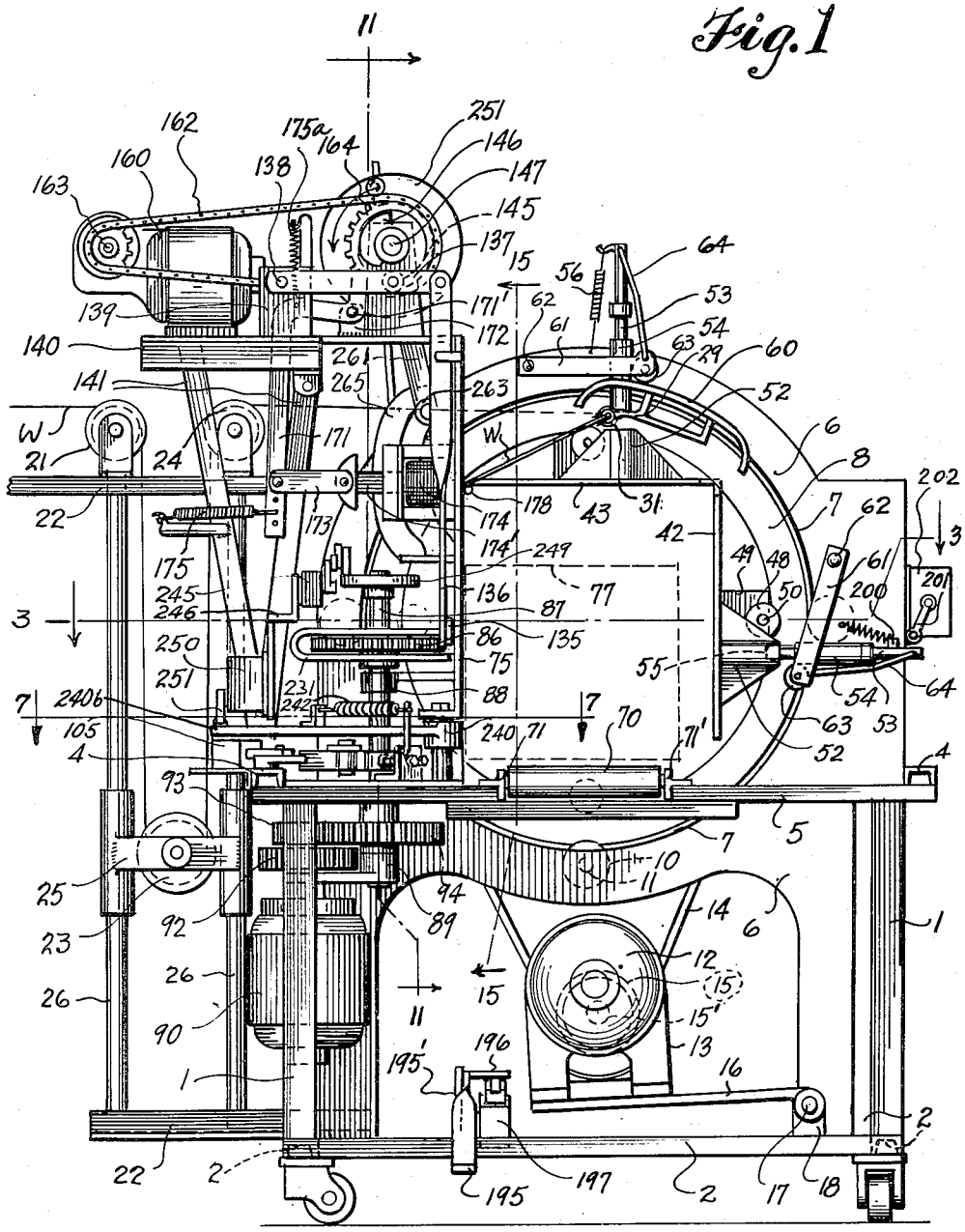
Aug. 26, 1952 A. E. CRANSTON, SR 2,608,150

WIRE BINDING MACHINE

Filed Nov. 30, 1946 14 Sheets-Sheet 1

Fig. 1



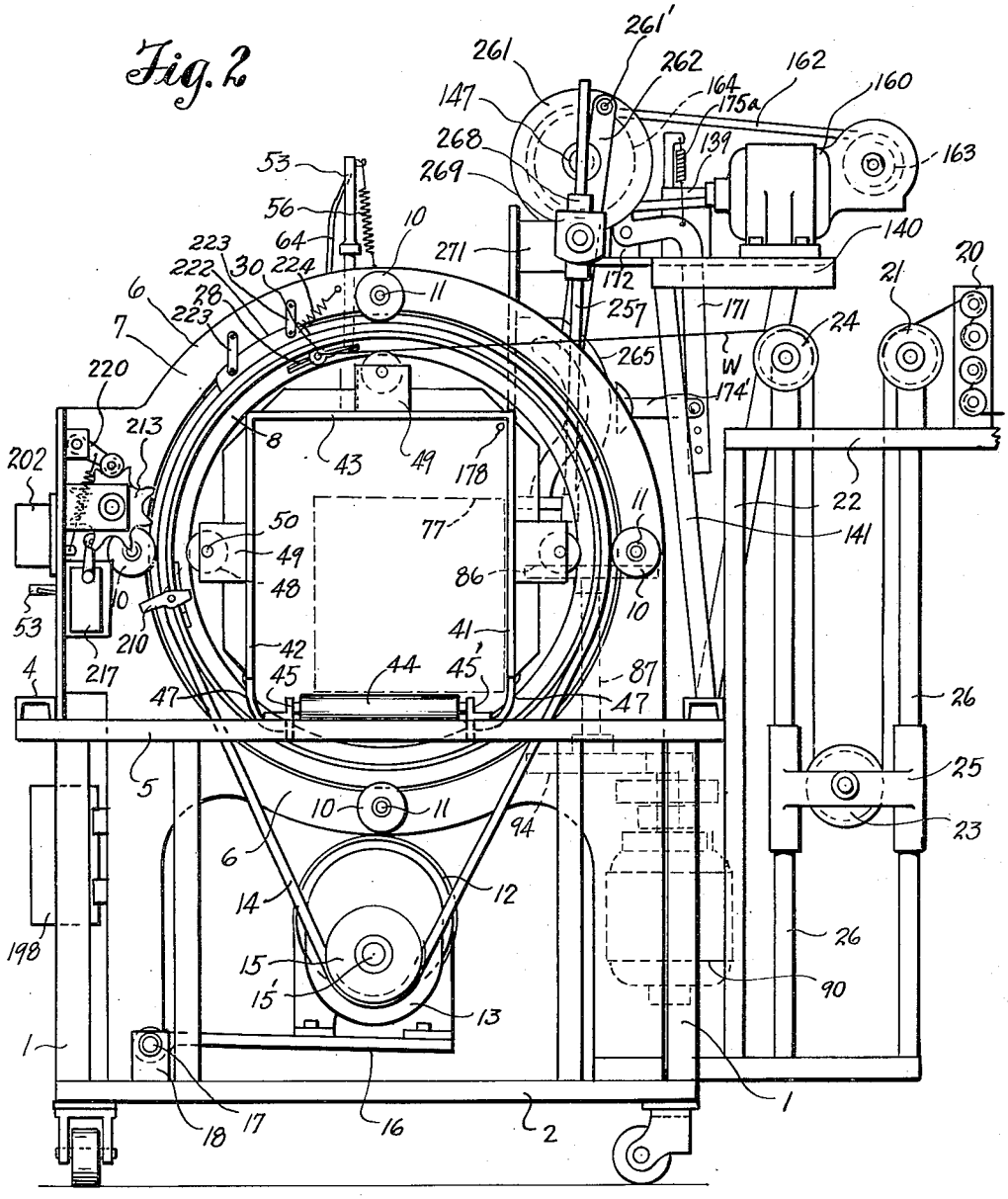
INVENTOR.
ALBERT E. CRANSTON, SR.
BY
Cook & Robinson
ATTORNEYS

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WIRE BINDING MACHINE

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Fig. 2.



INVENTOR.
ALBERT E. CRANSTON, SR.
BY
Cook & Robinson
ATTORNEYS

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WIRE BINDING MACHINE

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Fig. 3

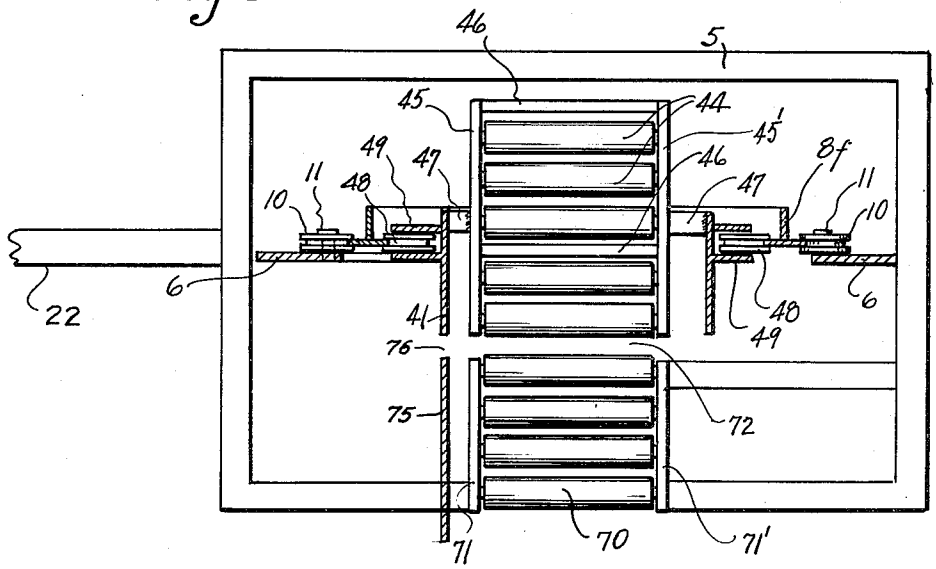


Fig. 4

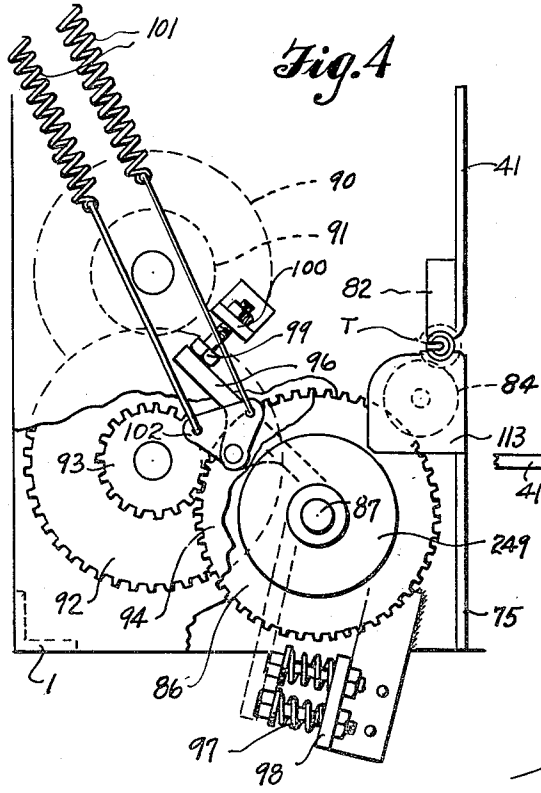


Fig. 5

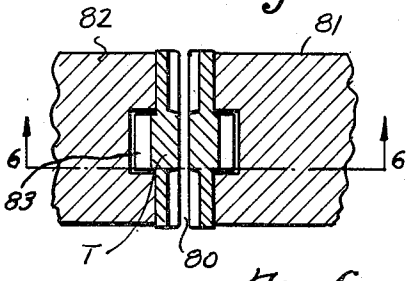
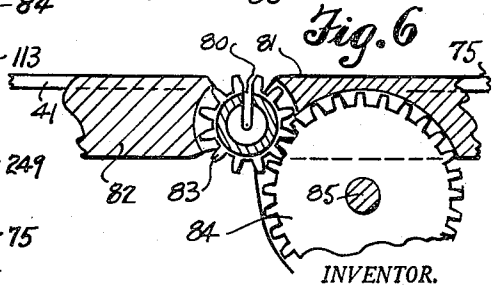


Fig. 6



INVENTOR.
ALBERT E. CRANSTON, SR.
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Cook & Robinson
ATTORNEYS

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Fig. 7

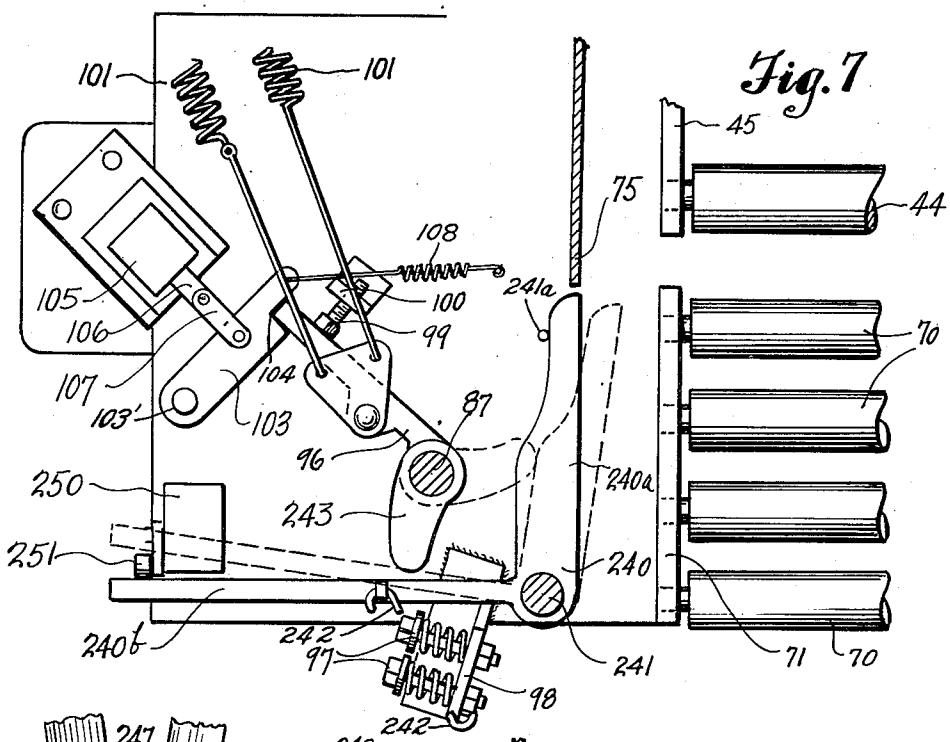
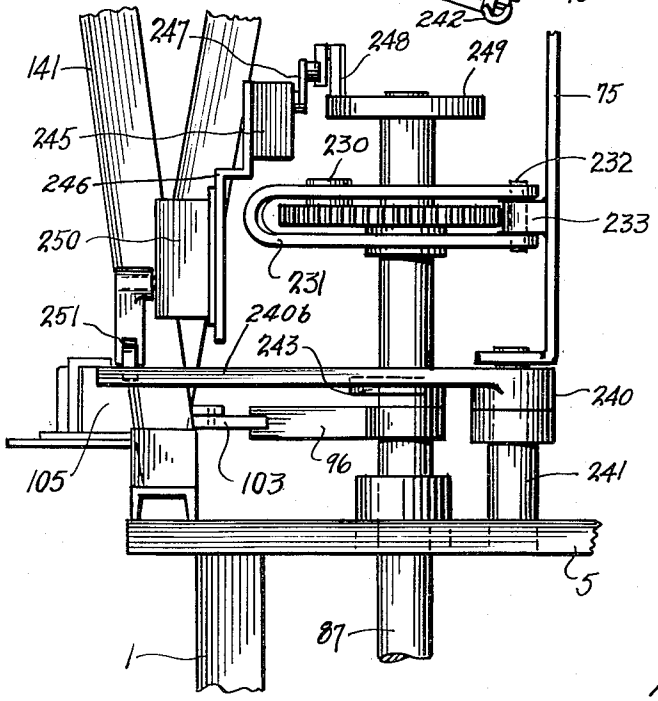


Fig. 8



INVENTOR.
ALBERT E. CRANSTON, SR.
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Cook & Robinson
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WIRE BINDING MACHINE

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Fig. 9a

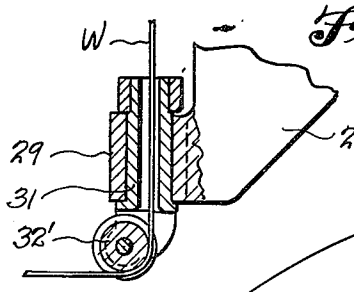
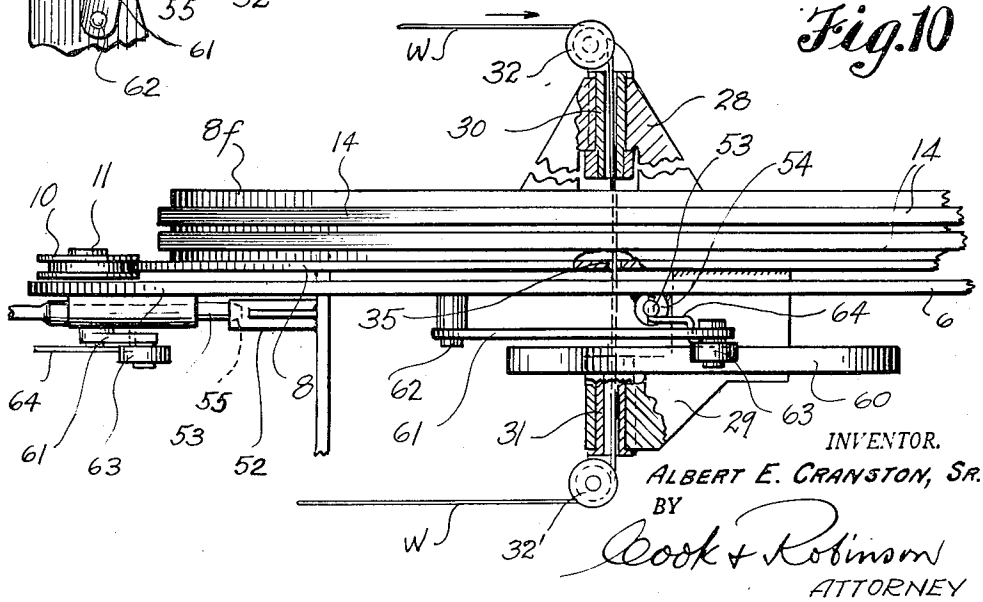


Fig. 9

Fig. 10



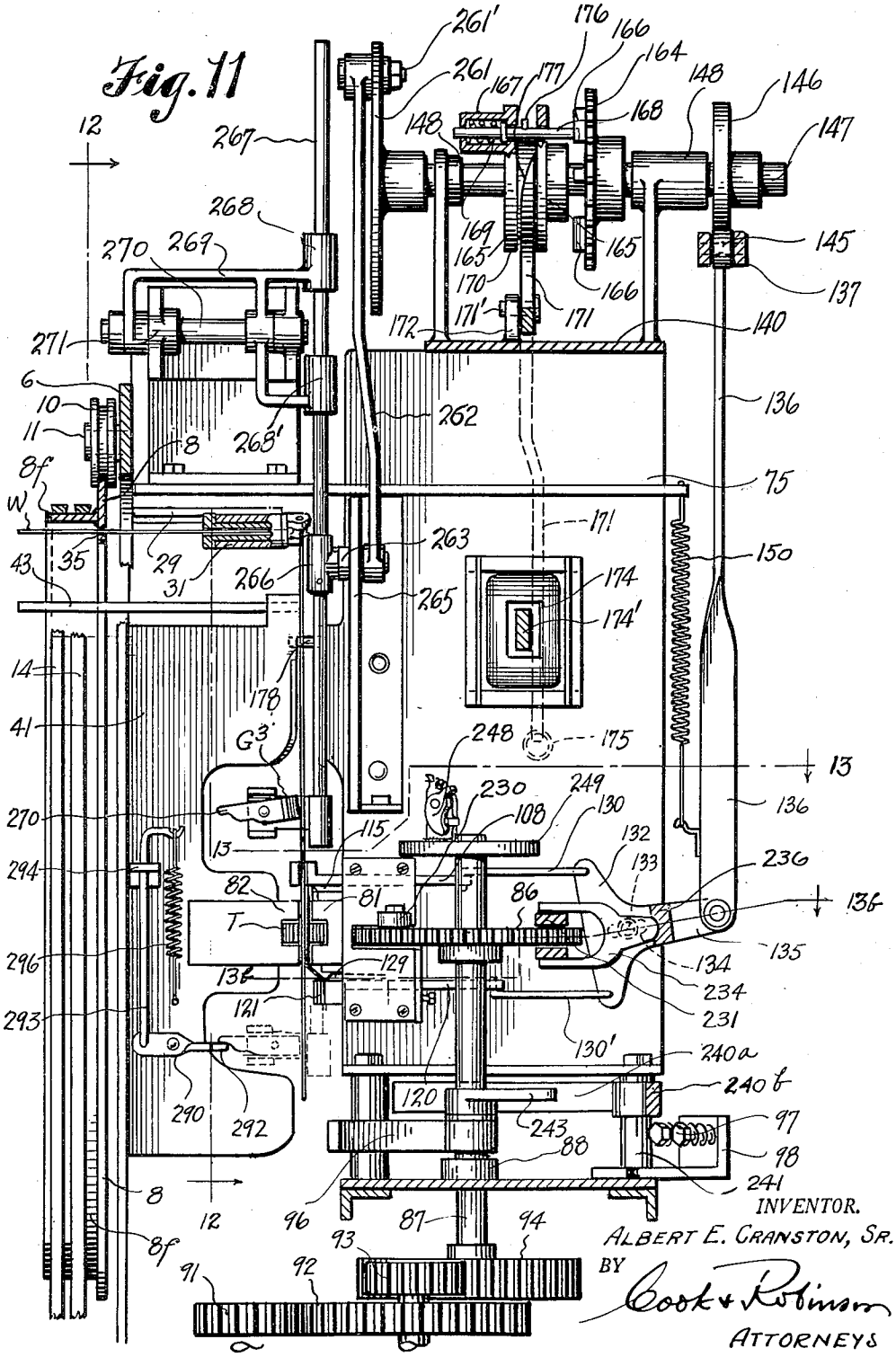
INVENTOR.
ALBERT E. CRANSTON, SR.
BY
Cook & Robinson
ATTORNEY

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WIRE BINDING MACHINE

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Fig. 11



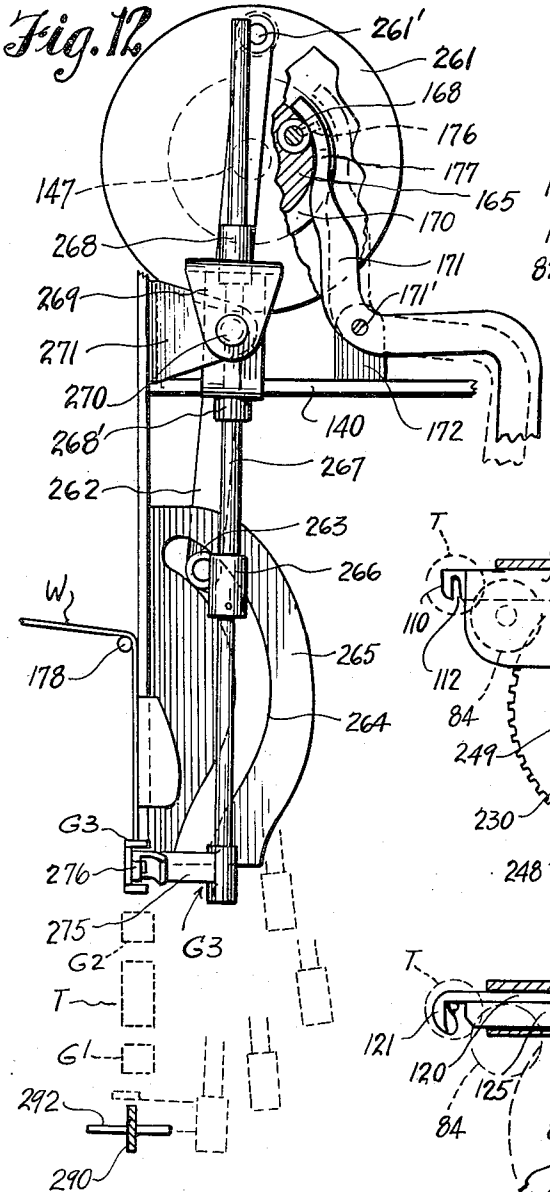
INVENTOR.
ALBERT E. CRANSTON, SR.
BY Cook & Robinson
ATTORNEYS

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WIRE BINDING MACHINE

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Fig. 12



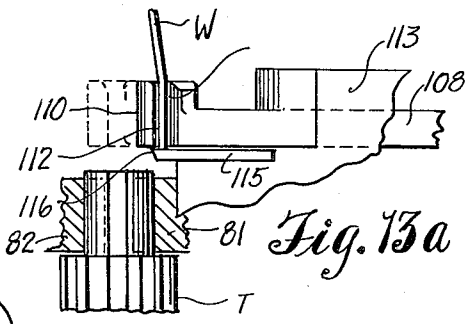


Fig. 13a

Fig. 13

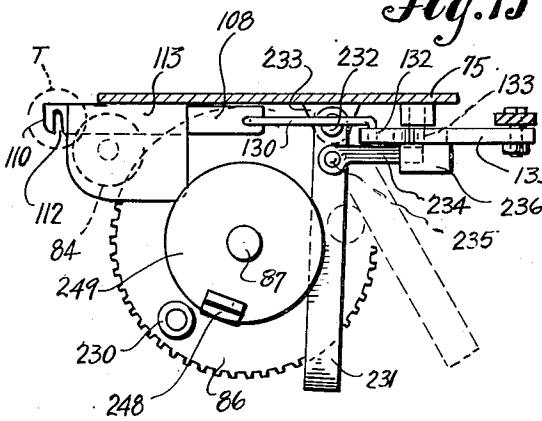
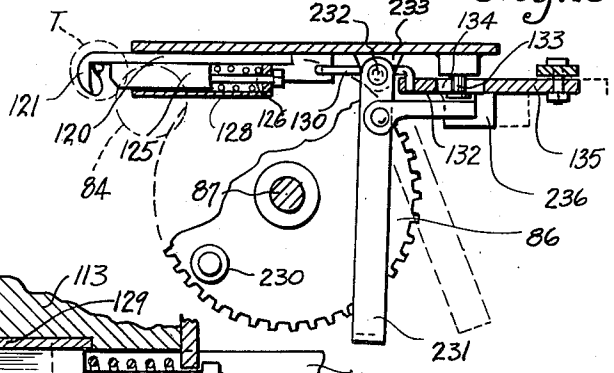


Fig. 13b



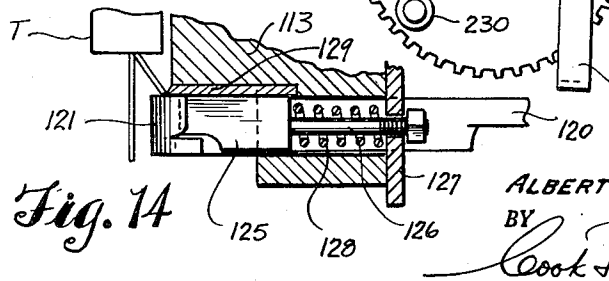


Fig. 14

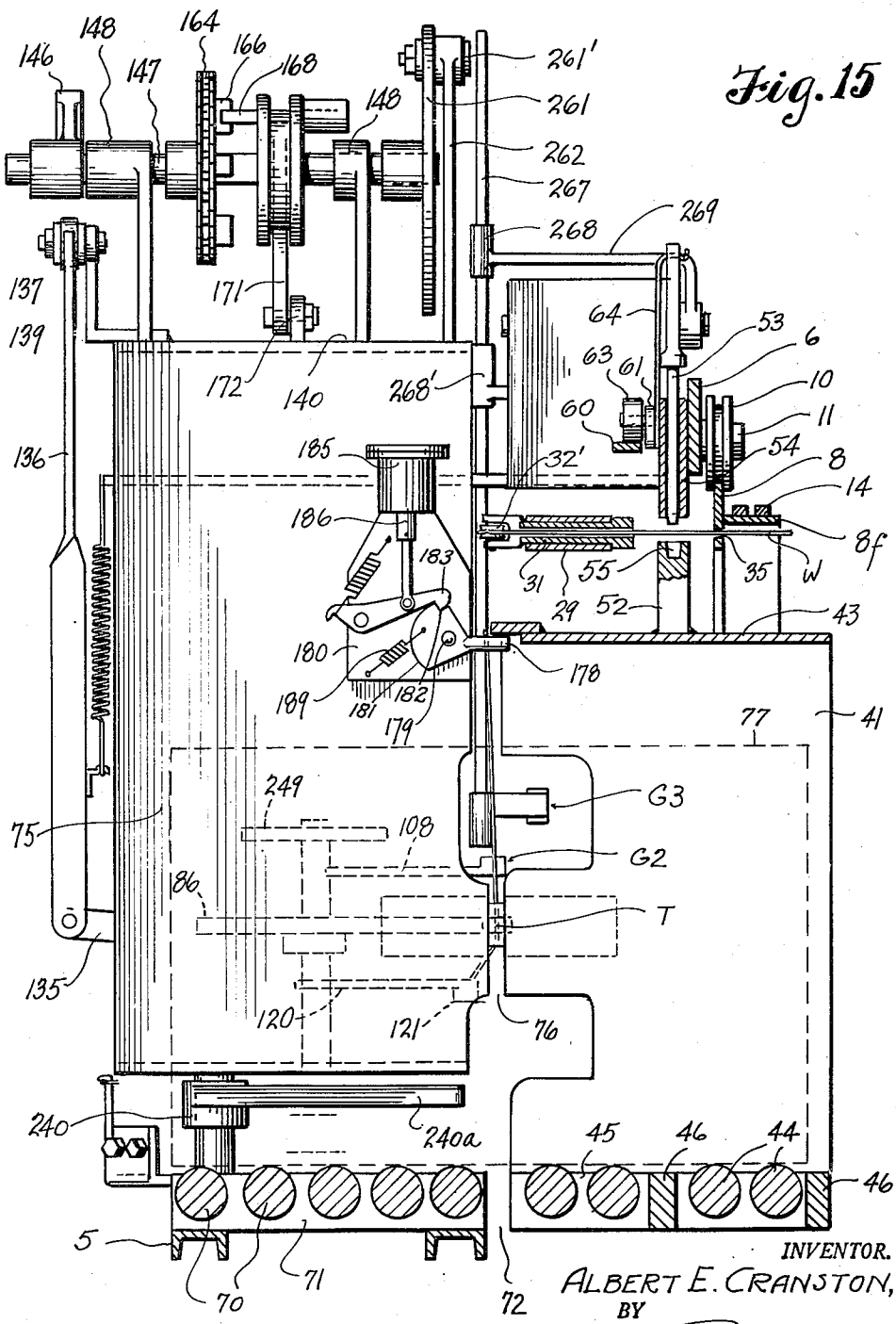
INVENTOR.
ALBERT E. CRANSTON, SR.
BY
Cook & Robinson
ATTORNEYS

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Fig. 15



INVENTOR.
ALBERT E. CRANSTON, SR.
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WIRE BINDING MACHINE

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Fig. 16

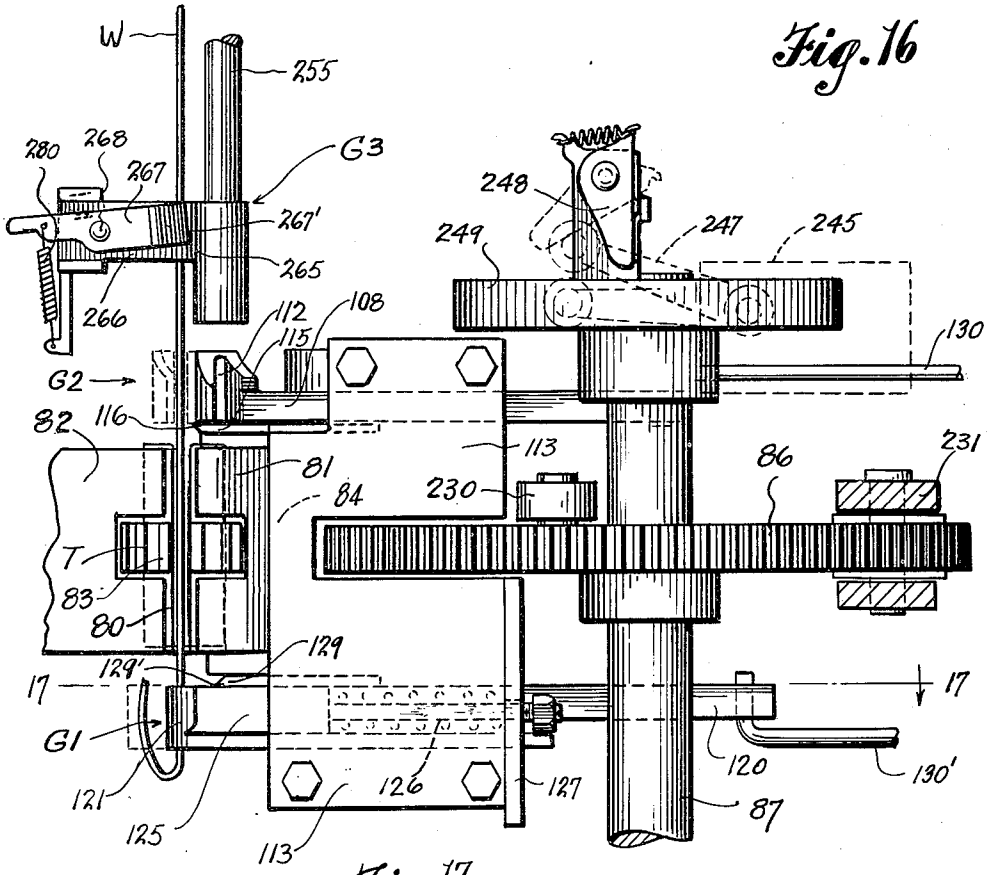


Fig. 17

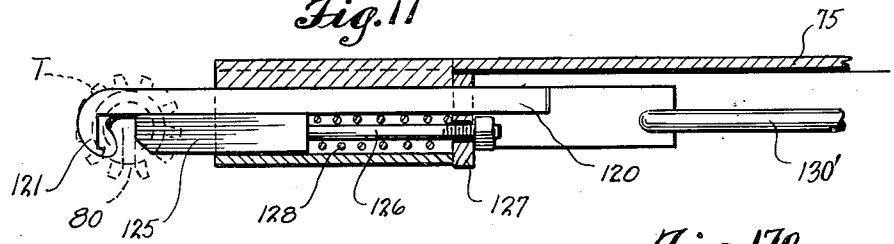
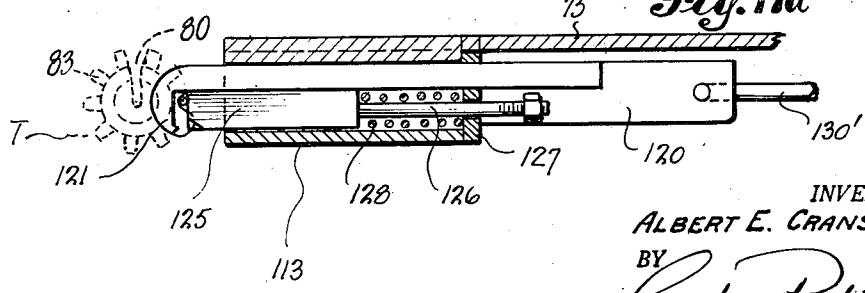


Fig. 17a



INVENTOR.
ALBERT E. CRANSTON, SR.
BY
Cooke & Robinson
ATTORNEYS

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WIRE BINDING MACHINE

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Fig. 18

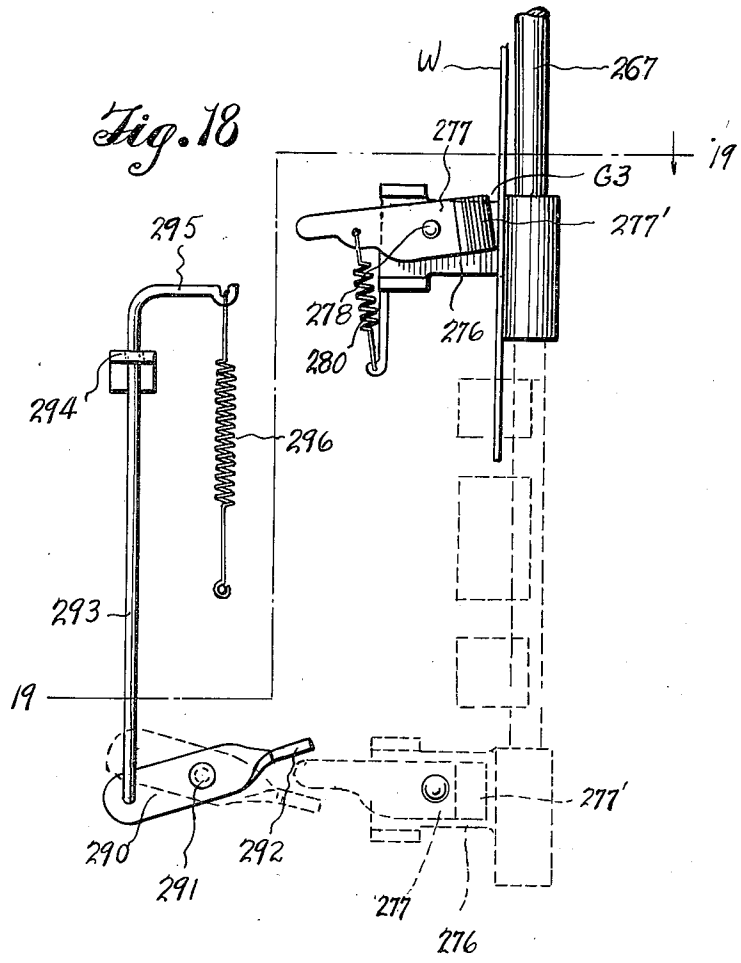
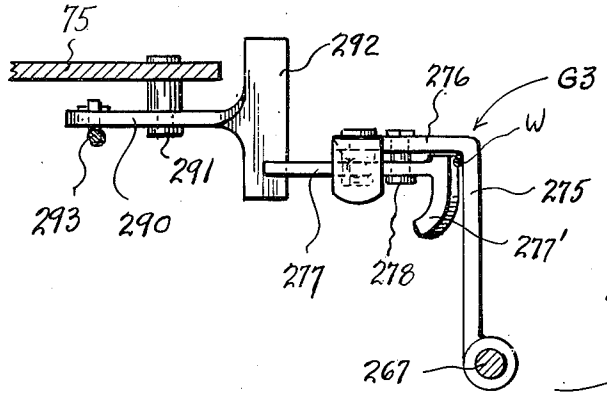


Fig. 19



INVENTOR.
ALBERT E. CRANSTON, SR.
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Cook & Robinson
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WIRE BINDING MACHINE

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Fig. 20

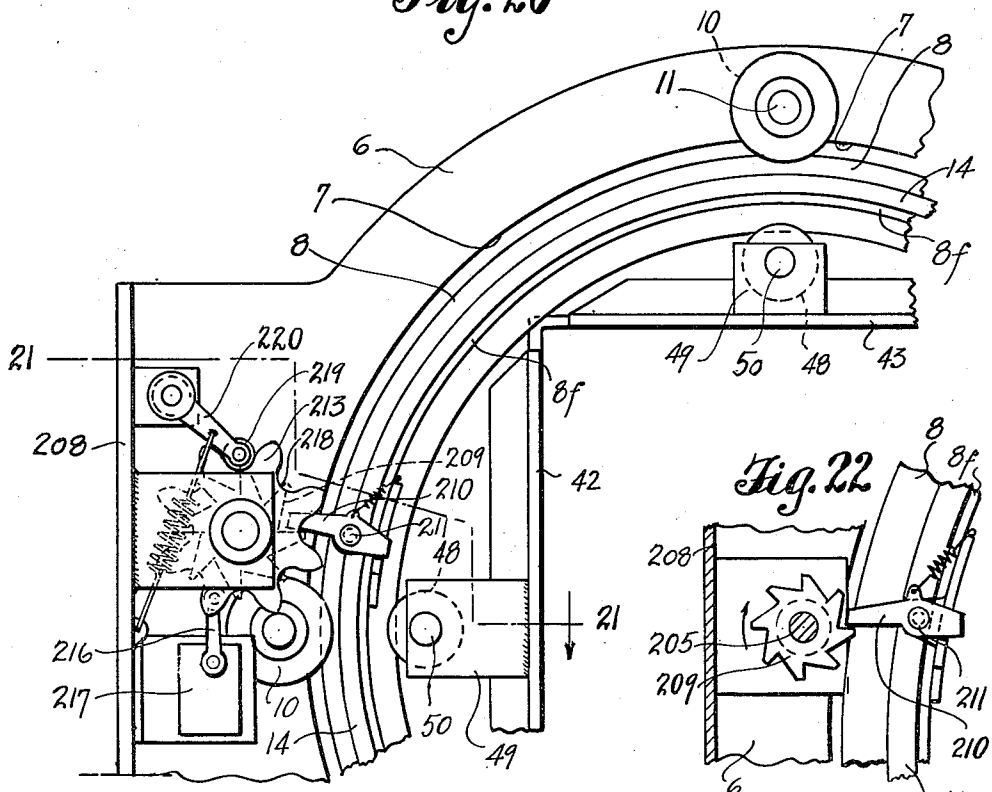
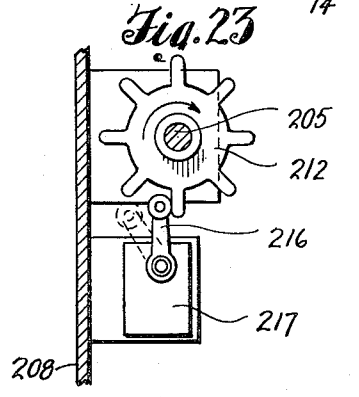


Fig. 22

Fig. 23



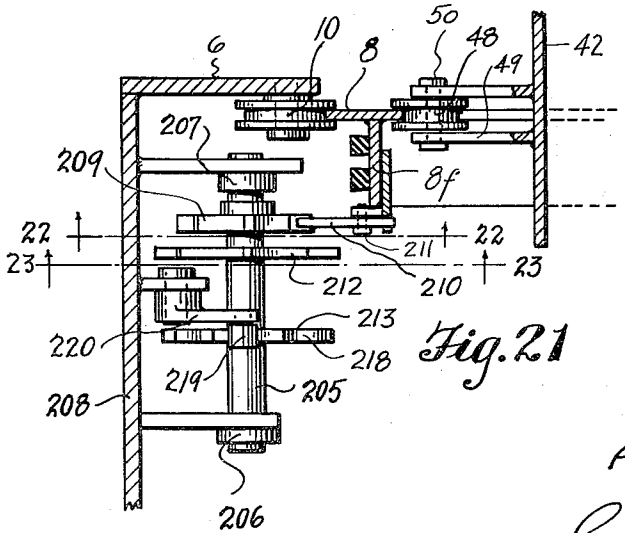


Fig. 21

INVENTOR.
ALBERT E. CRANSTON, SR.
BY
Cook & Robinson
ATTORNEYS

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WIRE BINDING MACHINE

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Fig. 24

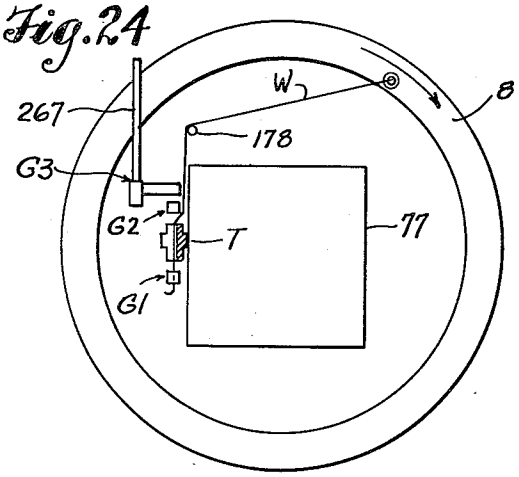


Fig. 25

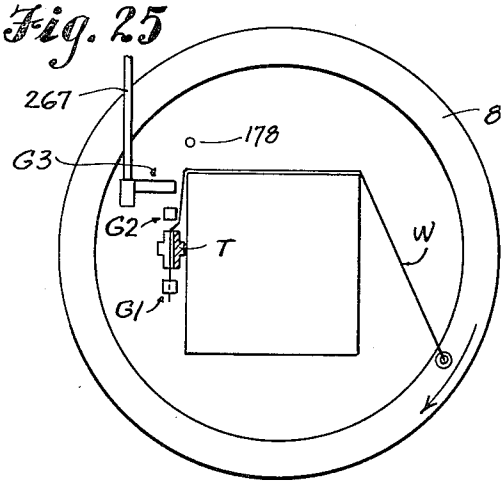


Fig. 26

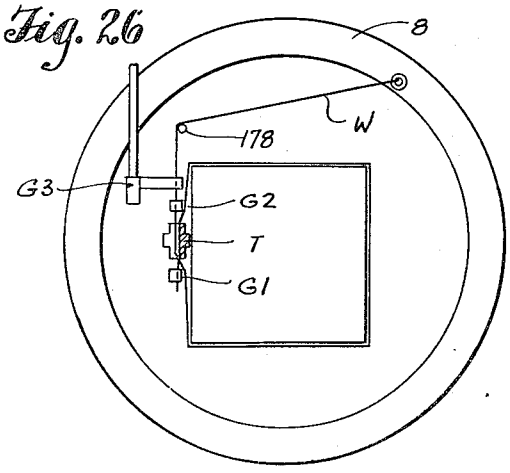


Fig. 27

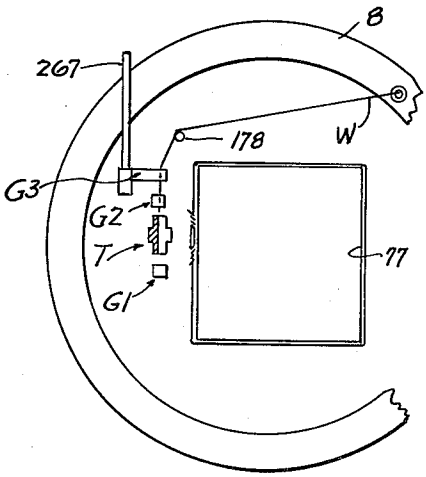
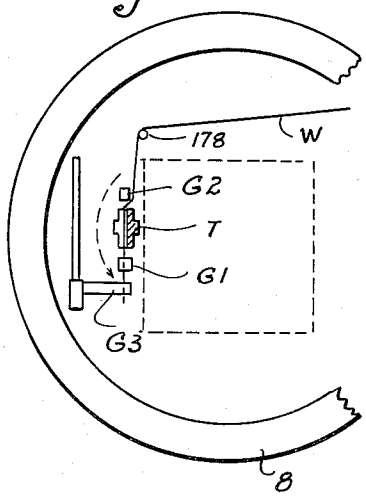


Fig. 28



INVENTOR.
ALBERT E. CRANSTON, SR.
BY
Cook & Robinson
ATTORNEYS

Aug. 26, 1952 A. E. CRANSTON, SR 2,608,150

WIRE BINDING MACHINE

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Fig. 29

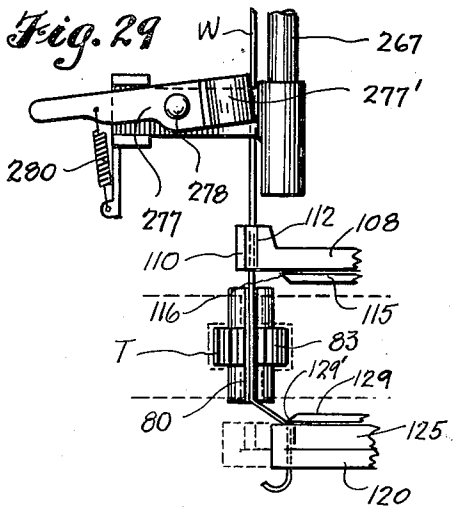


Fig. 31

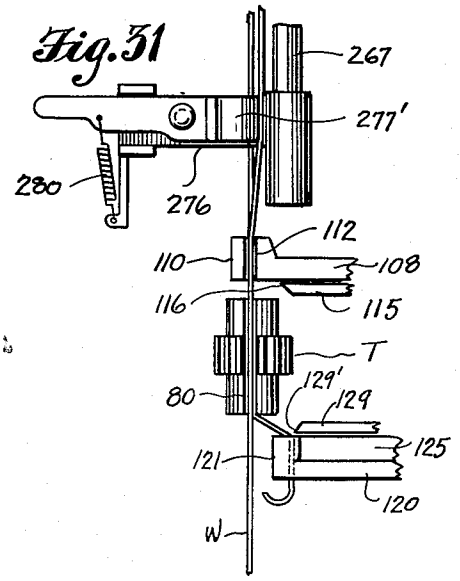


Fig. 30

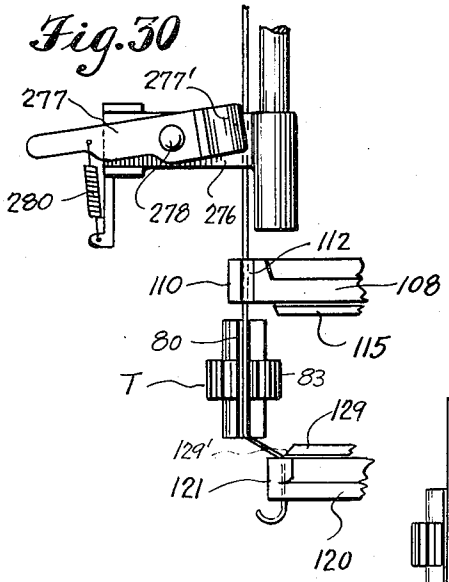


Fig. 32

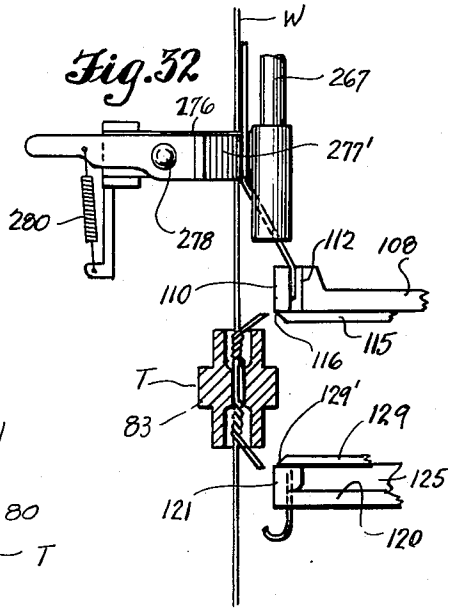
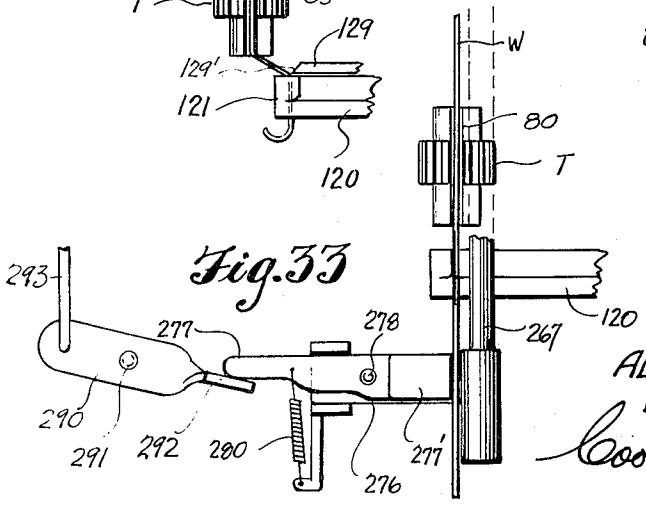


Fig. 33



INVENTOR.
ALBERT E. CRANSTON, Sr.
BY
Cook & Robinson
ATTORNEYS

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WIRE BINDING MACHINE

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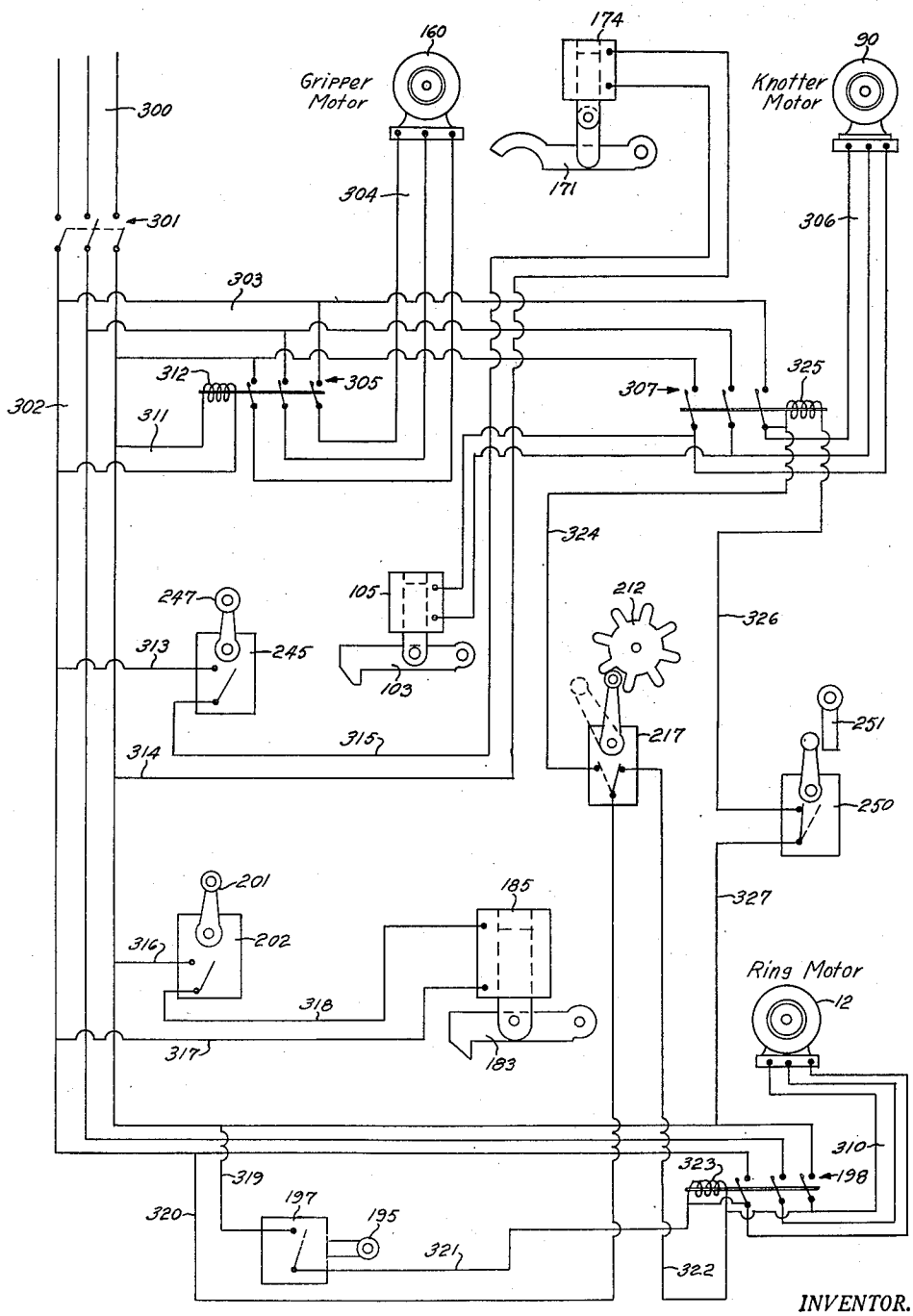


FIG. 34.

INVENTOR.
ALBERT E. CRANSTON SR

BY Cook and Schermerhorn
ATTORNEYS

Patented Aug. 26, 1952 2,608,150

UNITED STATES PATENT OFFICE

2,608,150

WIRE BINDING MACHINE

Albert E. Cranston, Sr., Oak Grove, Oreg.

Application November 30, 1946, Serial No. 713,224

27 Claims. (Cl. 100—27)

1

This invention relates to bundle, box and package binding machines, and it has reference more particularly to machines of that kind characterized by a wire reeving carrier, or ring, that is caused to revolve about a bundle and to thereby draw a wire strand from a source of wire supply and to lay it, under tension, about the bundle and to bring primary and secondary end portions of the band into overlapped relationship; the overlapped ends then being joined in a twisted knot and the wire strand cut adjacent the knot to free the bound bundle for removal from the machine.

It is the principal object of the present invention to provide an improved machine of the character above stated, wherein the wire laying ring, or carrier, rotates in the same direction for each successive binding operation, and with each cycle of operations, trains the wire strand, while held at its primary end in a stationary gripper, tightly about the package or bundle, and in doing this, lays both the primary and secondary end portions of the band in a slotted gear which, at the end of the band laying operation, is rotated to twist the band ends together in a flat knot, then the strand is cut adjacent the knot to free the bound bundle for removal from the machine, and finally, as a principal feature of this invention, the end of the strand, as then extended from the supply, is mechanically applied within the stationary gripper and the various associated parts reset in readiness for the next binding operation.

It is also an object of this invention to provide a wire binding machine of the character above stated wherein various devices thereof operate automatically, after an initial starting operation, to complete the wire band laying operation, the joining of the band ends, and the proper cutting of the strand to release the bound bundle for removal from the machine and wherein, after removal of the bound package, other parts are set in motion to apply that cut end of the strand, which with the cutting of the strand becomes the primary end, to the stationary gripper in readiness for the next binding operation.

Another object of the invention is to provide a bundle kicker for insuring the release of the band from the twister gear slot upon completion of the binding operation.

Another object of this invention is to provide gripper and cutter members of novel kind that coact for cutting the ends of the wire at both sides of the knot so as to leave no extended ends to cause injury. Furthermore, to provide a one-way, rotary carrier for laying, or training the

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binding strand about the bundles, and novel means for re-applying the end of the wire strand to the primary gripper without shifting the gripper.

It is also an object of the invention to provide a machine of the character above stated for accomplishing the above-stated objects which, by reason of the manner of applying the binding wire or strand under tension, eliminates the usual requirement of a clamping means for holding the bundle properly in place while the strand of wire is being trained thereabout.

Still further objects of the invention reside in the details of construction of the various parts of the machine, in their operative combinations and in the sequence of performing their various operations, as will hereinafter be fully described.

In accomplishing the above mentioned and other objects of the invention, I have provided the improved details of construction, the preferred forms of which are illustrated in the accompanying drawings, wherein—

Fig. 1 is an elevation of the present machine, showing that side into which bundles are delivered for binding and at which the operator normally would stand in feeding and controlling the machine.

Fig. 2 is an elevation of the machine as seen from the bundle discharge side.

Fig. 3 is a horizontal section of the machine, taken substantially on line 3—3 in Fig. 1.

Fig. 4 is an enlarged plan view of the gearing for rotating the knot twister gear and by which various other mechanisms are controlled and actuated.

Fig. 5 is an enlarged, longitudinal section of the twister gear, and its supporting bearings.

Fig. 6 is a horizontal section of the twister gear taken on the line 6—6 in Fig. 5.

Fig. 7 is a plan view, substantially on line 7—7 in Fig. 1, of the bundle kick-out mechanism, and the latch device for the twister gear drive shaft.

Fig. 8 is an elevation of the parts shown in Fig. 7, as seen from the feeding side of the machine.

Fig. 9 is an enlarged elevation of a part of the band laying ring and bundle guide frame, showing also the wire reeving guide, the cam runner, as fixed to the ring, and the guide frame locking bolts that are actuated by the cam runner.

Fig. 9a is an enlarged, axial section of one of the tubualr strand reeving guides as carried on the band laying ring.

Fig. 10 is a top view of the parts shown in Fig. 9, some being in section for better understanding.

Fig. 11 is a view taken on line 11—11 in Fig. 1,

showing, in elevation, the relationship of the wire grippers and their actuating means; the devices for re-applying the end of the wire strand to the primary gripper after each binding operation, and the gearing for driving these parts.

Fig. 12 is an elevation of the mechanisms for re-applying the end of the wire strand to the primary gripper, taken on the line 12—12 in Fig. 11.

Fig. 13 is a horizontal section taken on line 13—13 in Fig. 11.

Fig. 13*a* is an elevation of a part of the secondary, or upper gripper.

Fig. 13*b* is a horizontal section taken on line 13*b*—13*b* in Fig. 11.

Fig. 14 is an elevation of a part of the primary or lower gripper.

Fig. 15 is an enlarged section taken on line 15—15 in Fig. 1.

Fig. 16 is an enlarged elevation of the gripper mechanism and twister gear as seen from the left-hand side in Fig. 1.

Fig. 17 is a horizontal section on line 17—17 in Fig. 16, showing the gripper jaws open.

Fig. 17*a* is a similar view showing the gripper as shifted out of alinement with the twister gear and the jaws closed.

Fig. 18 is an elevation of the strand replacing gripper and its releasing latch.

Fig. 19 is a section on line 19—19 in Fig. 18.

Fig. 20 is an elevation of the ring stopping switch and its operating means.

Fig. 21 is a horizontal section on line 21—21 in Fig. 20.

Fig. 22 is a section on line 22—22 in Fig. 21.

Fig. 23 is a section on line 23—23 in Fig. 21.

Figs. 24 to 28 are views diagramatically illustrating successive steps in the wire band training and knotting operations.

Figs 29 to 33 are views diagrammatically showing gripper movements during the wire cutting and replacing operations.

Fig. 34 is a wiring diagram for the electrical equipment in the machine.

Referring more in detail to the drawings—

The various driving motors, electrical devices, switches and other operating parts of the present machine are mounted in or upon an open base frame structure that, as seen best in Figs. 1, 2 and 3, is of rectangular, table-like form and comprises vertical corner posts or beams 1 that are rigidly and solidly joined at their lower ends, across the ends and sides of the frame, by bars 2, and at their upper ends, are joined across the ends of the frame by bars 4 and are joined lengthwise of the frame by bars 5.

Erected within the base frame, is a yoke, or arch frame designated generally by reference character 6. This comprises a strong flat plate that is fixed vertically and rigidly in a plane lengthwise of the base frame. The upper end portion of the plate extends substantially above the base frame and is formed with a circular opening 7 of substantial diameter, adjacent which the wire strand laying ring 8 is supported. The ring 8, which has an outside diameter just slightly less than that of opening 7, is mounted coaxially of the opening.

As shown best in Figs. 2 and 3, the ring 8 comprises a flat, annular ring body portion, to one side of which a cylindrical flange 8*f* is concentrically secured. The ring is revolubly supported by means of four equally spaced circumferentially grooved rollers 10 that are rotatably mounted on the yoke by supporting bolts or pivots 11. Each roller 10 receives therein the outer, peripheral edge of the ring body, thus to support and guide the ring as it is rotatably driven for the band laying operation.

The ring 8 is rotated, under control of various devices presently described, by means of an electric motor 12 that applies its power through a suitable reduction gear mechanism, designated in Fig. 2 at 13, and a pair of V-belts 14—14 that extend about the cylindrical flange 8*f* of the ring 8 and about a V-belt driving pulley wheel 15 that is fixed on the power output shaft 15' of the reduction gear mechanism, as observed in Fig. 2.

The motor 12 is here shown as being fixedly mounted on a base frame 16 that is supported at one end by a horizontal hinge shaft 17 carried in bearings 18 fixed in the base frame structure; the weight of the motor being partially sustained by the belts and thus the belts are maintained under adequate tension for operation of the ring and for preventing its slipping on the ring flange 8*f*.

The wire strand W, from which the bundle securing bands are formed, extends to the machine from a source of supply (not shown) over suitable tensioning means such as designated at 20 in Fig. 2, thence over a grooved wheel 21, rotatably mounted on a frame 22 extended from one end of the base frame, thence downwardly and about a tensioning wheel 23, thence upwardly and over another grooved wheel 24 mounted on the frame 22, and thence to the ring where it is threaded through wire reeving means from which it passes to the gripper mechanism.

The wheel 23 is rotatably mounted on a weighted frame 25 that has free up and down travel on vertical guide rods 26—26 fixed in the frame 22, and the weight of these parts operates automatically to take up slack and maintain tension on the strand at all times, particularly while it is being trained about a bundle by the rotating ring.

It is shown in Figs. 1, 2 and 10 that the ring 8 is equipped at opposite sides with alined and outwardly extending brackets 28 and 29, formed with bearing portions in which short, tubular wire guides 30 and 31 are rotatably mounted in axial alinement. At their outer ends, these guides are equipped respectively with wire carrying sheaves 32 and 32', as is best shown in Fig. 10.

The wire strand W, as it comes from the supply, is led off from the wheel 24 and threaded through the axially alined guide tubes, entering from the discharge side of the ring as shown in Fig. 10, and it is guided to and from these tubes as the wheel rotates, by the sheaves 32 and 32', over which it passes under tension. In passing from one tube to the other, the strand of wire passed directly through a small hole 35 in the inner edge portion of the ring 8, and from the sheave 32', the strand is extended, in a plane that is substantially parallel to the ring, across the top side of the area on which the bundle would be located for binding, and is applied at its end to a gripper located at one side of the bundle and referred to as the primary gripper, and presently to be described, which holds it secure for the binding operation. This initial threading of the wire strand is shown in Fig. 24.

Contained within the ring 8 is a bundle guide frame providing a rectangular opening and guideway through which the bundles to be bound are passed. As best shown in Figs. 1 and 2, this frame comprises opposite side plates 41 and 42, a top plate 43 and a bottom structure

(Figs. 3 and 15) that is made up of a plurality of conveyor rolls 44 supported in parallel relationship between and by parallel rails 45 and 45'. These rails are joined by cross bars 46 and also are solidly fixed to the side plates of the frame by tie straps 47, as shown in Fig. 3. These rigidly joined parts define a passageway of substantial size within which the bundles are partially contained and properly held while being bound and through which frame they are advanced from the machine after the wire band or bands have been applied thereto.

This bundle guide frame is supported by and within the ring 8 by means of four circumferentially grooved rollers 48 fixed to the outside of the frame wall members by flanges 49; it being herein shown that the flanges are welded to the wall members and the grooved rollers are revolubly mounted thereon by bolts 50 and receive the inner peripheral edge of the ring 8 in the roller grooves.

This frame is held properly in place and against rotation with the ring by means of three releasable locking bolts, seen in Fig. 1, and shown more in detail in Fig. 9, wherein it is noted that brackets 52 are fixed to the outside faces of the wall plates 41, 42 and 43 of the frame, and latch bolts 53 are alined with these brackets and are reciprocatively contained in bearing sleeves 54 that are fixed to the yoke 6 at the top and opposite sides of the opening 7. The inner end of each bolt is adapted to seat in a socket 55 in the corresponding bracket, and springs 56 are attached to the outer ends of the bolts and to the yoke frame plate to yieldingly seat the bolts in their respective sockets. It will be understood that with one or more of these bolts thus seated, the package guide frame will be held against any possible turning. However, in the present arrangement of parts, when the ring 8 is rotated for the purpose of training the wire about a bundle, the wire as extended between the tubular guides 30 and 31, must successively pass these several bolts, and it becomes necessary that the bolts be temporarily withdrawn from the bracket sockets for this passage of the strand. In Fig. 15, at the top of the ring, I have shown the bolt 53 withdrawn for this purpose.

Therefore, to accomplish this withdrawal of the bolts in proper timing, I have affixed a cam runner, or rail 60 to the front side of ring 8, as seen in Figs. 1 and 9, and have attached to the yoke 6, in association with each bolt, a bolt retracting lever 61. Each lever is pivoted at its outer end on the yoke by a pivot stud 62 and is epuipped at its inner end with a cam roller 63. Also, each lever 61 is pivotally connected by a link 64 with the outer end portion of the corresponding bolt 53. The cam rollers 63 are so located that they will be engaged by the cam runner 60 as the ring 8 rotates, and by this contact, their mounting levers will be actuated outwardly, thus to shift the bolts 53 outwardly from the bracket sockets and provide clearance between the inner ends of the bolts and the corresponding brackets for the passing of the wire strand. The relationship of the cam runner 60 to the ring 8 and place of passage of the wire strand therethrough is such that the bolts will be held withdrawn while the wire strand is carried through the open space between the retracted bolt and the bracket in which it normally seats.

In addition to the bundle conveyor rolls 44 and bundle guide frame shown in Figs. 3 and 15, it is further shown therein that a plurality of conveyor rolls 70 are mounted in the top portion of the base frame between parallel supporting rails 71 and 71' for the conveyance thereon of bundles into position for binding. These rolls 70 are alined with the rolls 44 and are at the same level. However, an open space 72 is provided between the two sets of rolls for the training of the wire strand, as payed out from the ring guide, about the bundle. This open space is shown in Figs. 3 and 15.

It is shown also in Figs. 3 and 15 that a plate 75 is fixed vertically upon the base frame in alinement with the side wall plate 41 of the bundle guide frame carried by the ring, and that there also is an open space 76 between the vertical edges of these vertical plates.

For its binding operation, each bundle is brought into position upon the conveyor rolls 70 and 44 and disposed against the aligned vertical plates 41 and 75 and across the open spaces 72 and 76. For better understanding of this position, a package 77 has been indicated in dotted lines in Figs. 1, 2 and 15. For purpose of later explanation, the plane in which the wire strand is laid about the bundle will be hereinafter referred to as the "binding plane" or "plane of the band," and it will be understood that this is the vertical plane that is substantially parallel to the ring 8 and passes through the axis of the twister gear, presently described, and centrally of the open spaces 72 and 76.

The band laying and tying operation is accomplished, in part, by the use of the ring 8 and a pair of band or strand grippers operating in conjunction with an axially slotted twister gear. The twister gear is well known in this art and is designated, in general, by reference character T, and is herein shown as being located in the binding plane just outside the plane of the inner surfaces of plates 41 and 75 as shown in Fig 4. In Figs. 24 to 28 inclusive, the relative positions of the grippers, twister gear, ring and bundle have been diagrammatically shown. Also, in Figs. 29 to 33, the shifting of the grippers has been indicated.

The strand grippers are designated, respectively and in general, by reference characters G1 and G2. The gripper G1 is referred to as the "primary gripper" and it is located closely below the twister gear and is adapted to hold the end of the wire strand W as it is trained about the package, under tension, by the ring. The gripper G2 is herein designated as the "secondary gripper" and it is located closely above the twister gear and is adapted to receive the secondary end of the wire band after the band has been laid about the bundle.

The twister gear T is of tubular form, as best shown in Figs. 5 and 6, and is disposed vertically and has a longitudinal slot 80 therein that opens to one side and to the ends of the gear, and into which slot the primary and secondary end portions of a band may be laid, by the strand laying devices, in overlapped relationship.

For proper understanding of the location of the twister gear with respect to the vertical plates 41 and 75, refer to Figs. 4 and 6.

It is shown in Figs. 4, 5 and 6 that the twister gear T is revolubly supported between bearing blocks 81 and 82 that are fixed to the plates 75 and 41 respectively. It is formed about its medial portion with a band of gear teeth 83, and it is driven by means of an idler gear 84, seen in Fig. 6, that is rotatable on a vertical pivot shaft 85 held in the bearing block 81. This idler, in

turn, is driven by a relatively large gear wheel 86 that is fixed on a vertical drive shaft 87 rotatably mounted in bearings 88 and 89 fixed in the frame structure at the outside of plate 75, as noted in Fig. 1. The means for driving shaft 87 comprises an electric motor 90 that is mounted in the frame, as seen in Fig. 4, and which operates through a train of speed reducing gear wheels 91, 92, 93 and 94. The gear 91 is fixed on the motor shaft and gear 94 is fixed on shaft 87. Operation of the motor is under control of starting and stopping switches presently to be described.

To properly accomplish the knot forming operation, and to provide that the twister gear may properly receive the wire strand as laid by the ring 8, and also to release the band after the knot is formed, the shaft 87 is definitely limited in its arc of rotation. The arc of turning of gear 86 is such as to cause the twister gear to rotate through three and one-half turns only. This will effect the desired twisting of the knot and will cause the twister gear to be stopped with the slot 80 facing the bundle for the release of the band from the gear, as is common procedure in devices of this kind.

To so limit the extent of rotation of the twister gear, I have fixed a radially directed lever arm 96 to the shaft 87 just above the top of the base frame, as shown in Figs. 4 and 7, and have mounted a pair of spring cushioned bolts 97 in a bracket 98 that is fixed on the frame in position to cause the bolts to be engaged to limit the swing of the arm in its motor driven direction. Also, I have mounted a stop bolt 99 in a bracket 100 that is fixed in the frame at a position to limit the swing of the lever arm in its return direction and to stop the twister gear in a position with its slot facing away from the bundle. Adjustment of bolt 99 in its bracket provides for accuracy of stopping position of the twister gear.

It is to be explained that for this particular operation, the motor 90 is of that kind known as a "torque motor." When energized, it operates through the gear train above described to swing the lever arm 96 from a position engaged against the stop bolt 99 to a stopped position against the bolts 97 and then operates to retain it in that latter position until energizing current is cut off from the motor. When current is cut off, the lever arm 96 is immediately restored to starting position by means of a pair of coil springs 101—101 that are attached, under tension, to a pivotal link 102 on the lever arm 96 and to a frame member, as has been shown in Fig. 4, the said frame member being outside the field of view.

Rebound of the lever arm 96 upon its striking the stop bolt 99, is prevented by means of a latch lever 103, shown in Fig. 7, that is pivoted on the frame as at 103', and which has an end notch 104 that holdingly receives the end of the lever arm 96 therein. Release of the latch lever is effected by the energization of a solenoid 105, which has its core bar 106 connected by linkage 107 with the latch lever. Normally, the latch is drawn toward holding position by a spring 108 attached thereto, but when the solenoid is energized, the latch is disengaged from its holding position. Energization of the solenoid is coincident with energization of the motor 90.

Referring now to the band grippers G1 and G2 as shown in their preferred spaced relationship to the opposite ends of the twister gear T in Figs. 11 and 16 and in Figs. 29 to 33 inclusive:

The upper gripper G2 comprises a horizontal bar 108 having a head portion 110 at one end that is formed with a vertical, slightly wedge-shaped slot 112, see Fig. 13, that faces away from the bundle and into which a wire strand may be laid and closely confined when seated at the base of the slot. The bar 108 is reciprocatively mounted in a bearing block 113 that is fixed to the face of plate 75 opposite that face against which the bundle is held while being bound; for example, see Figs. 3 and 4.

Closely underlying the bar 108, and held in the bearing block, is a wire cutter plate 115 which has a shearing edge 116 against which the secondary end of the wire band, extended downwardly through the slot 112 of gripper G2, will be pulled with shearing effect, and severed when the bar 108 is shifted inwardly, as in Fig. 32, for this particular purpose. The limits of longitudinal shifting of this gripper bar are indicated by the full line and dotted line showing of the head portion in Fig. 13*a* and also by the positions in which the bar is shown in Figs. 31 and 32.

The gripper G1, which is located below the twister gear, comprises a horizontally mounted bar 120, that is reciprocatively contained in the bearing block 113, and which has a gripper head 121 at its outer end adapted, by shifting the bar to its limit in one direction, to be alined with the twister gear, as in dotted lines in Fig. 29, and when shifted to its opposite limit, to be moved out of alinement with the twister gear, as in full lines in Fig. 29. The gripper head 121 has an outer jaw of hook form, as noted best in Fig. 17, and an opposedly related and yielding jaw, 125. This latter is in the form of a slide bar and is longitudinally movable from and toward the jaw 121. The bar is supported in place by the housing permitting its movement from and toward the fixed jaw, and a bolt 126, fixed in the bar at its inner end, has limited movement in a stationary bar 127 that is fixed to the bearing block 113, and this bolt limits the extent to which the bar 125 may move with the jaw bar 120 when moved to its extended position, as shown in Fig. 17. The jaw bar 125 is at all times urged toward jaw 121 by a coil spring 128 that encircles the bolt and bears at its ends against the bar 127 and the adjacent end of the jaw member. The jaw parts are so related in this gripper that when the gripper bar 120 is extended to a position to cause the mouth of the jaws to be alined with the twister gear slot, the mouth between jaw 121 and bar 125 will be held slightly open and thus provide that a wire strand may be easily laid between the jaws. The mouth of this gripper jaw also opens away from the bundle and when the gripper is extended, the parts assume the position relative to the twister gear as shown in Fig. 17.

Also associated with the gripper G1 and immediately above bar 120, is a wire cutter plate 129 mounted in the bearing block 113. This plate has a sharpened edge 129' facing the jaw or head 121 and against which a wire strand held in the jaws of this gripper will be pulled with shearing effect when bar 120 is shifted inwardly for this purpose.

It is shown best in Fig. 11 that the jaw bars 108 and 120 are connected at their outer ends by means of links 130 and 130' with opposite ends of a rocker lever 132 that is pivoted between its ends on the plate 75 by means of a pivot bolt 133. As shown in Figs. 11 and 13*b*, the pivot bolt 133 passes through a horizontally directed slot 134 in the rocker, and the rocker lever has an arm 135 extended therefrom and this is connected at its end to the lower end of an upwardly directed

link 136 which, at its upper end, is pivotally connected with one end of a cam lever 137, as has been shown in Fig. 1.

The cam lever 137 is substantially horizontally disposed and is pivotally secured at one end by bolt 138 to a bracket 139 fixed on an elevated frame or table structure designated at 140. This frame has a fixed connection at its inner end with the top edge of plate 75 and has bar supports 141 at its outer end attached to a cross rail 4 of the base frame. At its swinging end, the cam lever 137 has a roller 145 thereon adapted to be engaged and actuated downwardly by a cam 146 that is fixed on a horizontally supported cam shaft 147 carried in bearings 148 that are mounted on the frame 140, as best shown in Fig. 11. When the cam 146 actuates the lever 137 downwardly, the link 136 actuates the rocker lever 132 on its pivot to cause simultaneous endwise shifting of the gripper bars 108 and 120, in opposite directions; the upper gripper G2 moving to the right, as shown in Fig 11, and the lower gripper G1 moving to the left. The synchronizing of these movements with operations of other parts, and the reason for thus shifting the gripper jaws, will presently be explained.

A coil spring 150 is attached under tension to link 136 and to the plate 75, as in Fig. 11, to pull the link back to a lifted position after the cam 146 has disengaged the roller 145, and thereby dispose the grippers in the positions referred to as normal, in which they are shown in Figs. 11 and 29 to 31.

Referring now more particularly to Figs. 1 and 2, it is seen that the cam shaft 147 is adapted to be rotatably driven by means of a continuously energized electric motor and reduction gear mechanism, designated generally at 160, that is mounted on table 140 and which has a sprocket chain belt 162 operating over a sprocket wheel 163 on the motor drive shaft and over a sprocket wheel 164 that normally rotates freely on the cam shaft 147, but which may be caused to be locked therewith upon release of a normally disengaged clutch bolt 168, presently described, that is carried by a clutch wheel 165 keyed on the shaft 147, as noted in Fig. 11. The timed rotation of the cam shaft has two purposes: first, to momentarily shift the grippers from normal position, as in Fig. 29, to a position as in Fig. 32, for purposes presently understood; and, second, to actuate devices whereby the severed secondary end of the wire strand, that is released from the band after the knotting operation, will be carried downward from the upper gripper and laid again within the twister gear slot and applied to the primary or lower gripper, to be held by the latter as a primary end for the next binding operation.

The clutch mechanism whereby this driving connection with shaft 147 is made and released, is shown in Figs. 1, 11 and 12, and it comprises the sprocket wheel 164 which normally rotates freely on the cam shaft, and the clutch wheel 165 that is keyed to the shaft adjacent the sprocket wheel. The sprocket wheel has four equally spaced, projecting lugs 166 on that side next to wheel 165 and mounted in a bearing 167 on the wheel, is the sliding clutch bolt 168. A spring 169, see Fig. 11, contained in the bearing, acts against the bolt to urge it to an extended position. Upon being extended, the outer end of the bolt will be engaged with one of the lugs 166 to thereby effect a driving connection between the driven sprocket wheel 164 and the clutch wheel 165 through which the cam shaft 147 will be rotated for the purposes previously noted.

The clutch bolt is operated under control of parts now to be explained.

Formed in the clutch wheel 165 is an encircling groove 170 in which one end of a clutch bolt release lever 171 is normally contained, as in Fig. 12. This lever is pivoted at 171' on a bracket 172 fixed upon the table 140 and extends downwardly, as best seen in Fig. 1, and at its lower end, is connected by a link 173 with the sliding core bar 174' of a solenoid 174 that is fixed on the back side of plate 75.

Coil springs 175 and 175a, shown in Fig. 1, are attached to the frame and to the lever 171 to pull it to such position that its upper end portion will normally be yieldingly retained in the groove 170 of the clutch wheel 165, as noted in Fig. 12. The clutch bolt 168 has a pin 176 fixed therein that extends into the wheel channel, see Fig. 11, in positioin that as the wheel rotates, this pin will engage against a beveled end surface 177 of the lever to cause the bolt to be shifted against the pressure of spring 169 and released from engagement with the lug 166 on the sprocket wheel. This stops rotation of shaft 147. When the solenoid 174 is energized, it operates to rock the lever 171 in a manner such as to swing its upper end from contact with the clutch bolt pin so that the clutch bolt, under pressure of the spring, will be actuated into contact with the sprocket wheel to effect the driving connection. This clutch mechanism provides that upon release of the clutch bolt and its engagement with the sprocket wheel lug, the shaft 147 will be driven through one complete rotation only, then stopped. This is by reason of the solenoid 174 being only momentarily energized. This stopping is by reason of the pin 176 again contacting the end of the release lever and riding therealong to effect retraction of the bolt.

Before describing in detail the devices for effecting the actuation of the grippers G1 and G2 for the cutting of the wire strand at opposite sides of the knot, and the traveling gripper head G3 for reapplying the end of the cut strand to the primary gripper after a binding and strand cutting operation, the band laying or training operation will be explained in order that a better understanding of the later operations may be had. This explanation will be best understood by reference to Figs. 24 to 33 inclusive.

First, it will be explained that the wire strand as extended from the ring (see Fig. 1) is passed over a supporting latch bar 178 that is supported from plate 75, as shown in Fig. 15, and thus the wire is held above the bundle passage out of the way of an advancing bundle. This latch bar extends horizontally across the open space 76 between plates 41 and 75 and it is pivotally secured by a pivot 179 to a plate 180 that is fixed to plate 75. The latch bar is formed with an arcuate head 181 at one end and this has a notch 182 in its top edge into which a hook 183, pivoted on plate 180, may drop to hold the latch bar normally extended across the space 76. A solenoid 185 is mounted on the plate 180 above the hook and this has its core bar operatively connected by a link 186 with the hook so that upon energization of the solenoid, the hook will be lifted and the latch will be released, and the wire strand as supported thereon under tension,

will be freed and permitted to be tightened across the top of the positioned bundle. A coil spring 189, attached to plate 180 and to the latch head, restores the bar 178 to functional position immediately upon deenergization of the solenoid.

Assuming that the wire strand has been extended from the supply over the various tension applying sheaves shown in Fig. 1, and through the tubular guides carried on the ring as in Fig. 10, it is then carried to the left, as in Figs. 1 and 24, over the latch bar 178, thence downwardly and is manually laid in the slot of the twister gear, then facing away from the bundle, and is secured between the jaws of the lower gripper G1. At this particular time, the gripper G2 is extended and the gripper G1 is inwardly disposed from alinement with the twister gear, as shown in Fig. 29, and in this manual initial threading of the wire, the primary end portion is laid back of both the then extended upper gripper G2 and the wire replacing gripper G3, which presently will be fully described. The primary end of the wire, and the grippers are at this time in the relationship shown in Figs. 24 and 29, and the machine is ready to start upon the placing of a bundle in position.

With the wire so placed, the machine is then set in motion by energizing the ring driving motor 12, this being accomplished by depressing a foot pedal 195 that is pivoted on a bracket 195' in the base frame structure, as seen in Fig. 1, and which pedal has a lateral flange 196 adapted to engage and actuate a starting switch 197 that is electrically connected to the motor through a control switch 198, as shown in the diagram of Fig. 34.

When the motor 12 is energized, the ring 8, then positioned as in Figs. 1 and 24, is set in motion, turning clockwise, thus first training the strand of wire and held at its primary end in gripper G1 and supported by latch bar 178, across the top of the bundle. The strand will be supported above the bundle by the latch bar 178 until the wire reeving guides on the ring have reached the position indicated in Fig. 25. At this time the cam runner 60 is actuating the bolt 53 at the right hand side of the machine as shown in Fig. 1, toward its outer limit for passage of the strand of wire past the bolt, and as the bolt moves outwardly, a lug 200 fixed thereon engages an actuating lever 201 of a control switch 202 fixed to the yoke. The switch 202 is electrically connected through a source of electrical energy, with the solenoid 185 that, upon being momentarily energized, releases the wire supporting latch bar 178 and the wire strand snaps therefrom, and being under tension, it snaps against and tightens across the top of the package. The direction of pull on the wire strand then becomes such as to urge the package against the supporting rollers and against plates 41 and 75. Thus the necessity for a clamp mechanism for this purpose is eliminated.

As the ring 8 continues to rotate, through positions shown in Figs. 25 and 26, it trains the wire across the right side of the package, then across the bottom, then carries it upwardly across the left side, and in this latter arc of travel, it lays the strand into the open jaws of the gripper G2 and again in the slot of the twister gear and also into gripper G3. The ring is automatically stopped in its rotation by de-energizing the driving motor 12 when the ring has again approximately reached the starting position, and has again laid the wire strand across the latch bolt 178, as indicated in Fig. 26.

The means for de-energizing the motor 12 comprises the parts shown in Figs. 2 and 20 to 23 wherein 205 designates a horizontal shaft that is revolubly mounted in bearings 206–207 extended from a vertical plate 208 that is affixed to and extends perpendicularly from the yoke. Fixed on the shaft 205 is an eight-toothed ratchet wheel 209, see Fig. 22, adapted to be operatively engaged by a one-way spring-pressed latch 210 that is pivotally mounted, by a pivot stud 211, on the ring 8. Also, fixed on the shaft 205 is an eight-point star wheel 212, see Fig. 23, that is so located that, as advanced intermittently by the shaft in accordance with the rotational advance movements of the ratchet wheel, it will engage a switch lever 216 of stop switch 217. Also fixed on the shaft 205 is an indexing wheel 213 with eight equally spaced notches 218 in which a roller 219 on a spring-loaded arm 220 may be seated to retain the shaft yieldingly at the positions to which it is advanced by the latch 210 in engaging and passing the ratchet 209. The arrangement of these parts is such that with the turning of the ring 8, the latch 210 will, near the end of a binding operation, engage the ratchet wheel 209 and thus rotatably advance shaft 205 one-eighth of a turn. This causes a point of the star wheel 212 to actuate the switch lever 216 to open the switch 217 and thus to open the circuit to the driving motor 12 and stop the turning of the ring. A friction brake mechanism shown at 222 in Fig. 2, retains the wheel against reverse rotation under tension of the wire. The arcuate shoe 222 is pivotally mounted on parallel arms 223 which are in turn pivotally mounted on frame 6. A spring 224 holds the shoe against the belts 14 to function as a one way brake permitting normal counterclockwise rotation of the strand laying ring 8 but preventing its reverse rotation.

Coincident with the de-energization of motor 12 by the actuation of switch 217, the latch releasing solenoid 105 and the motor 90 are energized; this also being effected by the same action of switch 217 that stopped motor 12. The energized motor 90 operates through the gear train shown in Fig. 4, to rotate the twister gear to form the knot as has been previously explained. During the final turn of the gear T in the formation of this twisted knot, the wire strand is cut at opposite sides of the knot, thus to release the bound bundle for removal from the machine. The wire cutting operation is effected by the means now to be described, reference being directed particularly to Figs. 8 and 11.

Mounted on the gear wheel 86 is a cam roller 230, located at such position thereon that as the gear wheel 86 approaches its limit of turning as determined by lever arm 96 and stops 97, it will functionally engage, as understood, with the outer end portion of a cam lever arm 231 that has its inner end pivotally affixed to a lug 233 on the plate 75 by a pivot bolt 232. This lever has one end of a push bar 234 pivotally attached thereto, as at 235, the other end of which is pivotally engaged against a keeper block 236 on the lever arm 135 of rocker lever 132. When the lever 231 is thus actuated outwardly by the contact therewith of cam roller 230, it causes the push bar 234 to be shifted accordingly and by its engagement with the block 236 to bodily shift the rocker lever outwardly; this being permitted by reason of the rocker lever being provided with the longitudinal

slot 134 therein through which the pivot bolt 133 extends. With the outward shifting of this rocker lever, both gripper bars 108 and 120 are shifted and those portions of the wire strand carried therein are thereby brought back against the corresponding wire cutters 115 and 129 and severed as has been shown in Fig. 32. Thus the band that has been tied about the bundle is freed from the supply strand and is permitted to snap out of the twister gear slot, and the bundle is freed for removal from the machine.

In order to insure the release of the bundles from the twister gear, I have provided a bundle kick out means shown in Fig. 7. This comprises a bell crank lever 240 pivotally mounted in a horizontal plane at one side of the bundle guideway on a vertical post 241. One arm 240*a* of the bell crank extends along the adjacent side of the bundle and the other arm 240*b* extends laterally away from the bundle. A coil spring 242 is attached to the arm 240*b* and to the bracket 98 on the frame to yieldingly retain the bell crank in a position against a stop 241*a* at which the arm 240*a* is flush with the plane of plate 75. Fixed on the shaft 87 in the horizontal plane of the bell crank, is a cam 243 of such length that it will engage with the lever arm 240*a* as the shaft 87 rotates through its final limits under the driving influence of motor 90, thus to actuate it outwardly against the bundle, and kick the bundle away from the plate 75 into the passage.

Coincident with the kicking out of the bound bundle by the bell crank, the motor 90 is de-energized, and the twister gear mechanism restored to starting position. This de-energization of the motor is effected by the actuation of a stopping switch 250 that is mounted in the frame just above the arm 240*b* of bell crank 240, and which has a switch lever 251 located in such position as to be engaged and actuated by arm 240*b* with that movement of the bell crank that kicks out the bundle.

With the de-energization of motor 90, the gear 86 is rotated back to its starting position by the pull of the springs 101 attached to lever arm 96, as seen in Fig. 4.

With the return of the gear 86 to starting position, devices are set in motion for the replacing of the end of the wire strand, then held in gripper G3, in the primary gripper. This is accomplished by the momentary energization of the solenoid 174. This energization is accomplished by the closing of a switch 245 that is fixed in the frame by a bracket 246, seen in Fig. 1, and which switch has an actuating lever arm 247 extended to a position at which it will be actuated by a pivoted latch pawl 248 carried on a disk 249 fixed to the upper end of the shaft 87 as seen best in Fig. 16. This pawl is so pivoted as to ride freely past the switch arm with the turning of the disk, as driven by motor 90, but is held against pivoting in its opposite direction, and due to this, will actuate the switch arm to close the energizing circuit of solenoid 174 as the disk rotates back to normal position.

The momentary energization of the solenoid 174 actuates the clutch lever 171, and the cam shaft 147 is set in operation, and by the turning of the shaft through one complete turn, the end of the wire strand, as extended from the supply, is replaced in gripper G1.

The replacing mechanism will now be described and the description should be considered more particularly in connection with the showing of parts in Figs. 1, 11 and 12:

Fixed to the left end of cam shaft 147, reference being had to Fig. 11, is a crank disk 261 and pivotally fixed thereto, at 261', is the upper end of a link 262 which, at its lower end, is pivoted to a cam follower 263 that is contained in a cam slot 264 formed in a plate 265 that is secured vertically to the adjacent face of plate 75. Pivoted on the cam follower 263 is a bearing 266 in which a rod 267 is fixed. The upper end portion of this rod is slidably guided in bearings 268—268' of a rocker member 269 that is pivotally mounted by a horizontal hinge shaft 270 in a bracket 271 that is fixed to plate 41. The cam slot 264, from its upper end downwardly, is arcuately curved, as seen in Fig. 12, in such manner that as the follower 263 is moved downwardly therealong, the lower end portion of the rod 267 will be caused to move in an arc, and in a direction away from the bundle, from a location above the twister gear to a position below it, as has been indicated by the successive dotted line showing of these parts in Fig. 12.

At its lower end, the rod 267 mounts a wire gripper thereon which has been designated as the wire replacing gripper G3. This gripper (see Figs. 18 and 19) comprises an angular jaw forming member 275 that is solidly fixed to the lower end of the rod 267 and which has a laterally turned foot 276 at its end upon which a gripper jaw member 277 is pivotally attached by a pivot 278. This gripper jaw 277 has a gripper foot 277' that coacts with the bar 275 to form a mouth adapted to receive and to hold the wire strand when it is laid between them by the final rotative action of the ring 8. A spring 280 is attached to the outer end of jaw 277 and to the foot 276 to pull the gripping end of the jaw toward gripping engagement with the wire. The mounting of jaw 276 is such that the upward pull on the wire strand, when placed in the gripper, will tighten the hold of the gripper jaw thereon.

It is to be remembered that the primary end of the band, held by gripper G1 is held by the primary gripper and is laid in the twister gear slot and back of extended gripper G2 and gripper G3. Also, that at the end of the band laying operation, the secondary end portion of the wire band is laid by the ring in the gear slot and in the slot 112 of the upper gripper G2. Finally, it is drawn tightly within the mouth formed by the gripping jaws 275 and 277' of the strand replacing gripper G3; the gripper G3 then being in its upper position as in Figs. 11 and 31, and therefore, with the cutting of the wire which follows the knot tying operation, the cut end of the wire, as extended from the ring, will be held secure in gripper G3 and it will not become unthreaded due to the tension that is maintained on the strand.

The replacing of the cut end of the wire strand in gripper G1 by the travel of gripper G3 through the arc shown in Fig. 12, is started by the closing of the circuit of solenoid 174 which is caused by the closing of switch 245. The energization of the solenoid effects the actuation of the clutch bolt release lever 171 and causes the cam shaft 147 to be rotated through a complete turn, then to be stopped, as has previously been explained. Thus gripper G3 is actuated from its upper position, as in Fig. 29, to its lower position, as in Fig. 33, and then returned to starting position.

Due to the turning of cam shaft 147, the rod 267 will be reciprocated, and the end of the wire strand, then held in gripper G3, will be carried

down and applied to the open jaws of the lower gripper G1 which then closes and holds this end of the wire secure.

It is to be remembered that the cam 146 rotates with the shaft 147, and that this cam actuates the gripper rocker lever 132 to such position that the lower gripper G1 will be extended into alinement with the twister gear, as in Fig. 33, and its jaws held in an open position ready to receive the wire strand when brought thereto by gripper G3. After the wire has been laid in the open jaws of gripper G1, but before the wire is released by gripper G3, the gripper jaw 120 of gripper G1 is actuated laterally by the timed action of rocker lever 132, and this causes the jaws of gripper G1 to close on the wire.

The release of the primary end of the wire from the gripper G3 is effected immediately after the end of the strand has thus been placed in gripper G1. This is by reason of the outer end of gripper bar 277 being engaged by a stop member which is fixed to plate 75 and which is carried on parts shown in Fig. 18. This stop comprises a lever 290, supported horizontally by a pivot 291 that is applied through it at about its medial point. One end of the lever 290 is equipped with a transverse head portion 292, shown best in Fig. 19.

At its other end, the lever has pivoted connection with a vertical rod 293, the upper end portion of which extends through a guide 294 and at its end has a lateral arm 295 to which a coil spring 296 is attached under tension to pull the rod downwardly. This holds the head portion 292 in position that when gripper G3 moves downwardly through its final travel, the outer end of jaw lever 277 will engage the head 292, and the jaw will be rocked to an open position, thus releasing its hold on the end of the wire.

It is here to be explained also that the reciprocating action of the gripper bars 108 and 120 takes place in such timing with the downward actuation of gripper G3, by reason of a proper setting of cam 146 on shaft 147, that gripper G2 will be retracted, as gripper G1 is moved outwardly to a position alined directly below the twister gear slot, and at which the mouth between its jaws will be opened, just prior to the gripper G3 reaching its lower position. This results in the wire strand being laid on the twister gear slot and into the open jaws of the gripper G1. Then, with the release of the strand from gripper G3, the gripper bars are actuated to shift gripper G1 inwardly and gripper G2 outwardly. Thus, at the start of a binding operation, the strand of wire, as extended from the ring, lies over the supporting latch 178, thence extends downwardly back of gripper G3 and gripper G2, through the slot of the twister gear, and is held at its end in gripper G1, then positioned as in Fig. 29.

Figure 34 illustrates a wiring diagram for the electrical equipment of the machine. This equipment is supplied from a three-wire circuit 300 which branches at the main switch 301 into two three-wire circuits 302 and 303. The branch 303 supplies a first three-wire circuit 304 for the gripper motor 160 under the control of magnetic switch 305, and a second three-wire circuit 306 for the knotter motor 90 under the control of a second magnetic switch 307. The branch 302 supplies a three-wire circuit 310 for the ring motor 12 under the control of magnetic switch 198, and a number of two-wire control circuits.

One of these control circuits is designated at 311 to energize the solenoid coil 312 of the magnetic switch 305. Wires 313, 314 and 315 supply solenoid 174 through switch 245. Wires 316, 317 and 318 supply solenoid 185 through switch 202. Wires 319, 320, 321 and 322 connect the solenoid 323 of switch 198 to branch 302 through switches 197 and 217. Switch 217 is a double throw switch which is connected with another wire 324 to energize solenoid 325 of magnetic switch 307 in series with switch 250 through wires 326 and 327 when both of these switches are closed in this circuit.

Switches 197, 202 and 245 are normally open as shown, as are also magnetic switches 198, 305 and 307. Switch 250 is normally closed and switch 217 normally rests in the position shown. When main switch 301 is closed, the solenoid coil 312 of magnetic switch 305 is immediately energized to close this switch and start gripper motor 160 which then runs continuously as long as the main switch is closed. It will be remembered that the movements of the grippers are timed by a clutch mechanism which utilizes this motor as a continuously available source of power to operate the grippers whenever they are needed. Before a binding operation is initiated, the other circuits are all inactive.

To perform a binding operation, the foot pedal 195 is depressed momentarily, closing switch 197 to energize the solenoid coil 323 of switch 198 causing the latter to close to energize circuit 310 to start the ring motor 12. Magnetic switch 198 is of a conventional type having a holding circuit to hold the switch closed after the foot switch 197 is re-opened.

The first automatic operation is the momentary closing of switch 202 by the movement of the ring 8 between the positions shown in Figures 24 and 25 to energize solenoid 185 and release the latch 178 shown in these figures. The ring 8 then continues to rotate until it reaches the end of its travel whereupon it actuates the star wheel 212 to shift the movable contact in switch 217 to break the circuit through solenoid coil 323 allowing the switch 198 to open and stop the ring motor 12. This movement of switch 217 closes a circuit through wires 320, 324, 326, and 327 to energize solenoid coil 325 of magnetic switch 307 to start the knotter motor 90. The magnetic switch 307 is also provided with a holding circuit to hold itself closed after momentary closing of the switch 217 to complete the circuit between wires 320 and 324.

Solenoid 105 is energized along with the motor 90 to allow the knotter mechanism to operate. It will be remembered that the function of the latch 103 associated with solenoid 105 is to hold the knotter mechanism and twister gear indexed in its rest position whereby this latch must be released before the knotter mechanism can operate.

The motor 90 shuts itself off by the momentary opening of switch 250 when the twisting of the knot is completed. Switch 250 then returns to its normally closed position without re-starting knotter motor 90.

At this stage of the operation, the knotter mechanism is returning to its rest position by spring action. In its return movement it also momentarily closes limit switch 245 to energize solenoid 174 to trip the clutch connected with gripper motor 160. The replacing gripper G3 is operated by the one revolution clutch to perform its function and come to rest, allowing the motor 160 to continue to operate without further effect.

Limit switch 245 then returns to its normally open position.

At the end of each knotting operation, the switches and other circuit elements, except 305, are thus returned to their initial position illustrated to be in readiness for the next binding operation. Magnetic switch 305 remains closed, as described, as long at the main switch 301 is closed.

Having thus described my invention, what I claim as new therein and desire to secure by Letters Patent is:

1. In a bundle binding machine, a bundle support, a primary gripper adjacent thereto, a replacing gripper, a one-way rotary carrier operable about the bundle through one complete turn to draw from a supply a binding strand while held at its primary end in the primary gripper, and to lay it under tension about a bundle on said support and place a secondary portion thereof in overlapped relationship with the primary end portion and to apply it, beyond the overlap, to the replacing gripper, means operable to join the overlapped portions of the strand together, means for cutting the strand between the joined ends and the replacing gripper, and means for actuating the replacing gripper to draw the strand out from the carrier and to apply the end gripped thereby to the primary gripper.

2. In a bundle binding machine, a bundle support, a primary gripper adjacent thereto having open and closed positions, a replacing gripper, a one-way rotary carrier operable about the support through one complete turn to draw from a supply, a binding strand held at its primary end in the primary gripper, and to train it, under tension, about a bundle and overlap a secondary end portion thereof with the primary end portion and to apply it, beyond the overlap, to the replacing gripper, means operable to join the overlapped end portions of the strand together, means for severing the strand between the joined portions and the replacing gripper and for opening the primary gripper, means for actuating the replacing gripper to draw out the strand from the carrier and apply the end thereof to the primary gripper, means for closing the primary gripper on the strand as applied by the releasing gripper, and means for releasing the replacing gripper from the strand for its return to starting position.

3. A bundle binding machine comprising a bundle support, a primary gripper having open and closed positions and a replacing gripper adjacent one side thereof, a one-way rotary carrier operable by one complete turn, to draw from a supply, a binding strand held at one end in the primary gripper and to train it under tension, progressively about a bundle on said support and place a secondary end portion thereof in overlapped relationship with the primary end portion and then in the replacing gripper, means for joining the overlapped portions of the strand together to secure a band about the bundle, means for severing the strand at opposite sides of the joined ends to release the bound bundle, means for opening the primary gripper, means for actuating the replacing gripper to draw out the strand from the carrier and to apply it to the primary gripper, means for closing the primary gripper thereon, means for releasing the replacing gripper from the strand, and means for returning it to initial position.

4. A bundle binding machine comprising a bundle support, a slotted twister gear at one side thereof, a primary gripper below the twister gear, a replacing gripper above the twister gear, a one-way rotary carrier operable through one complete turn about the support and bundle thereon to progressively lay a wire strand, that has its primary end portion held in the primary gripper and laid in the slot of the twister gear, about the bundle under tension and in a manner whereby in the initial travel of the carrier, the wire draws the bundle against the support and then progressively encloses the bundle and is laid again in the twister gear slot and applied to the replacing gripper, means for actuating the twister gear to join the ends of the strand therein, means for severing the strand at opposite ends of the gear for release of the bundle from the machine, and means for actuating the replacing gripper to draw out the strand from the carrier and lay the end portion thereof in the twister gear slot and to the primary gripper and then return the replacing gripper to initial position.

5. In a bundle binding machine, in combination, a support for a bundle to be bound, a gripper at one side of the support for holding the primary end of a wire strand, a one-way rotary carrier operable about the support and bundle thereon to train a binding strand, held at one end in the primary gripper, progressively across the top of the bundle, then downwardly along one side thereof, then across the bottom and then upwardly to locate a secondary end portion thereof in position for being joined with the primary end portion, a strand supporting latch disposed above the level of the bundle and in position to sustain the tension thereof, as applied by the carrier, from the bundle through an initial part of the orbit of the carrier, and means for actuating the latch to free the strand therefrom for tightening against the bundle after the carrier has advanced to a position at which the pressure of the strand against the bundle will be directed toward the support.

6. In a bundle binding machine, the combination with a bundle support, a gripper so disposed as to be close to one side of a supported bundle, a one-way rotary carrier operable about the bundle to train a binding strand, as held at its primary end in the gripper, under tension, progressively about the bundle, a strand supporting latch member disposed above the bundle and in position to sustain the strand tension from the bundle as the strand is drawn upwardly and then across the top of the bundle, and means operable under control of the rotary carrier to actuate the latch to disengage the strand therefrom for tightening by the carrier against the bundle after the carrier has advanced to a position at which the tension of the wire as sustained by the bundle will act to clamp the bundle against the support.

7. A bundle binding machine comprising a bundle support, a wire tieing mechanism so located as to be closely adjacent a side of a bundle disposed on said support, a wire gripper below the tieing mechanism, a strand retaining latch above the level of the bundle and substantially vertically aligned with the tieing mechanism, a one-way rotary carrier operable through one turn to progressively lay a wire that is held at its primary end by the gripper and extended across the latch, across the top of the bundle, thence downwardly across a side, and thence across the bottom and thence upwardly through the tieing mechanism, means disposed to be actuated by the carrier in turning to actuate the latch to disengage the wire therefrom after it has been laid in a position at which the wire tension will be downwardly against the bundle, a control means for releasing and resetting the

latch, and means on the carrier for determining the actuating period of the control means.

8. In a wire binding machine, a slotted twister gear, primary and secondary grippers at opposite ends of the twister gear, a one-way rotary carrier and means for actuating it through one complete turn to lay a wire strand, as held at its primary end in the primary gripper and laid through the twister gear slot, progressively and under tension about a bundle and place a secondary portion thereof in the twister gear slot, a replacing gripper disposed to receive the secondary end portion of the strand after being placed about the bundle and in the slot, means for actuating the twister gear to knot the band ends therein and to face the slot toward the bundle, means for cutting the strand at opposite ends of the gear, a kicker operable to push the bundle away from the gear, and means for oscillating the replacing gripper to draw out the strand from the carrier and to lay the end portion in the twister gear slot and apply it to the primary gripper preparatory to the next binding operation.

9. A combination as in claim 8 including also means for shifting the primary gripper out of the wrapping plane after the wire has been applied thereto by the replacing gripper, and means for actuating the secondary gripper to position for receiving the secondary end portion of the strand as laid about the bundle.

10. In a wire binding machine, a bundle support, a slotted twister gear at one side thereof, primary and secondary grippers at opposite ends of the gear, a one-way rotary carrier operable about the support and a bundle thereon to lay a wire strand, as held at its primary end in the primary gripper and laid through the slot of the twister gear, progressively and under tension about the bundle and place a secondary portion of the strand in the gear slot, a replacing gripper disposed to receive the said secondary end portion beyond the secondary gripper, means for actuating the twister gear to join the ends of the strand therein in a twisted knot, and face the gear slot toward the bundle, means operable to cut the wire strand between opposite ends of the gear and grippers to free the bound bundle and to rotate the gear to face the slot away from the bundle, and devices for oscillating the replacing gripper to draw out the wire from the carrier, and lay it through the twister gear slot and apply its end to the primary gripper; said wire cutting means being located laterally of the wrapping plane of the wire strand and there being means operable in synchronism with the rotation of the carrier to shift the grippers into and from the wrapping plane and to pull the wire as held therein against said cutters.

11. In a wire binding machine, a slotted twister gear, primary and secondary grippers at opposite ends of the twister gear, a one-way rotary carrier operable to lay a wire strand, as held at one end in the primary gripper, and extended through the gear slot, about a bundle and place a secondary portion of the strand again in the slot, means for actuating the gear to join the ends of the strand, wire cutting means supported adjacent the grippers, and means operable to shift the grippers laterally from the wrapping plane an initial distance after receiving the wire strand therein, and for shifting them an additional distance after the knot has been formed to sever the strand to free the bound bundle.

12. In a machine of the character described, a frame structure, a ring mounted to rotate therein, a bundle guideway supported by and within the ring, means for reeving a wire strand, as extended from a source of supply, through the ring for training it about a bundle in the guideway as the ring rotates, a plurality of retractable latch devices mounted on the frame and extended therefrom into holding contact with the guideway to hold it against turning, and means on the ring for effecting retractive movements of the latch devices for the passing of the wire strand past said devices.

13. In a machine of the character described, a frame structure, a ring mounted to rotate therein, a bundle guideway supported by and within the ring, means for reeving a wire strand, as extended from a source of supply, through the ring for training it about a bundle in the guideway as the ring rotates, a plurality of socket members fixed on the guideway at spaced intervals thereabout, spring pressed latch bolts mounted on the frame to seat in said sockets members to hold the guideway against rotation, cam rollers on the bolts, and a cam shoe on the ring adapted to successively engage said rollers as the ring rotates to retract the latch bolts for passage of the wire strand.

14. In a bundle binding machine, the combination with a slotted twister gear, a gripper at one end thereof, a one-way rotary means for laying a wire strand under tension about a bundle and twice in the same direction through the twister gear for joining thereby, and means for cutting the wire to free the bundle from the gear after the ends have been joined thereby; of a replacing gripper located to receive the wire strand after being laid the second time in the twister gear, and means operable after the wire has been cut, to move the replacing gripper in an arcuate path in the wrapping plane to draw out wire from the rotary means and lay it in the twister gear and apply it to the gripper at the end thereof.

15. In a binding machine of the character described, the combination of a rotary carrier for laying a binding strand under tension progressively about a bundle, a support for the bundle, a pivoted strand sustaining latch over which the strand is drawn by the carrier, a hook normally engaged with the latch to hold it in strand supporting position, a solenoid for disengaging the hook from the latch, a circuit for the solenoid, and a switch operable by the carrier to energize the solenoid.

16. In a bundle binding machine, a bundle support, a rotary member having strand reeving means rotatable around a bundle on said support to lay a binding strand under tension progressively about the bundle, a member arranged to hold a portion of the reeved strand temporarily away from the top side of the bundle, and means actuated by said rotary member to withdraw said holding member and allow the reeved strand to lay against the bundle when the reeving means has rotated part way around the bundle.

17. In a bundle binding machine, means for reeving a binding strand under tension progressively about a bundle, means cooperating with said reeving means to form a partial loop of the binding strand above and out of contact with the bundle, and means to release said partial loop to engage the top of the bundle before the strand is reeved around the rest of the periphery of the bundle.

18. In a bundle binding machine, means to form a partial loop of binding strand above and

out of contact with a bundle to be bound, means to release said partial loop into engagement with the top of the bundle, and means comprising elements of said loop forming means to continue to lay the strand under tension progressively around the rest of the periphery of the bundle.

19. In a bundle binding machine, a bundle support having a lateral abutment, means to form a partial loop of binding strand above and out of contact with a bundle to be bound on said support, and means to release said partial loop into engagement with the bundle under tension to hold the bundle in a fixed position against said abutment for completion of the laying of the strand and securing of the strand.

20. In a bundle binding machine, a bundle passage having a bundle support and a lateral abutment to position a bundle on the support, a gripper adjacent said abutment for securing the end of a binding strand, means for reeving the strand about a bundle on said support progressively from said secured end, means at the top of the bundle passage to hold a portion of the reeved strand in a loop above and out of contact with the bundle, and means to release the loop holding means when the loop is long enough to hold the bundle against said abutment.

21. In a bundle binding machine, a wire joining device for joining together portions of a binding strand laid about a bundle, grippers at opposite ends of said device to hold said strand under tension during operation of the device, and a replacing gripper movable from a position adjacent one of said grippers to a position adjacent the other gripper to grip the strand temporarily and transfer it from one gripper to the other.

22. In a bundle binding machine, a rotatable ring for reeving a binding strand about a bundle to be bound, a bundle guide frame within said ring, means for supporting said guide frame only on said ring, and means to hold said guide frame against rotation.

23. In a bundle binding machine, a rotatable ring for reeving a binding strand about a bundle to be bound, a bundle guide frame supported by and within said ring, a plurality of means in the path of movement of the binding strand arranged to hold said frame against rotation, and means for temporarily withdrawing said holding means one after the other to allow the strand to pass said means as the ring rotates.

24. In a bundle binding machine, a bundle passage, a strand joining device at one side of said bundle passage, a gripper adjacent said strand joining device for holding the primary end of a strand, a retractable strand engaging member mounted at the top of said bundle passage at said one side of the passage, a rotary carrier for reeving a strand from said gripper over said member and under tension about a bundle in said bundle passage, and means actuated by said carrier at an intermediate point in its rotation to retract said member before the strand is laid around the bottom of the bundle.

25. In a bundle binding machine, a bundle passage, a strand joining device at one side of said bundle passage, a gripper adjacent said strand joining device for holding the primary end of a strand, a retractable strand engaging member mounted at the top of said bundle passage at said one side of the passage, rotary means for reeving a strand from said gripper under tension first upwardly at said one side of the passage, over said strand engaging member, across the top of said passage to the opposite side of said passage, down said opposite side, and back under the bottom of the passage to said one side, and means actuated by said reeving means in its downward movement to retract said member from engagement under said strand.

26. In a bundle binding machine, a joining device for joining together portions of a binding strand, means for laying a strand under tension about a bundle, a primary gripper at one side of said joining device for holding the primary end of the strand during operation of said strand laying means and joining device, a secondary gripper at the opposite side of said joining device for holding a portion of the strand during operation of said joining device, means for cutting the wire between said grippers and joining device on both sides of said joining device after operation thereof, thereby forming a new primary end on said strand at said secondary gripper, a replacing gripper for transferring said new primary end from said secondary gripper to said primary gripper after each operation of said cutting means, and means to release said primary end from said replacing gripper during operation of said strand laying means and said joining device.

27. In a bundle binding machine, a frame structure, a strand laying ring for reeving a binding strand about a bundle to be bound, a plurality of rollers on said frame supporting said ring for rotation, a bundle guide frame within said ring, a plurality of rollers on said guide frame supporting said guide frame on said ring, and means to hold said guide frame against rotation.

ALBERT E. CRANSTON, SR.

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