps or turns.

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