

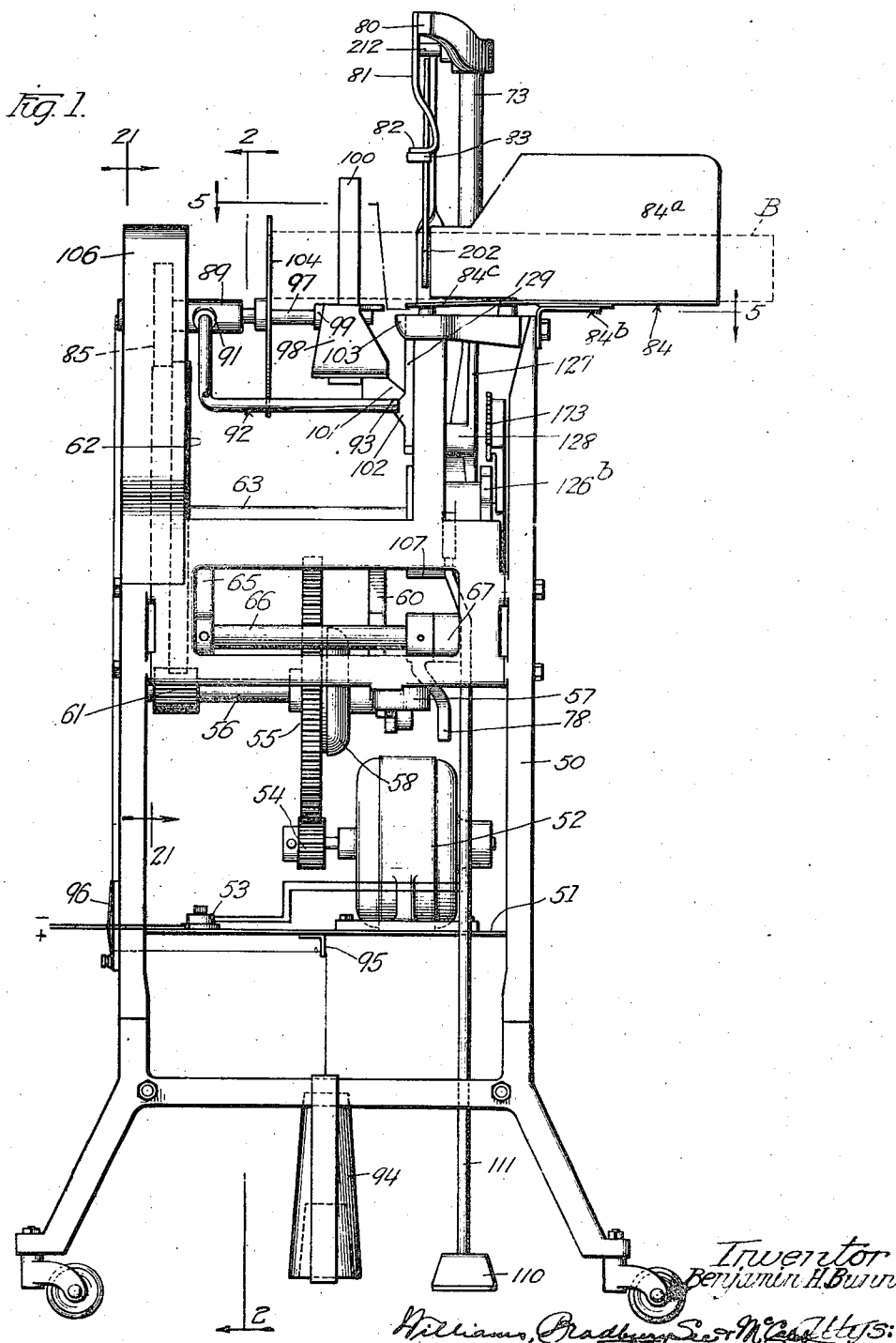
Nov. 9, 1926.

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B. H. BUNN

TYING MACHINE

Filed August 25, 1920 17 Sheets-Sheet 1



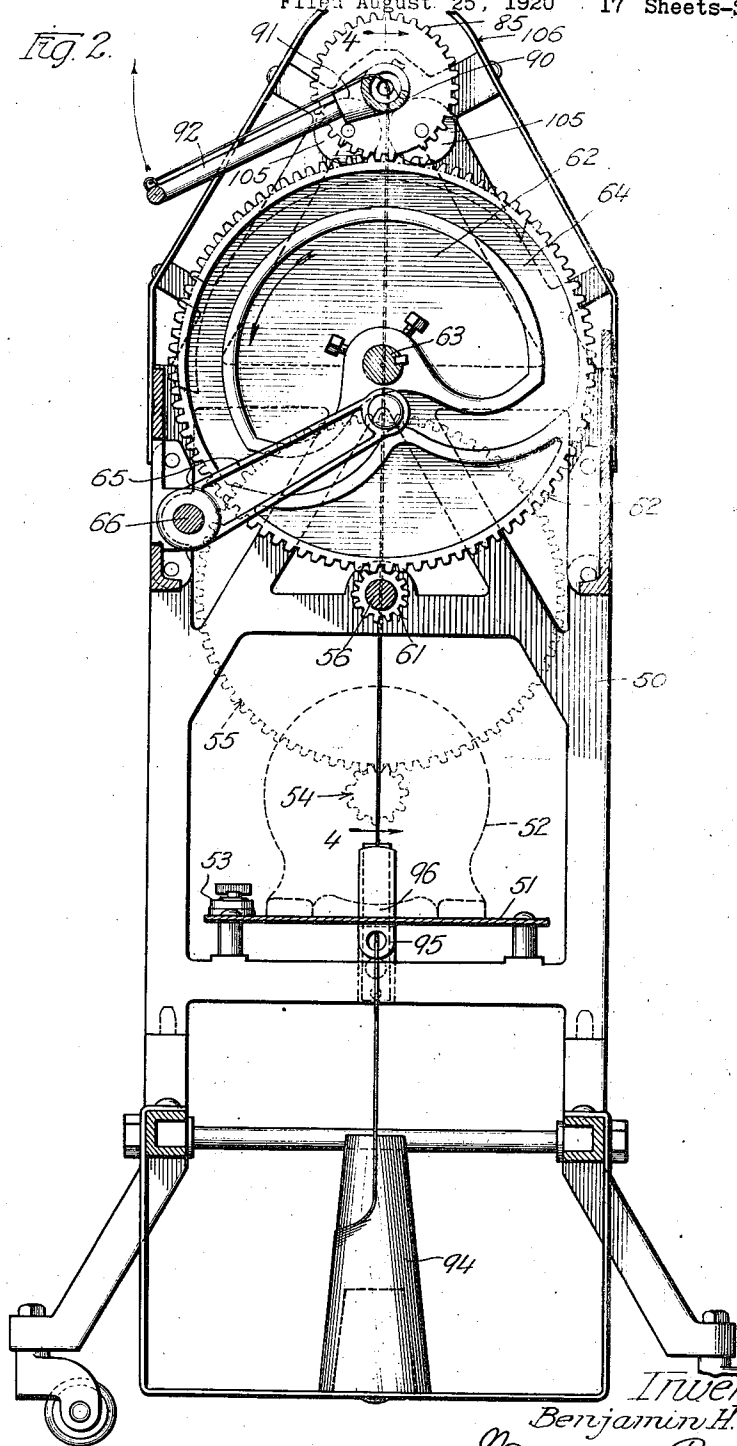
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TYING MACHINE

Filed August 25, 1920 17 Sheets-Sheet 2



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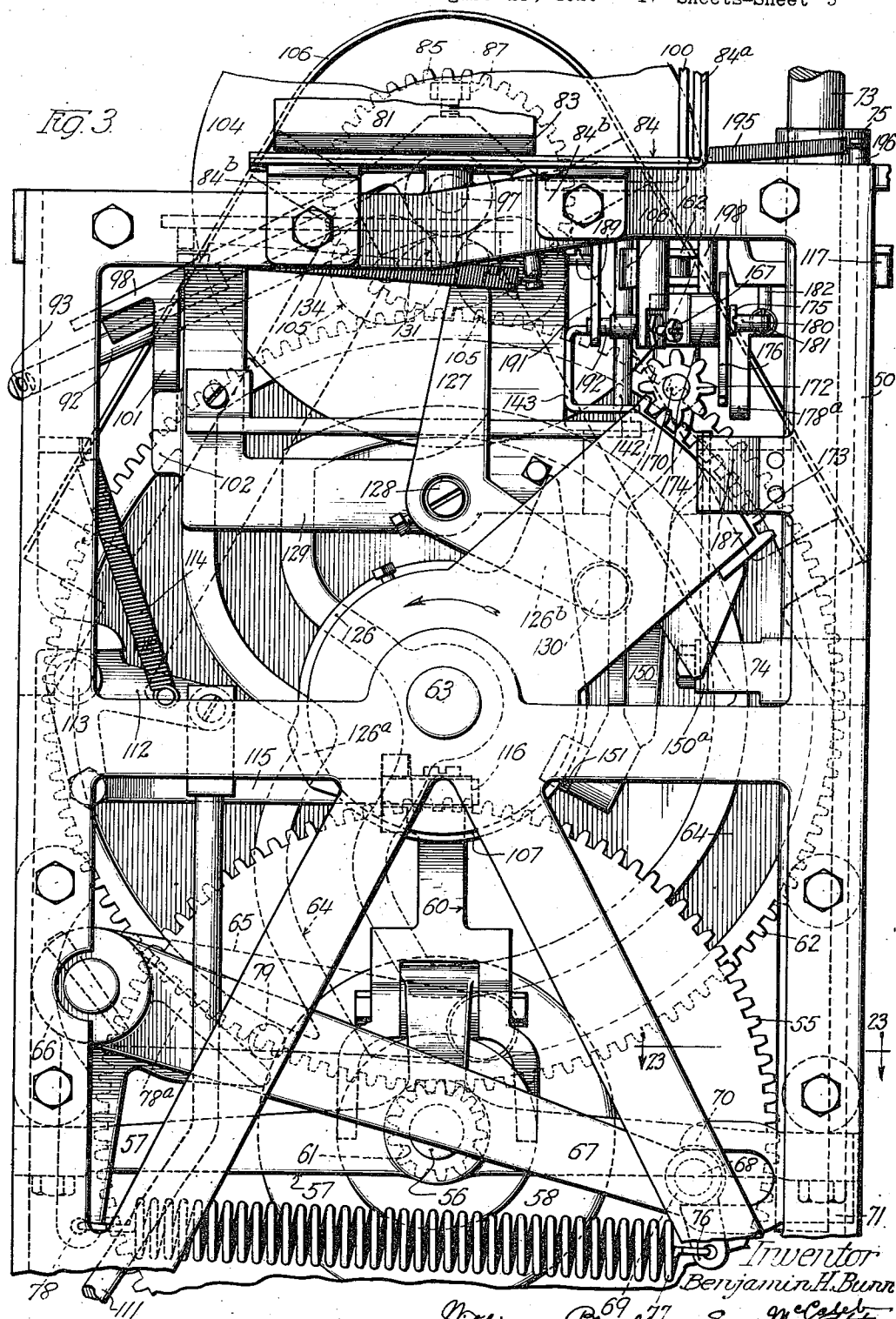
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B. H. BUNN

TYING MACHINE

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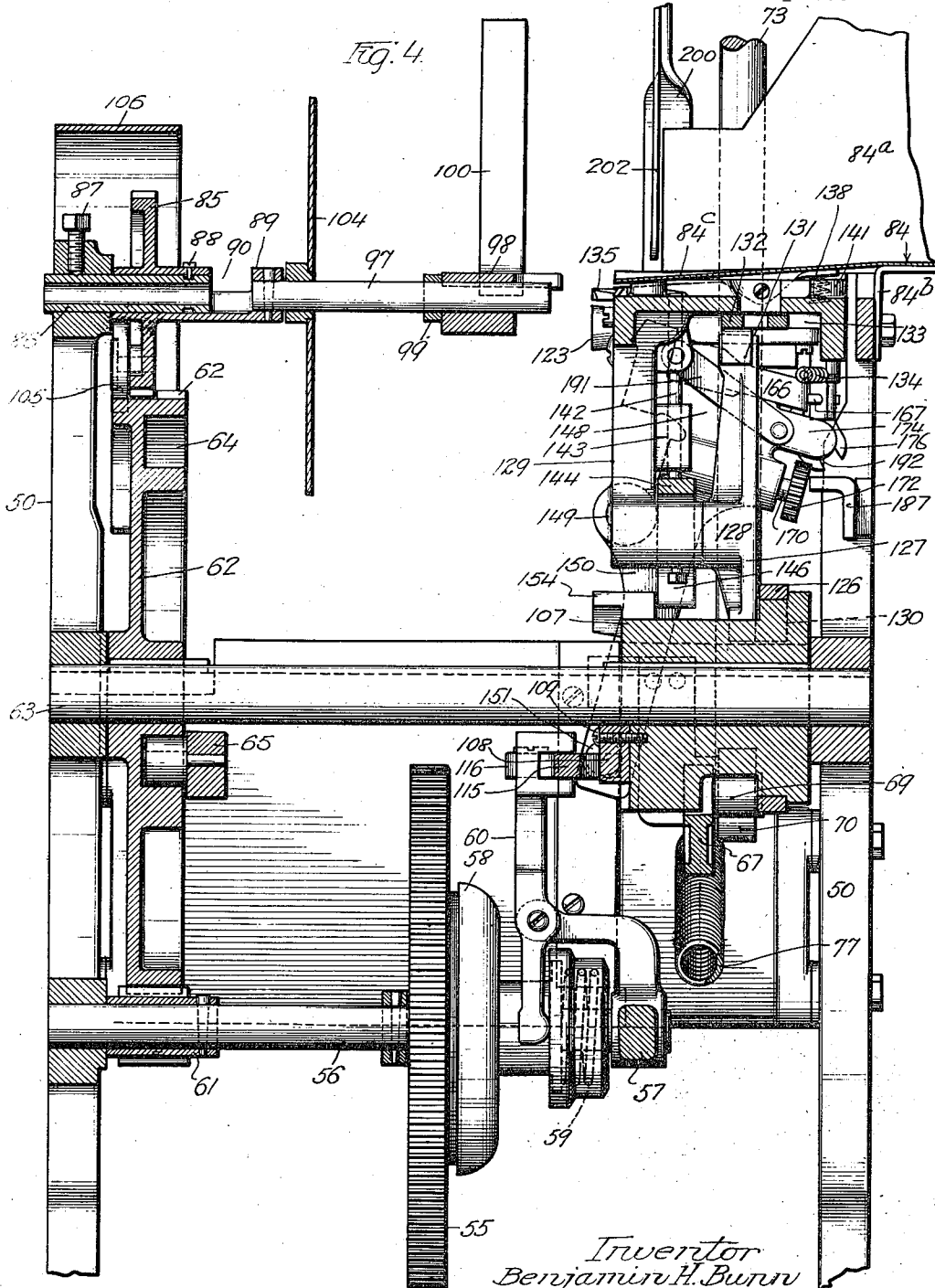
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TYING MACHINE

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Fig. 4.



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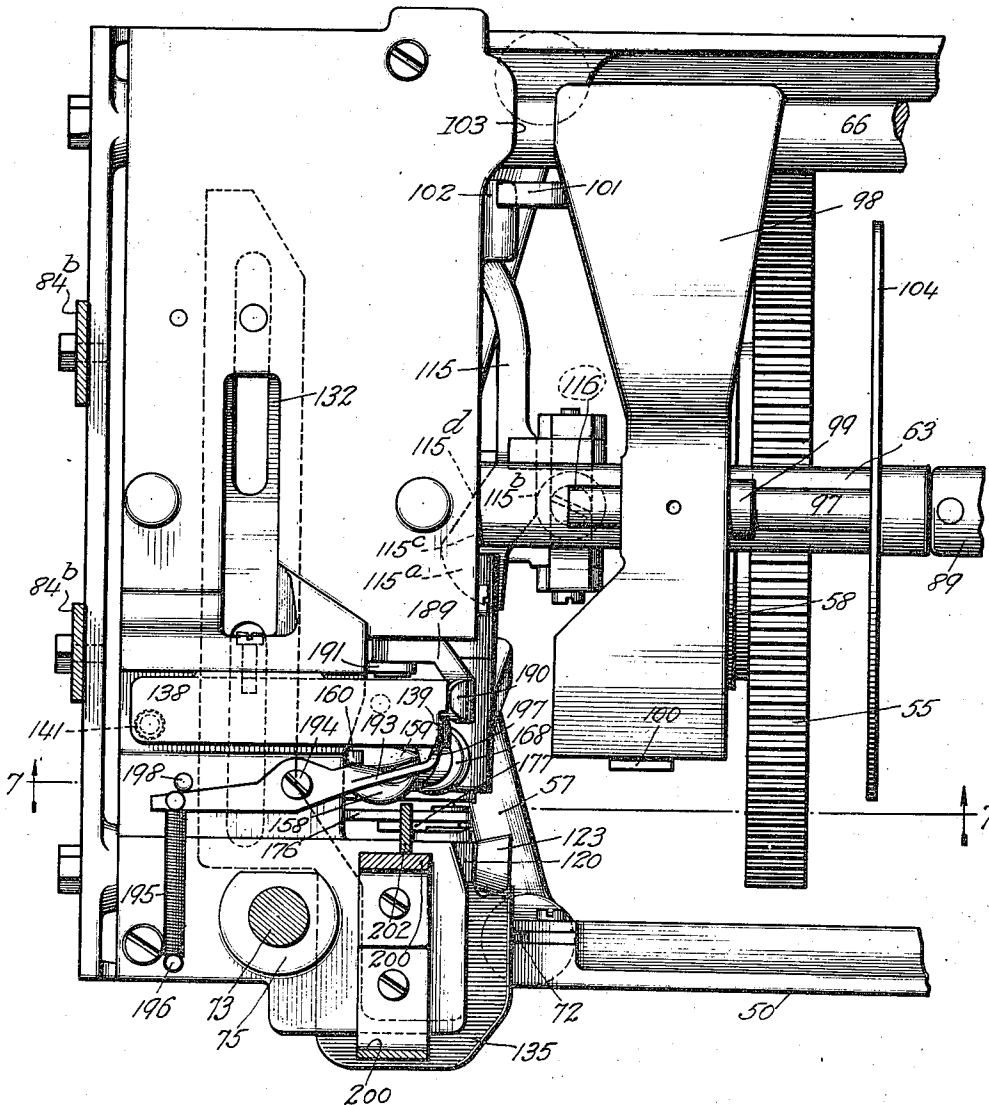
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TYING MACHINE

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Fig. 5.



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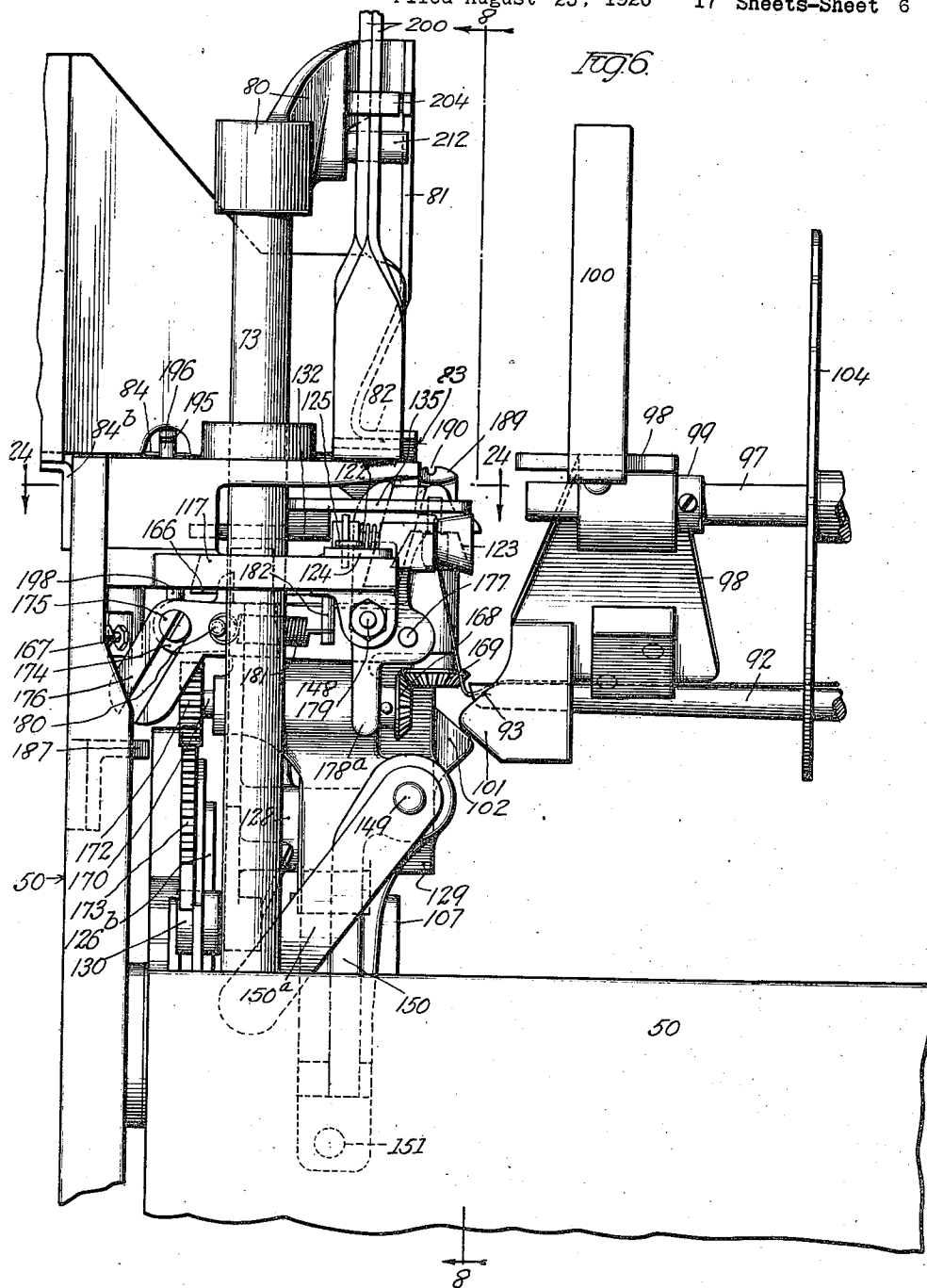
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TYING MACHINE

Filed August 25, 1920 17 Sheets-Sheet 6



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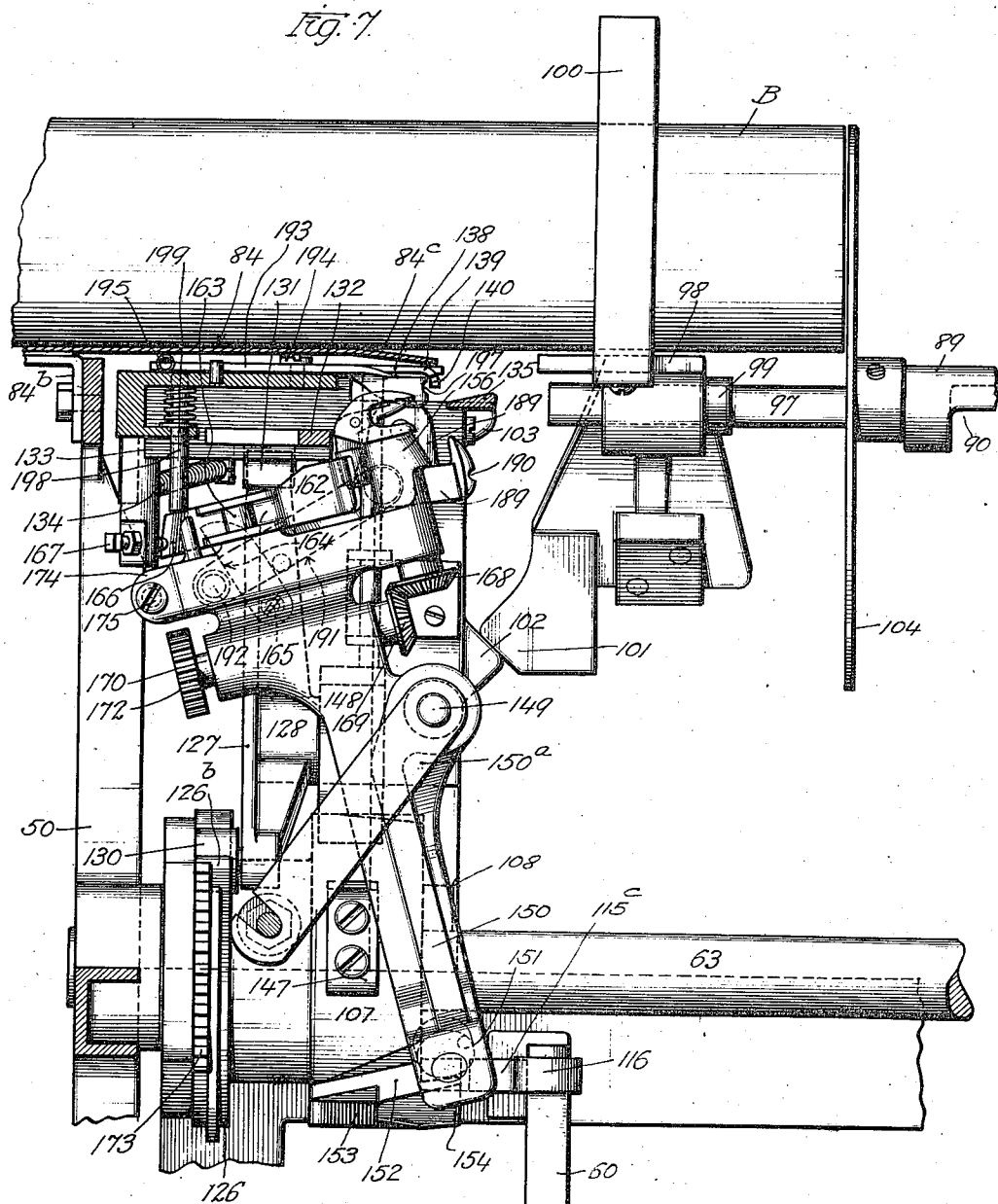
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TYING MACHINE

Filed August 25, 1920 17 Sheets-Sheet 7



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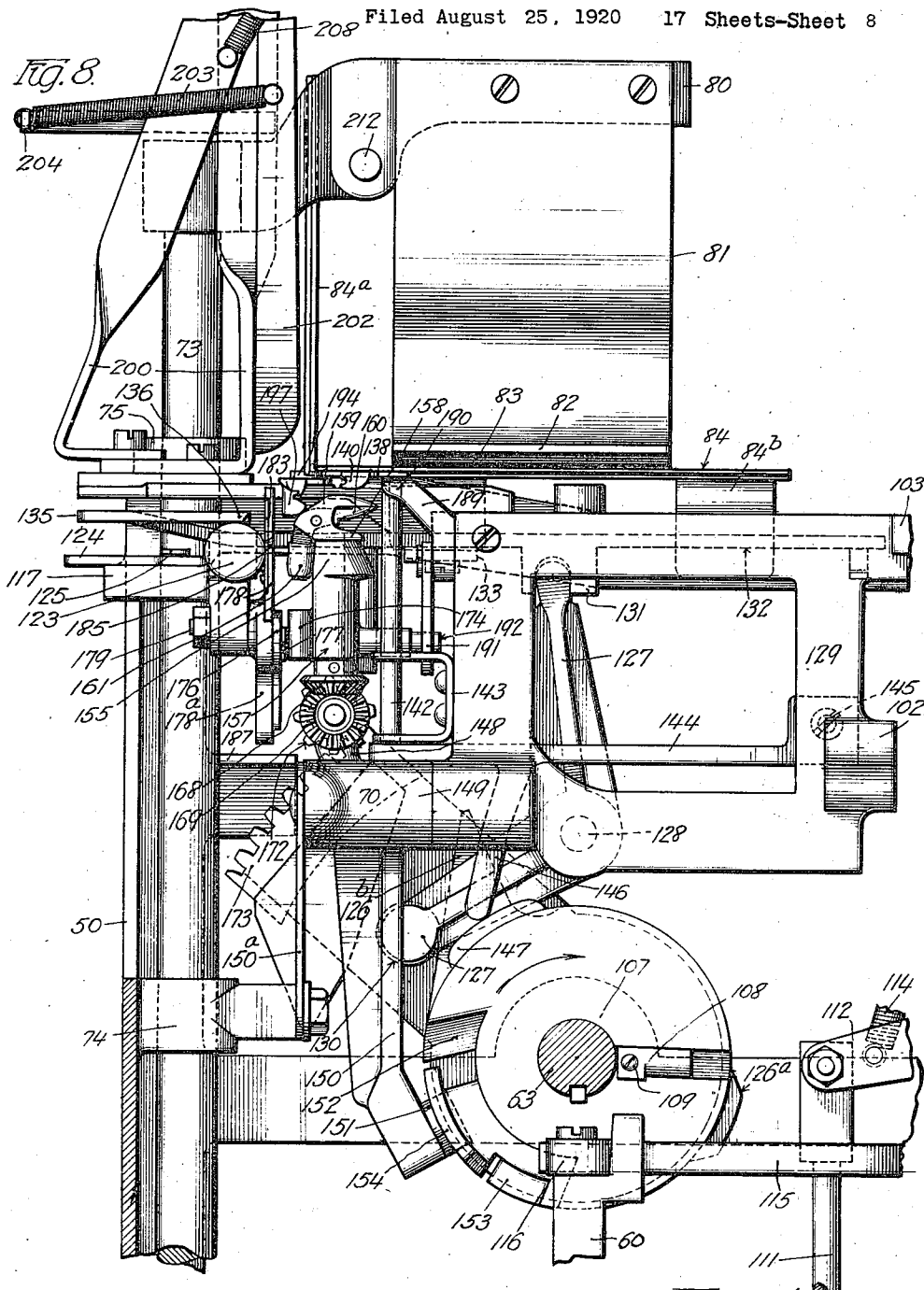
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TYING MACHINE

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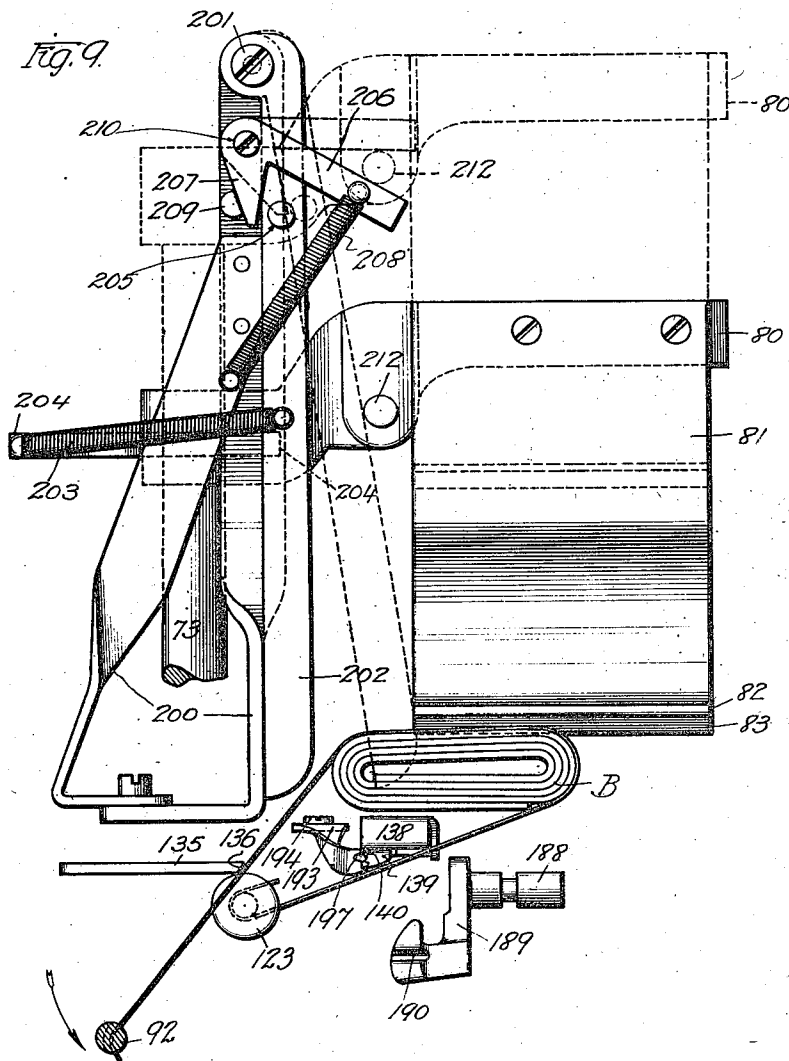
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TYING MACHINE

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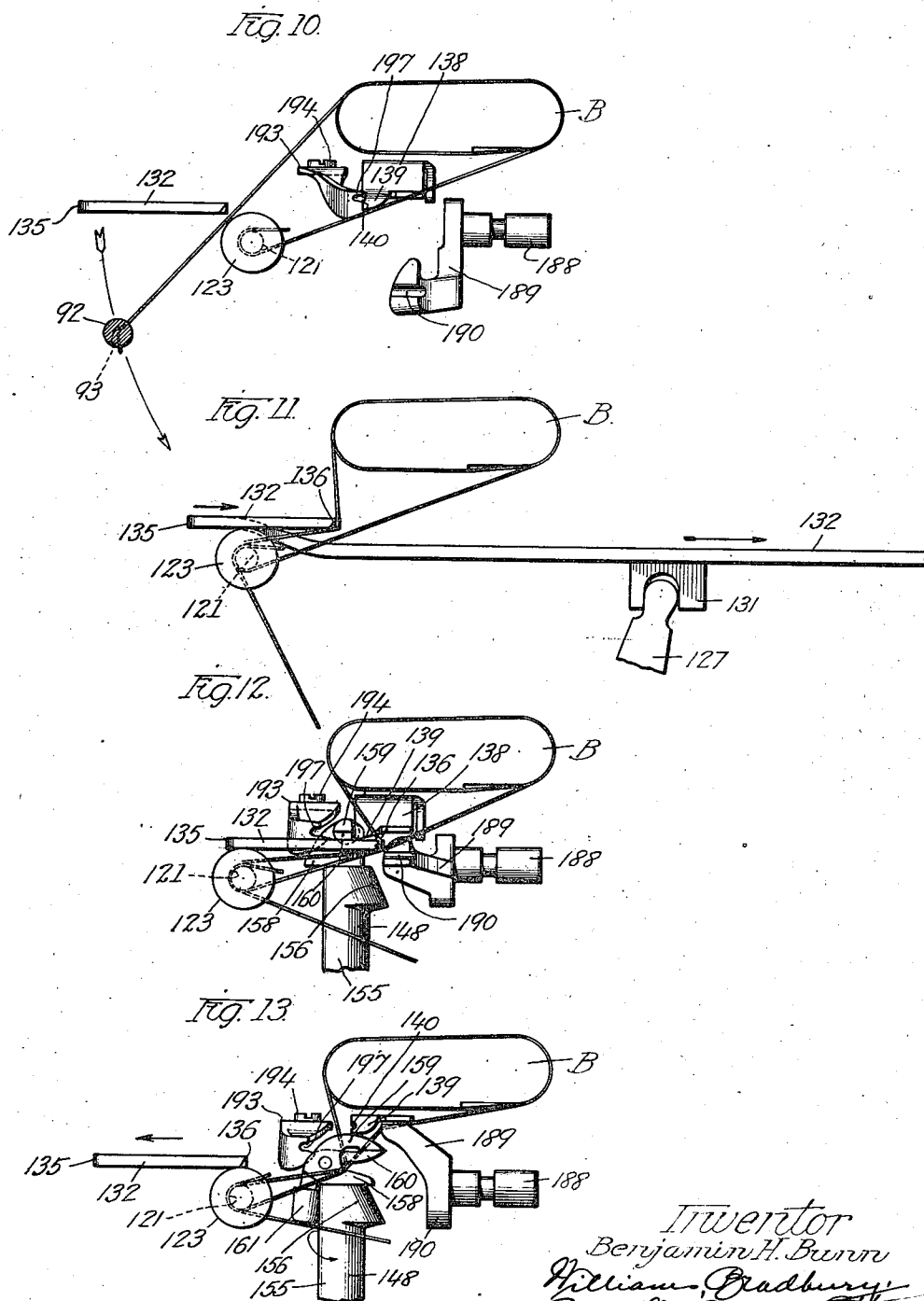
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Fig. 14.

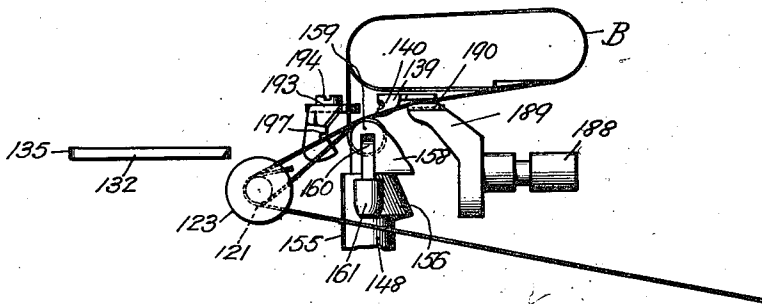


Fig. 15.

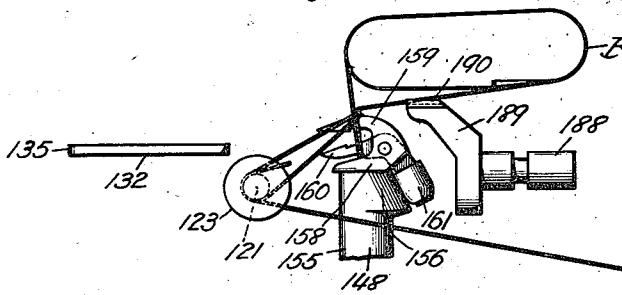


Fig. 16.

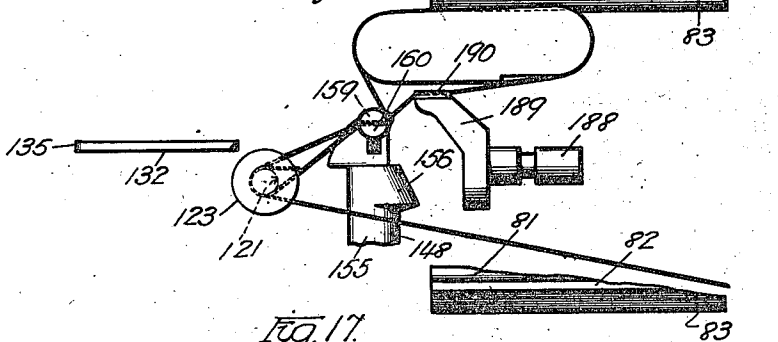
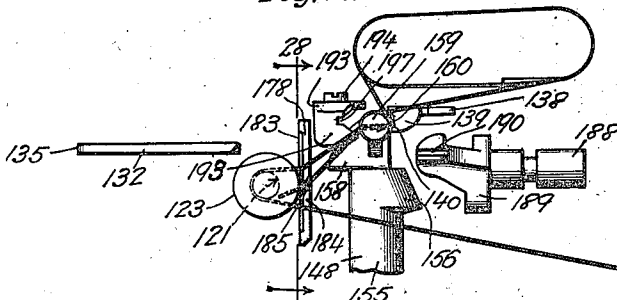


Fig. 17.



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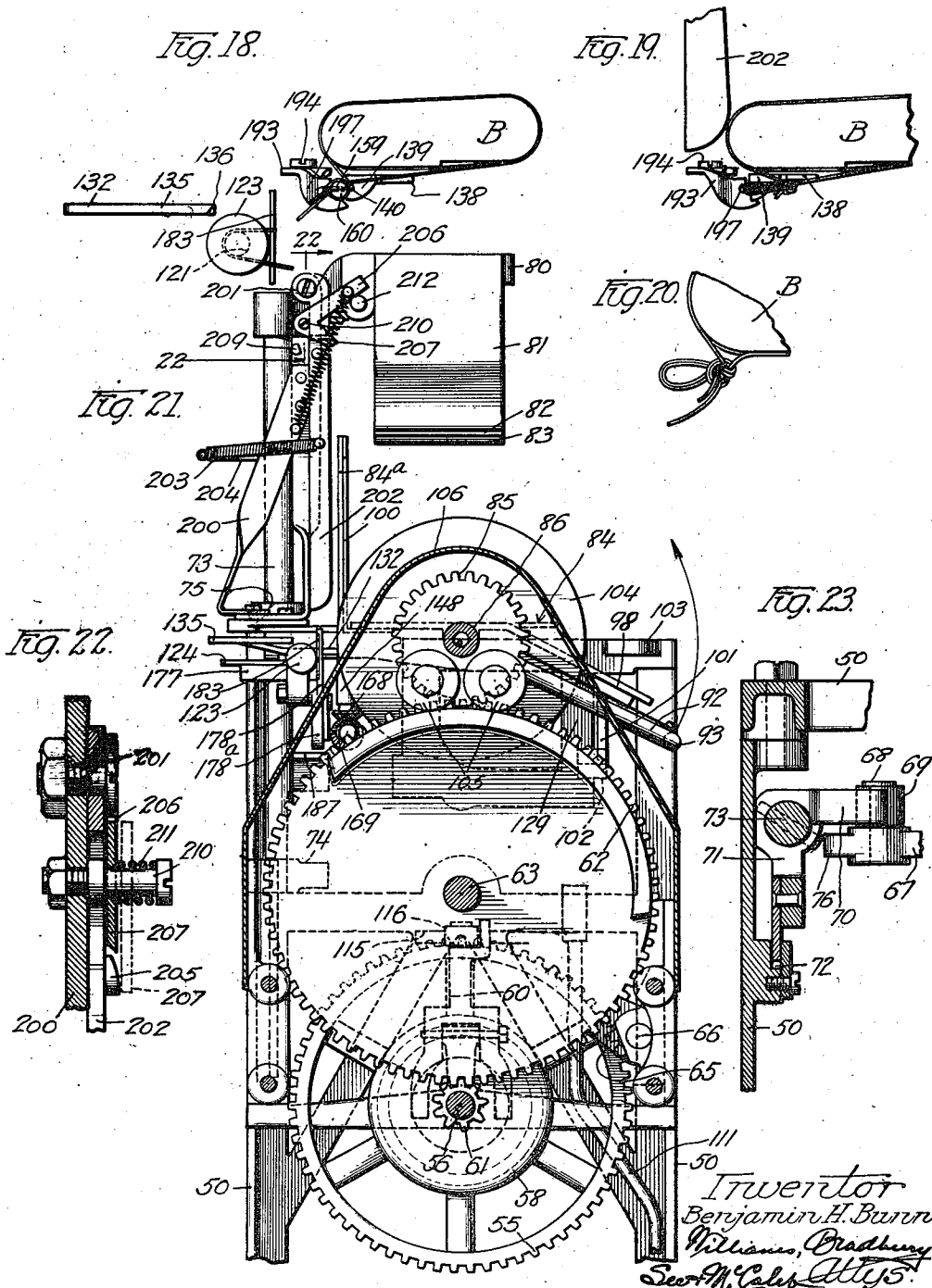
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B. H. BUNN

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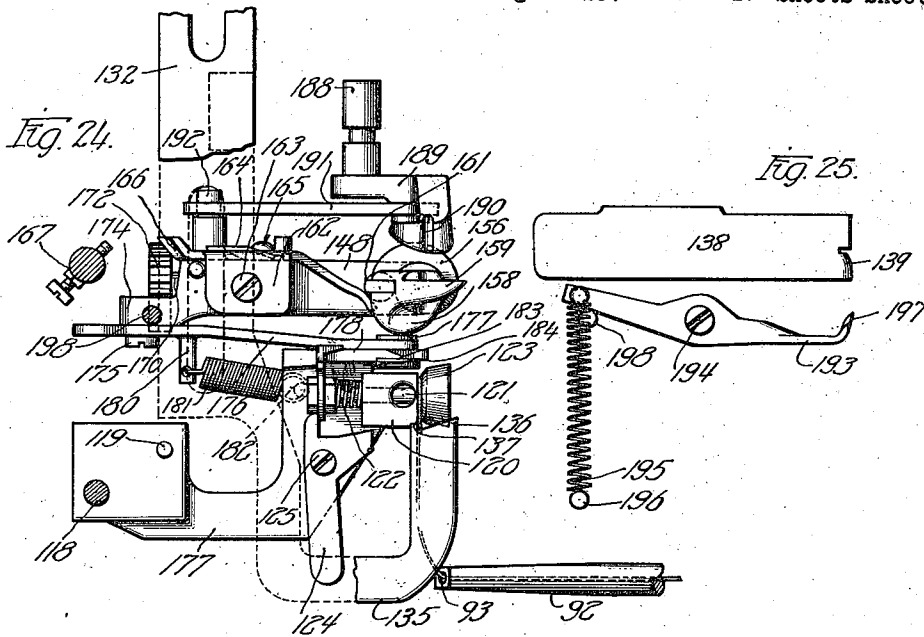


Fig. 26.

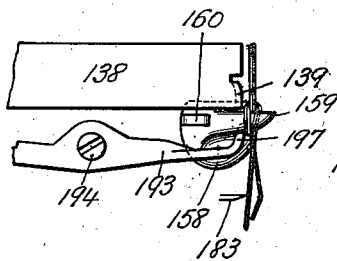
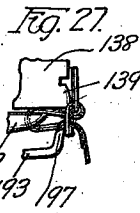


Fig. 28.

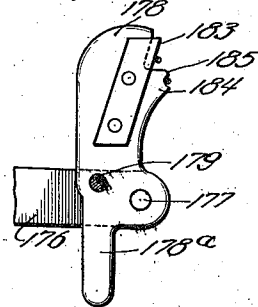
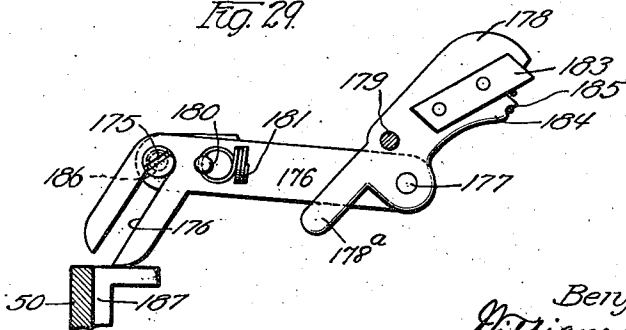


Fig. 29.



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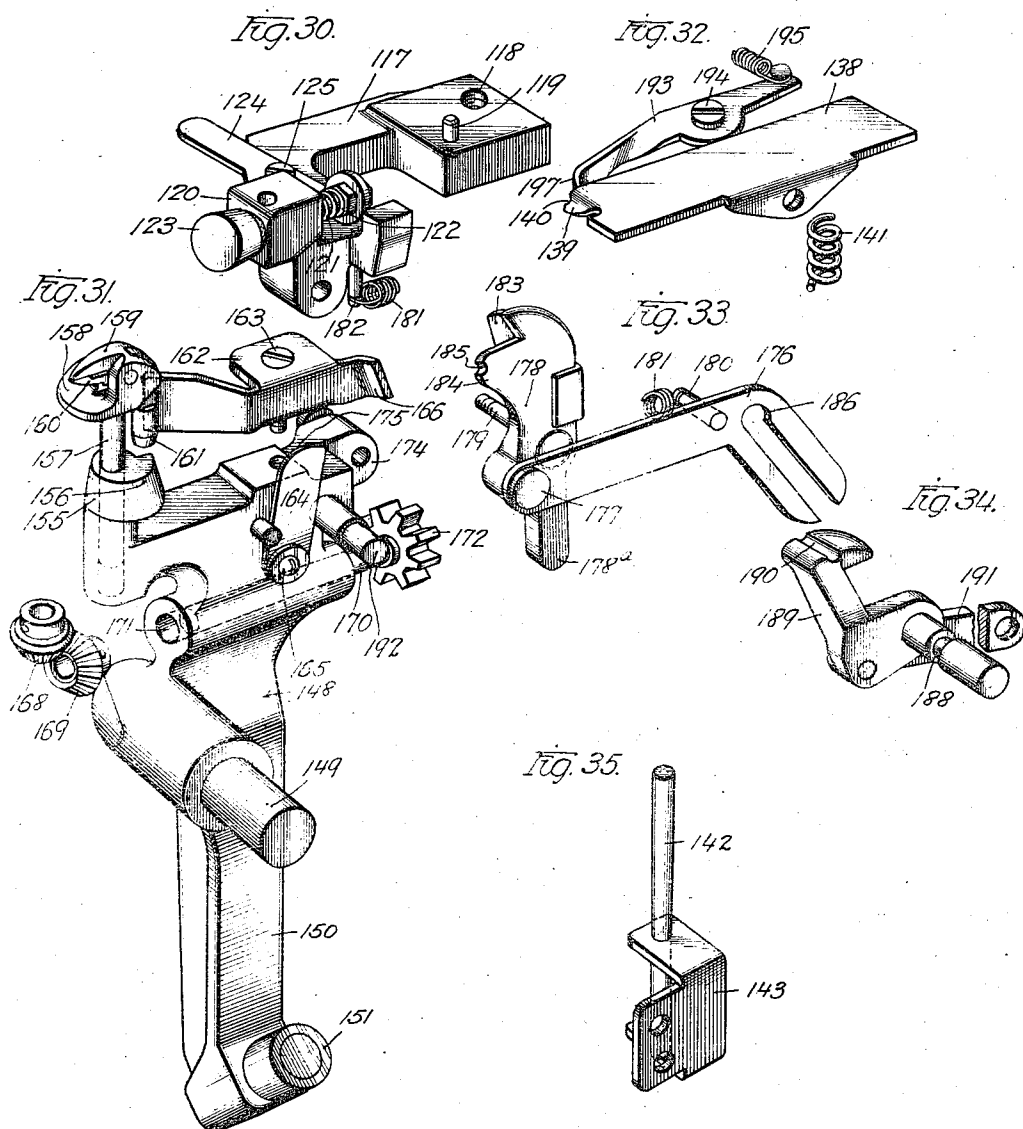
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TYING MACHINE

Filed August 25, 1920 17 Sheets-Sheet 14



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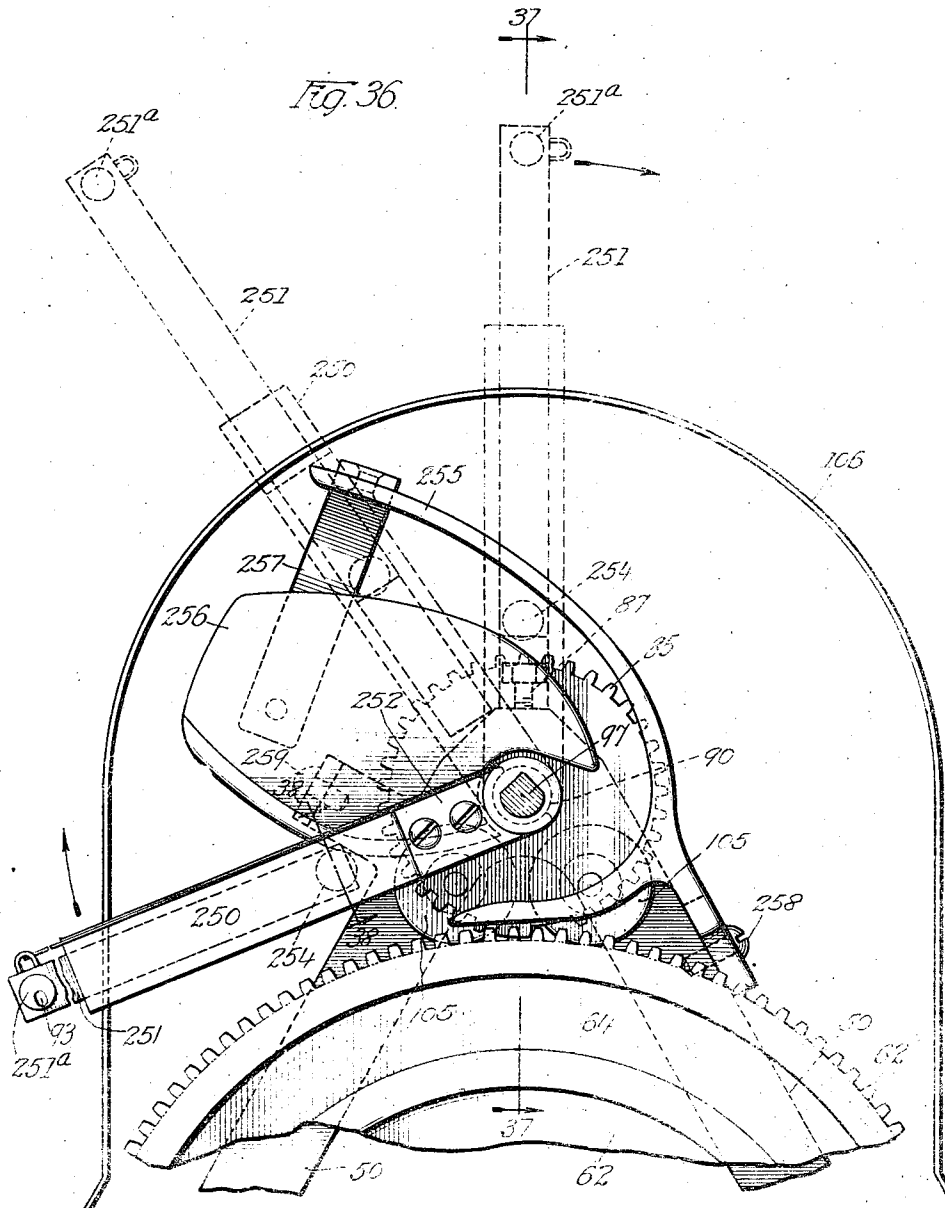
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TYING MACHINE

Filed August 25, 1926 17 Sheets-Sheet 15



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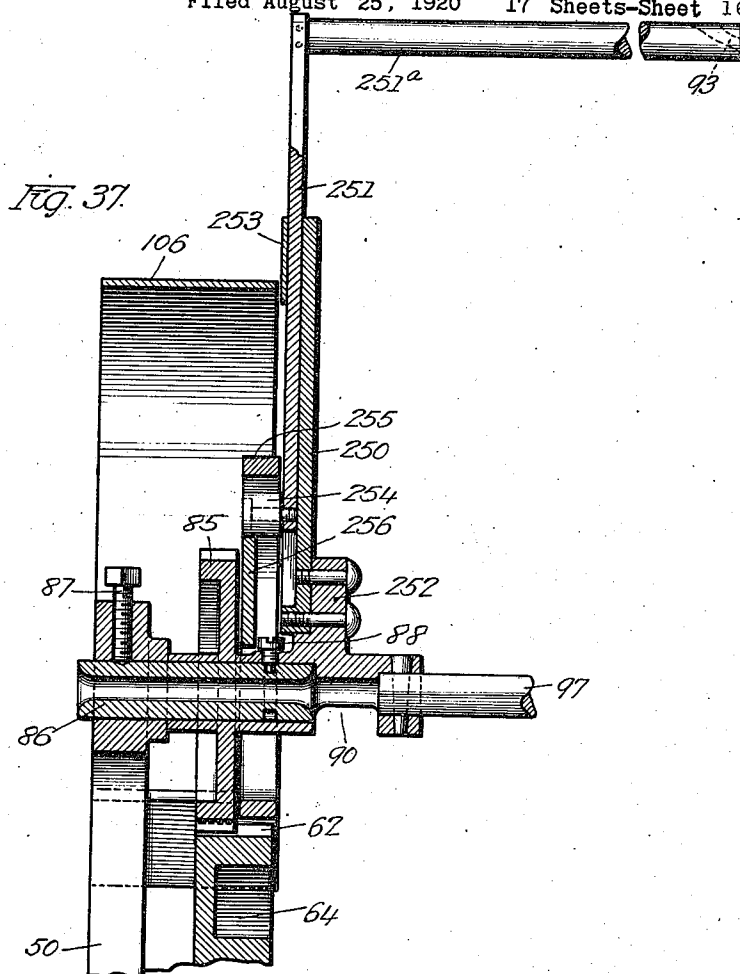
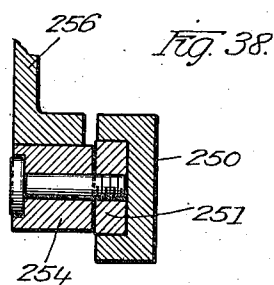
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TYING MACHINE

Filed August 25, 1920 17 Sheets-Sheet 16



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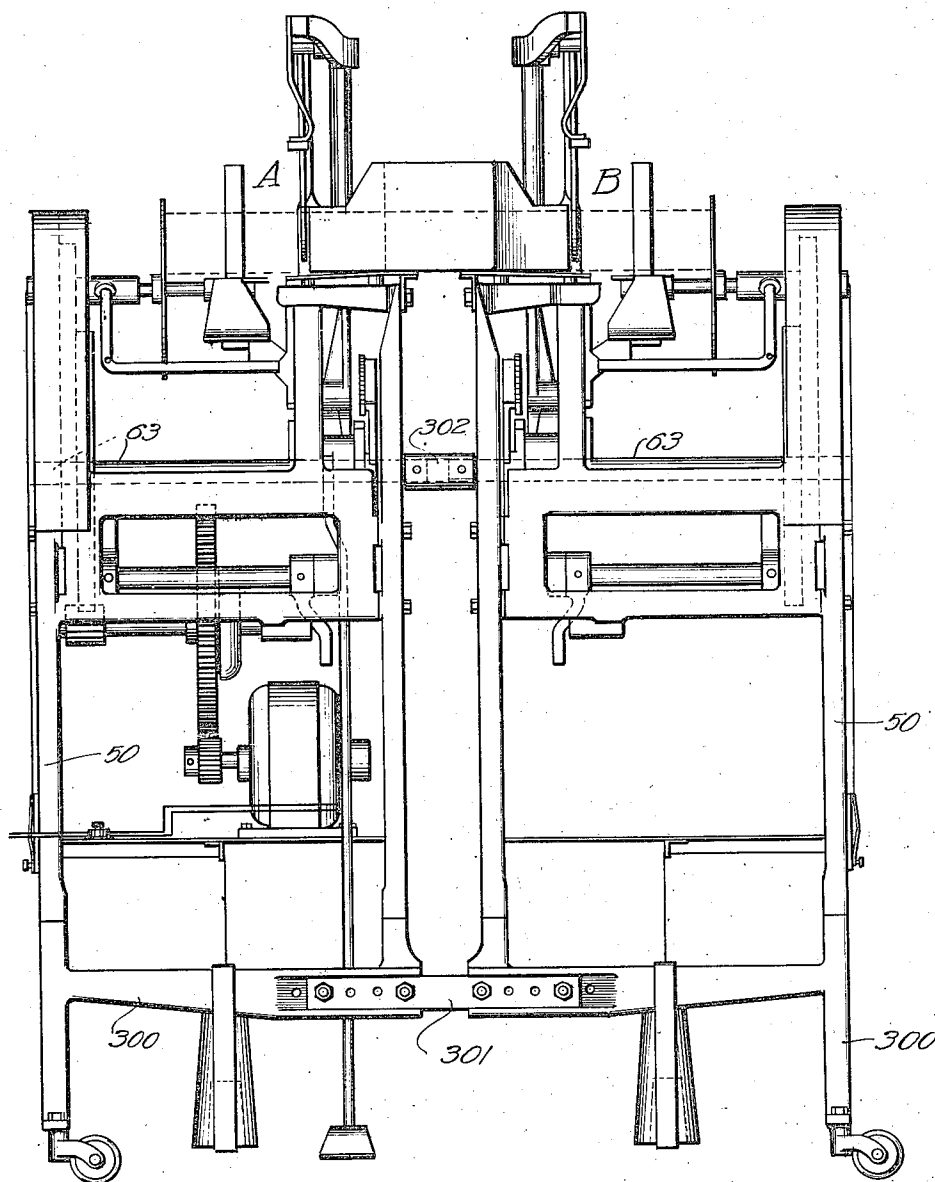
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Fig. 39



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UNITED STATES PATENT OFFICE.

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TYING MACHINE.

Application filed August 25, 1920. Serial No. 405,974.

My invention relates to an apparatus capable of tying up packages, parcels and bundles of various kinds.

One of the more specific objects of the present invention is to provide an apparatus of this class that comprises devices arranged when operated to place two or more parallel wraps of the twine around the bundle, package or parcel being tied, and then securely to tie the twine around the same.

In addition to the accomplishment of the object last above mentioned, my invention contemplates various improvements in the construction, arrangement, co-operation and mode of operation of the various parts of the apparatus, all of which improvements will be most clearly understood, from a detailed description read in connection with drawings illustrating the various features of the apparatus.

In the accompanying drawings illustrating my invention,

Fig. 1 is a front elevational view of the machine illustrating the several parts thereof in their normal positions;

Fig. 2 is a vertical sectional view taken on the line 2—2 of Fig. 1, looking in the direction indicated by the arrows;

Fig. 3 is a fragmentary elevation of the upper portion of the right-hand side of the machine, this view, for the purpose of clearness in illustration, showing the several parts in the positions which are assumed thereby in the operation of the machine at the time the knotter operating sector has just come into engagement with its co-operating knotter operating pinion;

Fig. 4 is a fragmentary vertical sectional view taken on the line 4—4 of Fig. 2, looking in the direction indicated by the arrows;

Fig. 5 is a fragmentary plan view taken on the line 5—5 of Fig. 1;

Fig. 6 is a fragmentary elevational view of the upper portion of the rear of the machine, this view showing the several parts in the respective positions occupied thereby when the several parts shown in Fig. 3 are in the positions shown in that figure;

Fig. 7 is a fragmentary vertical sectional view taken on the line 7—7 of Fig. 5, looking in the direction indicated by the arrows;

Fig. 8 is a fragmentary vertical sectional

view taken on the line 8—8 of Fig. 6, and looking in the direction indicated by the arrows, the several parts shown in this view being illustrated in the positions occupied thereby when the several parts shown in Figs. 3 and 6 have advanced to the positions shown in those figures;

Fig. 9 is an isolated detail view of the mechanism shown in the upper left-hand corner of Fig. 8, Fig. 9 illustrating the several parts in the positions occupied thereby when the wrapping arm has traveled approximately three-fourths around on its first rotation in the cycle of machine operation;

Figs. 10 to 19, inclusive, are views illustrating positions assumed by the knotter and appurtenant mechanism during a cycle of operation;

Fig. 20 illustrates a completed knot;

Fig. 21 is a vertical sectional view taken on the line 21—21 of Fig. 1, this view illustrating in detail the mechanism for operating the wrapping arm;

Fig. 22 is a fragmentary sectional view taken on the line 22—22 of Fig. 21;

Fig. 23 is a fragmentary sectional view taken on the line 23—23 of Fig. 3;

Fig. 24 is a fragmentary plan view taken on the line 24—24 of Fig. 6;

Fig. 25 is a fragmentary plan illustrating the positions assumed by the strippers when the several parts shown in Fig. 24 are in the positions illustrated in that figure;

Fig. 26 illustrates the manner in which the strippers co-operate with the knotter at the time the latter starts on its backward movement to effect the tying of a knot;

Fig. 27 illustrates the same parts after the knotter has moved back to the position where it releases the twine;

Fig. 28 is a fragmentary detail of the twine cutter and releaser; this view may be regarded as having been taken on the line 28—28 of Fig. 17;

Figure 29 illustrates the same parts in the positions occupied thereby after the cutter has been removed forward to sever the twine;

Figure 30 is a detail perspective, illustrating the twine catcher and the manual releasing lever therefor;

Figure 31 is a partially disassembled view

in perspective of the mechanism for operating the knotter;

Figure 32 is a partially disassembled perspective illustrating the arrangement of the 5 strippers which co-operate with the knotter;

Figure 33 is a view in perspective of the cutter and twine releasing device;

Figure 34 is a view in perspective of the device which, at the proper point in the 10 cycle of operation, insures that the twine shall be held in a position where it may be grasped by the knotter, and which also serves to hold the twine tightly against the under side of the bundle to be tied during 15 the tying operation.

Figure 35 is an isolated detail in perspective of the vertically movable plunger which, at the proper moment in the cycle of operation, moves the horizontally pivoted 20 stripper out of the path of the knotter, and which also causes compression of the bundle at the point where the knot is tied;

Figure 36 illustrates a modified wrapping arm construction, together with a novel arrangement of cams for operating the wrap- 25 ping arm;

Figure 37 is a fragmentary vertical sectional view taken on the line 37—37 of 30 Figures 36;

Figure 38 is a fragmentary sectional view taken on the line 38—38 of Figure 36 and looking in the direction indicated by the 35 arrows, and

Figure 39 illustrates an embodiment of my invention that is capable of tying both 40 ends of a bundle at the same time.

Similar characters of reference refer to similar parts throughout the several views.

In view of the fact that a number of 45 sheets of drawings are necessarily required completely to illustrate the machine of my invention, I shall in this description first take up and describe the details of the several parts of the machine as well as their 50 mounting and assembly, pointing out in a general way the function of each part and later describe the operation of the machine and the manner of co-operation of the several parts of the mechanism.

Referring first to Figure 1, it will be seen 55 that the machine comprises a framework 50 which is conveniently mounted on casters so that the entire machine may be moved around as a unit. The construction of the 60 framework may be varied within wide limits and I, therefore, dispense with any detailed description of the framework, particularly since the details of its construction are clearly shown in the several sheets 65 of drawings.

Near its lower portion the framework is provided with a shelf 51 whereon is mounted the electric motor 52 and its controlling 70 switch 53. As will presently appear, the motor 52 constitutes the sole source of power

for the several operating parts of the apparatus. When the tying machine is in use the motor is continuously running, a manually closed and an automatically opened 75 clutch being employed to connect the several operating parts of the machine with the motor to effect a tying cycle and then to disconnect such parts from the motor. Mounted upon the armature of motor 52 is a pinion 54 which is permanently in mesh with a gear 75 55. Gear 55 is loosely mounted on a shaft 56 which has one end thereof journaled in the frame 50 and the other end thereof bearing in the bracket 57. The gear 55 and shaft 56 are operatively connected and dis- 80 connected as required by a clutch comprising the clutch element 58 which is keyed upon shaft 56 and is normally urged into engagement with the side face of the gear 55 by a spring 59. (See Fig. 4.) In order to discon- 85 nect the shaft 56 from the gear 55 it is necessary to retract disc 58 against the tension of spring 59. Actuation of the clutch is effected through the lever 60, (see Fig. 4.) the bifurcated lower end of which engages 90 in an annular groove in the clutch element in the usual manner. The arrangement for effecting the operation of the lever 60 will later more fully appear after I have described the construction and mode of opera- 95 tion of the treadle which permits the engagement of the clutch and of the cam which effects the automatic disengagement of the clutch.

Keyed upon the left-hand end of the shaft 100 56 (Figs. 1 and 4) is a pinion 61 which is permanently in mesh with the gear 62. Gear 62 is keyed upon the shaft 63 having its ends journaled in the machine frame 50, as is most clearly shown in Figure 4. In addi- 105 tion to serving as part of the driving connection between the shafts 56 and 63, the gear 62 has other separate and distinct functions. It serves as the means for driving the wrapping arm which will presently be 110 described in detail, and also is provided with a cam channel which effects and controls the operation of the bundle clamping and ejecting mechanism. I shall first describe 115 the formation of the cam channel and the mechanism for clamping a bundle during the tying operation and for ejecting the bundle after the tying operation has been completed.

The right-hand face of the gear 62 (as the 120 same is viewed in Figs. 1 and 4) is provided with a cam channel 64. This channel, as is most clearly illustrated in Figure 2 extends around the periphery of the gear for about 240° and then turns in to a point adjacent 125 the axis of the gear. Operated by the gear 62 is a crank arm 65 having one end thereof fixed upon a shaft 66 which is journaled in the machine frame, as is clearly shown in the 130 drawings. The other end of the arm 65 is

provided with a pin which bears in and constitutes a follower for the cam channel 64. Figure 2 illustrates the positions normally occupied by the gear 62 and the crank arm 65. The arrow in Figure 2 indicates the normal direction of operation of the gear 62. Rotatably mounted upon that end of the shaft 66 opposite the arm 65 is an arm 67 which is provided with a pin 68 carrying roller 69 which is embraced by the bifurcated portion 70 of the casting 71, which is mounted for vertical reciprocation in a guide 72 carried by the machine frame 50, all as is clearly shown in Figure 23. The casting 71 is fixed upon the lower end of a rod 73 which is mounted for vertical movement in bearings 74 and 75 carried by the machine frame 50. (Fig. 3.) That end of the arm 67 which is provided with the pin 68 and roller 69 is furthermore provided with a short arm 76. A heavy coiled spring 77 has one end thereof connected with the arm 76 and the other end connected with an arm 78, which is fixedly mounted upon the shaft 66. It will thus be seen that movement of the arm 78 in a clockwise direction (Fig. 3) will place the spring 77 under tension and cause the arm 67 to move in a clockwise direction (Fig. 3), thereby causing the vertically movable rod 73 to be moved to its lower or depressed position, illustrated in Figure 3. Formed integral with the arm 78 is an arm 78^a which lies beneath a pin 79, which projects laterally from the arm 67.

Fixed upon the upper end of the vertically reciprocating rod 73 is a laterally extending arm 80 carrying a vertically disposed plate 81, which is provided at its lower end with a flange 82 having a facing 83 of soft rubber or suitable material. The function of the parts last mentioned is to clamp the bundle to be tied during the tying operation. The table whereon the bundle to be tied is placed is indicated at 84 in Figures 1 and 8. It will be understood that the vertically reciprocating rod 73 is operated from the transverse shaft 66, through the mechanism previously described. Attention is directed to the fact that the connection between the shaft 66 and the vertically reciprocating rod 73 is a yielding connection, so that bundles of various thickness may be placed under and be held by the clamping mechanism. After further descent of the rod 73 is prevented by a bundle with which the cushion of the lower edge of the plate 82 comes in contact, the spring 77 yields to prevent destruction of the bundle or damage to the clamping mechanism.

Referring now to Figure 2, it will be understood that when the gear 62 rotates in the direction indicated by the arrow, the arm 65 is turned in a clockwise direction (Fig. 2), resulting in a partial rotation of the shaft 66. Movement thus imparted to

the shaft 66 is transmitted to the arm 78 to place the spring 77 under tension. Tension placed upon spring 77 causes arm 67 to be turned in a clockwise direction (Fig. 3) until the clamping plate carried at the upper end of the rod 73 comes into engagement with the bundle to be tied. After the bundle has been thus engaged, further downward movement of the rod 73 ceases and further clockwise movement of the arm 78 is taken up by the spring 77.

I shall now describe the so-called wrapping arm and the arrangement for operating the same from the gear 62. In this connection, attention is directed particularly to Figures 2, 4, 8 and 21. While the teeth of gear 62 extend entirely around the periphery thereof, it will appear that through a considerable arc one-half of each tooth is cut away to provide a smooth surface, which, so far as the operating pinion for the wrapping arm is concerned, constitutes an interruption in the gear 62 since the said pinion indicated at 85 lies immediately above the left-hand portion of the gear 62, as the parts are viewed in Fig. 4. The arc through which the teeth of the gear 62 are cut away is clearly indicated in Figure 21. It will thus be seen that so far as the pinion 85 is concerned, the gear 62 is a mutilated gear, but so far as the pinion 61 is concerned, the gear 62 is a complete gear; this because of the fact that the pinion 61 co-operates with all of the teeth of the gear 62, whereas the pinion 85 co-operates only with the uncut teeth.

The pinion 85 is journaled upon a fixed and hollow shaft 86 which is held in position in the machine framework by a set screw 87. The set screw 88 carried by the hub of pinion 85 and engaging in an annular groove in the hollow shaft 86 prevents axial movement of pinion 85 on shaft 86 without preventing rotary motion thereon. It will be noted that the pinion 85 is provided with an elongated hub 89 which is cut away at 90. Formed integral with the hub 89 is a boss 91 in which is secured and from which projects the wrapping arm 92. It will be noted that the wrapping arm extends for a distance in a line at right angles to the axis of the pinion 85 and is then turned into a line parallel with the axis of the pinion 85. It will be noted that the free end of the wrapping arm 92 is provided with an aperture 93 through which the twine may be passed. The twine is carried on the usual spool 94, preferably disposed at the lower portion of the machine framework, as shown in Figure 1, is led upwardly through guides 95 and 96 to the outer end of the hollow shaft 86. The twine is led through the hollow shaft 86 and out through the opening 90 in the hub of the gear 85 outwardly to the twine guide at the bend in the wrap-

ping arm 92. The twine is then threaded through the opening 93 and is attached to the twine catcher presently to be described in detail. I might say at this point that the guide indicated at 96 and clearly illustrated at the lower portion of Figure 1 is preferably of the type comprising a flat spring which maintains the twine furnished to the wrapping arm under more or less tension.

Pinned at the right-hand (Fig. 4) of the hub of the gear 85 is a shaft 97, the free end of which terminates slightly short of the table 84, whereon the package to be tied is placed. The shaft 97 rotates with the pinion 85. In the use of the machine, the bundle to be tied is placed upon the table 84 with the portion thereof around which the twine is to be wrapped projecting to the left (Fig. 4) beyond the table. It is desirable that this portion of the bundle which projects beyond the table shall be supported in some manner and for that purpose I provide the member 98 which is conveniently in the form of a comparatively heavy cast metal lever pivotally mounted upon the extremity of the shaft 97, as is clearly shown in Figures 4 and 5. The position of the member 98 upon the shaft 97 is determined by the position of the collar 99 which may be secured at any desired position on shaft 97 by a set screw, as is clearly shown in Figure 6. At its shorter end the member 98 is provided with an upwardly extending arm 100 which normally lies in a plane parallel with the vertical wall 84^a of the bundle support 84. Despite the fact that the member 98 is mounted upon the rotatable shaft 97, the said member does not rotate with the shaft because of the fact that the longer and heavier end of the member 98 is provided with a laterally extending portion 101 which rests upon a projection 102 carried by the machine frame, as is clearly illustrated in Figures 5, 6 and 7. It will thus be understood that the bundle to be tied is placed upon the bundle support 84 and upon the member 98. As will hereinafter be more fully explained, the twine which is passed around the bundle is carried in the space between table 84 and the pivoted member 98 and at certain times the pivoted member 98 lifts up slightly to permit the twine to slip between the arm 101 and its co-operating projection 102.

If desired, the machine frame may be provided with an additional projection 103, which lies above and slightly behind the projection 102, the purpose of the projection 103 being to prevent the longer end of the member 98 from being raised beyond the plane of the package support under any circumstances.

I find that in many cases it is desirable to provide a gauge which will insure that the

twine which is wrapped around the package shall be placed a definite distance from the end of the package. To fulfill this requirement I provide the shaft 97 with a disc 104 which is secured at any desired position on the shaft 97 by a set screw, as is shown in Figure 7. Prior to the tying operation the package is placed upon the support 84 and the member 98 and pushed up against the disc 104 as well as against the arm 100 of the member 98 and vertical portion 84^a of the package support.

At this point attention is called to the fact that the wrapping arm operating pinion 85 is provided with two small rollers 105—105 which ride upon the smooth portion of the periphery of the gear 62 when the mutilated teeth of the said gear lie opposite the pinion 85, and thus prevent rotation of the pinion 85 under these circumstances.

It should be noted that the width of the gear 62 is greater at its mutilated portion than it is at its un mutilated portion. It is because of this arrangement that the rollers 105 are enabled to hold the pinion 85 against rotation when the mutilated portion of the gear 62 lies opposite said pinion and at the same time does not strike the gear 62 when the pinion 85 is meshing with un mutilated teeth of the gear 62. By referring to Figure 2 it will be seen that the pinion 85 at a point adjacent one of the rollers 105 is missing two teeth and is provided with one large tooth, the purpose of this arrangement being to insure proper co-operation between the gear and pinion and to take up the shock which is imparted to the pinion when it is suddenly moved from a state of rest when the un mutilated teeth of the gear 62 come into more or less violent contact therewith.

Figure 2 illustrates the gear 62, pinion 85 and the several parts connected therewith in their normal positions. When the cycle of machine operation starts and the gear 62 begins to move in the direction indicated by the arrow in this figure, said gear 62 moves through a definite arc before any movement is imparted to the pinion 85. The purpose of this arrangement is to permit the clamping mechanism to engage and firmly hold the package to be tied before any movement is imparted to the wrapping arm. As soon as the un mutilated teeth of the gear 62 come into mesh with the pinion 85, the said pinion and the wrapping arm are caused to make two complete revolutions, after which the mutilated portion of the gear 62 again comes opposite the pinion 85 and the said pinion is held stationary by its rollers 105—105. Thus, at the very end of the cycle of operation, the gear 62 moves through a definite arc without imparting any movement to the pinion 85 and the wrapping arm 92, and it

is in this interval that the knotter and appurtenant mechanism are permitted to complete the tying of a knot, as will presently be explained in detail. A shield 106 is desirably passed over the gear 62 and pinion 85, this, of course, being merely a precautionary expedient.

I shall now proceed to explain how movement imparted to the shaft 63 in the manner heretofore explained is utilized to effect the automatic disengagement of the clutch mechanism and to effect the operation of the knotting devices and their appurtenant mechanism.

Referring now to Figure 8, at 107 I have illustrated a cam block which is formed and adapted to accomplish a plurality of functions. This cam block 107 is mounted upon the right-hand end of the shaft, as the parts are viewed in Figure 4. Considering this cam block and the various functions thereof, attention is first directed to the cam surface which is provided by the metal block 108, which is secured to that face of the cam block nearest the clutch operating lever 60 by a screw 109. This block is beveled or rounded at its forward edge, as is clearly indicated by the manner in which said block is shaped in Figure 8. For the present it will suffice to say that the cam block makes one complete revolution in the direction indicated by the arrow in Figure 8 in a complete cycle of machine operation, and that at the end of the cycle of operation the said cam block 108 functions, in a manner which will be described in connection with my description of the treadle mechanism, to disengage the clutch.

Attention is now directed to the treadle 110 which is most clearly shown in Figure 1. This treadle is secured to the lower end of the operating rod 111, the upper end of which is pivoted to the long arm of the bell crank lever 112 (see Fig. 3) which in turn is pivoted to the machine frame 50 at 113. The coiled spring 114 acting between the long arm of said bell crank lever and the machine frame at all times opposes depression of the treadle. Having one end thereof pivoted to the short arm of the bell crank 112 is an arm 115, the other end of which is embraced by the bifurcated upper end of the clutch operating arm 60. The opening for the reception of the arm 115, which is provided by bifurcating the upper end of the arm 60 as just explained, is horizontally disposed so that the free end of the arm 115 will always be held in the path of the cam 108. That end of the arm 115 which co-operates with the cam 108, as just explained, is in the shape of a wedge, as is indicated at 115^a in Figure 5, and is provided with the surfaces 115^b and 115^c which co-operate with the roller 116 carried by the clutch operating lever 60. Figure 5 illustrates the arm

115 in the position normally occupied thereby. When in this position, the surface 115^a of the wedge-shaped end of the arm 115 lies against the clutch releasing cam 108 and the surface 115^b lies against the roller 116. As a result of this disposition of the arm 115, the upper end of the clutch operating lever 60 (Fig. 4) is held to the left and the clutch is held open. Upon depression of the treadle, the bell crank 112 is turned in a clockwise direction (Fig. 3) and the arm 115 is thrown forwardly until the surface 115^b thereof clears the roller 116. The roller then bears against the surface 115^c. The clutch operating arm 60 being no longer held with its upper end to the left, the clutch disc 58 (see Fig. 4) now engages the gear 55, thereby placing the motor in driving relation to the shaft 56. Closing of the clutch, of course, results in rotation of the shaft 63 and of the cam block 107. (See Fig. 8.) The shaft 63 and the cam block 107 make one complete revolution during a cycle of operation. After the cam block 107 starts to rotate and after the cam 108 has passed beyond the wedge-shaped end of the arm 115, the spring 114 associated with the treadle moves the arm 115 rearwardly, but since the cam 108 no longer lies opposite the end of such arm, such positioning of the arm does not result in opening the clutch. However, after the cam block 107 has made a complete revolution, the cam 108 again engages and forces the arm 115 as well as the clutch operating lever 60 to their normal positions. Another cycle of operation can now be initiated only by again depressing the treadle. It will thus be understood that the clutch is manually closed to initiate each cycle of machine operation and automatically opened by the cam 108 at the end of each cycle.

I shall presently describe how the cam block 107 functions during the first revolution of the wrapping arm to prevent the first turn of twine from being caught by the twine holder and catcher, and how later in the cycle of operation near the end of the second revolution of the wrapping arm the twine is permitted to be caught by the twine catcher and is then moved up into position to be engaged by the knotter. However, before describing the mechanism for accomplishing this purpose, I shall briefly describe the twine holder and catcher. Referring more particularly to Figures 4, 6, 9 and 30, it will be noted that at its right rear corner the machine frame is provided with a small bracket 117 which is secured in position by a screw passing through the opening 118, shown in Figure 30, and is held against displacement by the dowel pin 119. This bracket is provided with a substantially cubical block 120 having an opening therethrough in which is disposed a short

stem 121. A spring 122 acting between the block 120 and a nut and washer at one end of the stem normally retains the latter in the position shown. At its other end the stem 121 is provided with a substantially frustro-conical head 123, the smaller end face of which is resiliently held against the block 120 by the spring 122. As is clearly illustrated in Figure 24, that end of the frustro-conical head 123 next adjacent the block 120 is beveled to facilitate the insertion of the twine between the head 123 and the block 120. It is the tension of the spring 122 which clamps the twine between the head and block. I will now call attention to the lever 124 which is pivoted to the block 117 at 125 and has the smaller end thereof lying immediately adjacent the washer carried by the twine holder stem 121. This arrangement is perhaps most clearly shown in Figure 24. The sole function of the lever 124 is to afford means for manually releasing the twine which is caught between the head 123 and the block 120, as has just been explained. It will readily be seen that by moving the lever 124 in a clockwise direction (Fig. 24), the spring 122 is compressed and the head 123 is moved away from its block 120.

Referring now more particularly to Figures 3, 4, 7 and 8, it will be noted that the cam block 107 is provided near the right hand end thereof (Fig. 4) with a hardened steel collar indicated at 126. This collar is rigidly secured to the cam block by screws or other equivalent means. Formed integral with the collar 126 are two cams shown most clearly in Figure 3. These cams are illustrated at 126^a and 126^b. Bearing upon the ring 126 and at the proper times in the cycle of machine operation operated by the cams 126^a and 126^b is a bell crank lever 127 which is pivoted at 128 to a bracket 129 carried by the machine frame and disposed above the cam block 107. The short arm of the lever 127 is provided with a roller 130 which rides upon the ring 126 and is engaged by the cams 126^a and 126^b. The long arm of the lever 127 engages in a fork or bifurcated boss 131 which is formed integral with plate 132, said plate mounted for reciprocation on the under side of the top plate forming part of the machine frame. The reciprocating plate 132 works in guides 133—133 carried by the said top plate of the machine frame. A helical spring 134 acting between pins carried by the reciprocating plate and by the machine frame top plate normally tends to move the plate 132 to the right (as the parts are viewed in Fig. 3), and consequently at all times tends to hold the roller 130 of the bell crank 127 in engagement with the cam collar 126. As is perhaps most clearly shown in Figures 5 and 24, the reciprocating plate 132 is provided

at its rear end with a substantially U-shaped extension indicated at 135. One leg of this extension is formed integral with the plate 132, while the other leg thereof normally lies immediately adjacent the twine holder and catcher 123. Attention is directed to the fact that the leg of the U-shaped member 135 which lies adjacent the twine holder and catcher is provided with an oblique end indicated at 136 and with a small lug 137. The function of the U-shaped member 135 is to prevent the first wrap of twine from being caught by the twine catcher 123 and later during the second revolution of the wrapping arm to permit the twine to be caught by the twine catcher 123. Later the element 135 moves the second wrap of the twine over into the path of the knotter mechanism. These functions of the member 135 will more clearly appear after I have described the knotter mechanism. For the time being it will suffice to say that normally the member 135 lies in the position illustrated in Figure 5. It remains in this position until the cam 126^a of the hardened ring 126 engages the roller 130 of the bell crank lever 127. The cam 126^a turning the bell crank lever in a counter-clockwise direction (Fig. 3) shifts the plate 132 a short distance in opposition to the tension of the spring 134 and moves the extension 135 of the plate 132 into the position illustrated in Figure 9. I may say that the member 135 lies in this position while, upon the first revolution of the wrapping arm, the twine is being carried past the twine holder and catcher 123. After the cam 126^a has passed the roller 130, the member 135 drops back to the position shown in Figure 5 with the result that on the second revolution of the wrapping arm the twine slipping around the oblique end of the member 135 is permitted to engage behind the twine catcher 123. Subsequently the cam 126^b coming into engagement with the roller 130 of the bell crank lever 127 moves the plate 132 and its extension 135 a substantial distance to the left (Fig. 3) and as a result of this movement the member 135 carries the second wrap of twine into the path of the knotter.

I have heretofore referred to the support 84 which is designed to hold the package or material to be tied. Referring now to Figure 7, I wish to call attention to the fact that the said support is formed of flexible sheet metal and is secured to the machine frame by brackets 84^b. That end of the support 84 which lies to the right of the brackets 84^b (Fig. 7) is severed from its vertical flange 84^a for a short distance, as is indicated at 84^c, to the end that the free edge of the support 84 may be forced upwardly during the operation of the knotter by the mechanism now to be described. The flex-

ible bundle support 84 rests upon a small plate 138 which is pivoted on a horizontal axis in the machine frame top plate. The formation of the plate 138 is very clearly illustrated in Figure 32. One end of the plate 138 is provided with a down-turned lip 139 which is conformed as shown at 140 for the reception of a piece of twine. The lip 139, as will presently appear, constitutes one of the strippers which cooperate with the knotter. That end of the plate 138 opposite the lip 139 is normally held elevated by a short compression spring 141 acting between the plate 138 and the top plate of the machine frame. As will presently appear, it is essential that at a certain point in the operation of the machine that end of the plate 138 provided with the lip 139 shall be elevated. This is done for two reasons. It is necessary that the lip 139 be carried out of the path of the knotter when the latter comes forward into its twine engaging position, as will be presently explained, and it is also desirable that the plate 138 be raised in opposition to its co-operating spring 141, in order that the flexible end of the package supporting plate 84 may be flexed upwardly slightly to compress the bundle at the time of tying. It has been found that if the material being tied is compressed in this manner, there is practically no slack in the two wraps of twine placed around the bundle after the knotting operation has been accomplished. The plate 138 is raised at the proper time in the operation of the machine, for the purposes just mentioned, by a vertically movable plunger 142, which is mounted for vertical movement in the legs of a U-shaped bracket 143, said bracket being secured to the machine frame by screws or other equivalent means, as is shown in Figure 8. The upper end of plunger 142 lies immediately beneath that end of the rocking plate 138 which is provided with the down-turned lip 139. The lower end of the plunger 142 rests upon one end of the lever 144, the other end of which lever is pivoted to the machine frame, as illustrated at 145. It will be understood that the spring 141 associated with the rocking plate 138 at all times tends to hold the rocking plate in engagement with the upper end of the plunger 142 and consequently holds the lower end of the plunger upon its operating lever 144. Formed integral with the lever 144 is an arm 146 which once during each cycle of machine operation is engaged by a hardened cam 147 which is carried on the cam block 107. Engagement of cam 147 with arm 146 raises lever 144 and the movement imparted from lever 144 to its co-operating plunger 142 rocks the plate 138 against the pressure of its associated spring 141. The purpose of this, as previously explained, is to move the finger 139 of plate 138 out of the

path of the knotter and slightly to compress the bundle being tied prior to the knotting operation.

I shall now describe the devices for effecting the tying of a knot. Incidentally in the description of this mechanism I shall find it necessary to consider certain other instrumentalities which are either so closely associated with the knotting devices or which being operated thereby must necessarily be referred to in describing the knotting mechanism. Referring now particularly to Figures 6, 7, 8 and 31, I will call attention to the rather peculiarly shaped element 148 which is mounted for movement on a horizontal axis, said member 148 being journaled on the shaft 149 carried by the machine frame 50. The free end of the shaft 149 may, if desired, be braced by the bar 150^a which is very clearly shown in Figures 6 and 7. The member 148 is provided with a downwardly projecting arm 150, which at its lower end is provided with a roller 151 arranged to co-operate with the cam block 107 to cause the member 148 to be moved on the shaft 149. The upper portion of the member 148 is moved out toward the twine and is returned once during each cycle of operation. Referring now particularly to Figures 7 and 8, it will be seen that the cam block 107 is provided on its periphery with two channels 152 and 153 and is furthermore provided with a projection 154 which causes the roller 151 to enter the channel 152 when, in the course of the rotation of the cam block 107, the channel 152 is brought opposite the roller 151. When the roller enters the channel 152, as just mentioned, the arm 150 is moved to the left (Fig. 7) and consequently the upper portion of the member 148 is moved to the right (Fig. 7) to cause the elements carried by the upper portion of the member 148 to move outwardly toward the twine. After the roller 151 has traveled back in the slot 152, it enters the slot 153 whereupon the arm 150 is carried to the right (Fig. 7) and consequently the upper portion of the member 148 and parts carried thereby are restored to the position shown in Figure 7.

Referring now to Figure 31, it will be noted that at its upper portion the rocking member 148 is provided with a boss 155 which is provided with a vertical bore and has its upper portion conformed to provide a cam 156. Disposed in the bore of the boss 155 is a shaft 157 which at its upper end is provided with the member 158, with which is formed integral the upper jaw 159 of the knotter. The member 158 also pivotally supports the lower jaw of the knotter which is indicated at 160. It will be noted that the lower jaw 160 of the knotter constitutes one arm of a bell crank lever, the other arm of which is provided with a roller

161, which is arranged to co-operate with the cam 156. While Figure 31 shows the several elements now being described, partially disassembled, it will be understood that when assembled the member 158 lies directly on top of the boss 155, thus bringing the roller 161 down on the cam 156. When the roller 161 lies immediately behind the point of the cam 156, the lower jaw of the knotter lies in engagement with its co-operating upper jaw 159, but it will be understood that when the shaft 158 is rotated, the cam 156 co-operates with roller 161 to cause the jaws of the knotter to be separated. Normally, the roller 161 is held in position behind the point of the cam 156 by a lever 162, which is pivoted to the member 148 by a screw 163. A flat spring 164, which is secured to the member 148 by a screw 165, bears against the short arm of the lever 162 and tends to hold the long arm thereof against the roller 161, all as is very clearly shown in Figures 24 and 31. It will be noted that the short arm of the lever 162 is provided with an offset portion 166, which is designed to co-operate with a set screw 167. The set screw 167 is carried by an arm extending downwardly from the top plate of the machine frame, as is very clearly illustrated in Figure 7. I might say at this point that it is a function of the offset portion 166 of lever 162 and its co-operating set screw 167 to move the long arm of lever 162 out of engagement with roller 161 at the instant that the twine grasped between the jaws of the knotter is to be withdrawn therefrom. The particular time in the cycle of operation at which this function is performed will more clearly appear in connection with the detailed description of the machine in operation.

It will be noted that the shaft 157 (the knotter shaft) is provided at its lower end with a beveled pinion 168 which is permanently in mesh with a co-operating beveled pinion 169 in turn fixed upon one end of a shaft 170. The shaft 170 is mounted in a transverse bore 171 in the member 148 and is provided at its other end with a small spur gear 172. Once during each cycle of machine operation the spur gear 172 is engaged by a gear sector 173 which is fixed with respect to the cam block 107. Normally the spur gear 172 does not lie in the path of travel of the teeth of the gear sector 173, but each time the gear sector approaches the position shown in Figure 3, the member 148 has been rocked to a position such that the gear sector may engage and operate the spur gear 172. Each time the gear sector 173 engages the gear 172, it imparts sufficient movement thereto to turn the knotter shaft 157 through one complete revolution.

Referring now particularly to Figures 6,

it will be noted that the member 148 is provided with a projection 174 from one side of which projects a screw 175. This screw is embraced by the offset and bifurcated end of an arm 176, which is pivoted by screw 177 to a cutter carrier 178. The said cutter carrier is in turn pivoted by a screw 179 to the block 117. This block, as has previously been described, also carries the twine holder and catcher. The arm 176 is provided with a pin 180 to which is connected one end of a coil spring 181, the other end of which is attached to a pin 182 carried by block 117. The tension of the spring 181 normally tends to hold the arm 176 in the position shown in Figure 33. At this point it should be pointed out that the cutter carrier 178 is provided with a cutting knife 183 and is furthermore provided with an extension 184 which lies ahead of the edge of the knife 183. This extension 184 is provided with a small groove 185. It is the purpose of the extension 184 to engage the end of the twine and disengage the same from the twine holder, leaving only the second strand wrapped around the package to be cut by the knife 183. When the member 148 is rocked to carry the knotter toward the twine, as has previously been described, the screw 175 carried by the member 148 rides upwardly in the bifurcated portion of the cutter operating arm 176. No movement is imparted to the cutter when the screw 175 thus rides upwardly in the bifurcated portion of the arm 176. However, when the screw 175 reaches the top of the slot in the bifurcated portion of arm 176, it engages in the recess 186. By virtue of this arrangement, when the upper portion of the rocking member 148 recedes, the cutter carrier 178 is turned in a counter-clockwise direction (Fig. 33) to cause the cutter 183 and the projection 184 to function. By reference to Figures 6 and 29, it will be seen that the machine frame is provided with a ledge 187 which lies beneath the bifurcated offset portion of the arm 176. After the cutter carrier has been operated, as just explained, this ledge 187 engages the offset and bifurcated portion of arm 176 and permits the pin 175 to become disengaged from the recess 186. When this disengagement occurs the spring 181, which has been put under tension, restores the cutter carrier and parts connected therewith to normal. It will be understood that when the machine is at rest the screw 175 lies at the lower end of the slot in the bifurcated portion of the arm 176.

I prefer that the cutter carrier 178 shall be provided with an extension 178^a to provide a handle which may be grasped to effect manual operation of the cutter, if desired (see Fig. 33).

I shall now describe the device which functions to lift the second wrap of twine up under the lower jaw of the knotter

immediately prior to the rotation of the knotter. Pivoted to the machine frame by pin 188 and so disposed that it lies to one side of the knotter when the latter has been moved to its forward position, shown in Figure 24, is a lever 189, the details of which are most clearly illustrated in Figure 34. The free arm of this lever is provided with a widened extremity in which is formed a transverse depression 190. It is in this depression that the second wrap of the twine is caught for the purpose last above mentioned. The lever 189 is connected by a link 191 to a pin 192 which projects laterally from the rocking knotter carrier 148. By virtue of this connection it will be seen that when the rocking member 148 is in its normal position, the free end of lever 189 lies in the position shown in Figure 7. However, when the upper portion of the rocking member 148 and the knotter carried thereby are moved forwardly toward the twine, the free arm of lever 189 is moved from the position shown in Figure 7 to a position immediately adjacent the undersurface of the bundle to be tied. In the course of this movement the second wrap of the twine is engaged in the depression 190. The twine is thus lifted up under and against the lower jaw of the knotter. The lever 189 is restored to normal when the rocking element 148 is restored to its normal position.

I have had occasion heretofore in the progress of this description to refer to the rocking stripper plate 138, which stripper plate, it will be remembered, is mounted for movement on a horizontal axis. I shall now refer to a second stripper which is mounted for movement around a vertical axis. Disposed upon the upper surface of the machine frame top plate, under the bundle support 84 and to one side of the rocking stripper plate 138 is the lever 193 which is pivoted to the machine frame top plate by a screw 194. The long arm of this lever is normally urged into engagement with the rocking stripper plate 138 by a coil spring 195, which acts between the short arm of said lever and the pin 196 projecting upwardly from the machine frame top plate, as is very clearly illustrated in Figure 5. That end of the lever 193 which is normally held in engagement with the rocking stripper plate 138 is provided with a notch 197, as shown in Figure 9. The purpose of the notch 197 is to receive the twine held by the jaws of the knotter when, upon the recession of the knotter, the strippers 138 and 193 slip from the jaws of the knotter the twine which has previously been wrapped therearound to accomplish the tightening of the knot formed by the knotter. Referring now to Figures 5, 7, 24 and 25, it will be seen that the machine frame carries a plun-

ger 198, the upper end of which projects into an opening formed in the machine frame top plate immediately to one side of that arm of the stripper lever 193 which is connected with the spring 195. The plunger 198 is normally held in the depressed position shown in Figure 7 by a coil spring 199. The lower end of the plunger 198 is so disposed that when the rocking knotter carrier 148 is swung to carry the knotter beak toward the twine, the extension 174 of the member 148 engages the lower end of the plunger 198 and forces the upper end of the plunger up into the path of the stripper 193. Previously to the operation of the plunger, as just described, the stripper lever 193 is moved to the position shown in Figure 25, due to the fact that the knotter has come forward between the strippers 138 and 193. The upper end of the plunger 198 therefore serves to lock the stripper 193 in the position shown in Figure 25 until the knotter begins to recede. The reason for locking the lever 193 in the position shown in Figure 25 is to permit the knotter freely to rotate to accomplish the tying of the knot.

I shall now describe the mechanism which functions to eject the bundle from the bundle support 84 after the tying of the knot has been completed. This mechanism is most clearly illustrated in Figures 8, 9, 21 and 22. Mounted upon the machine frame top plate and disposed adjacent the vertically reciprocating bar 73 which carries the bundle clamp is the triangularly-shaped frame 200. Having its upper end pivoted to the frame 200 at 201 is the ejector bar 202, which is normally held in the position shown in full lines in Figure 9 by a coil spring 203, one end of which is connected with the ejector bar and the other end of which is attached to a bracket 204, extending laterally from the frame 200. Near its upper portion the ejector bar 202 is provided with a boss 205, the upper portion of which is beveled for a purpose which will presently be made apparent. Pivoted to the ejector supporting frame 200 and overlying the ejector bar 202 is a lever 206, provided with a tail piece 207. The coil spring 208 acting between the free end of lever 206 and a pin carried by the frame 200 normally holds the lever 206 in the position shown in Figure 9 with the tail piece 207 thereof resting against an abutment pin 209. Lever 206 is pivoted to the ejector supporting frame 200 by screw 210. It will be noted that the compression spring 211 is interposed between the lever and the head of screw 210, the purpose of this arrangement being to permit the tail piece 207 of the lever to slip over the beveled boss 205. Normally the free end of lever 206 overlies a pin 212, which projects laterally from the

bracket 80 whereon the bundle clamping plate 81 is carried. When the vertically reciprocating bar 73 is in its uppermost position, the lever 206 is held in the position shown in Figure 21, in which case the spring 208 is under tension. When the vertically reciprocating bar 73 is lowered and the pin 212 is carried away from the lever 206, the lever is turned in a clockwise direction (Fig. 9) under the tension of spring 208 and is moved to the position shown in Figure 9, the spring 211 associated with the pivot of lever 206 yielding to permit the tail piece 207 to slip over the beveled stud 205. Subsequently when the vertically reciprocating bar 73 moves upwardly the pin 212 engages under the free end of lever 206 and turns the same in a counter-clockwise direction. (Fig. 9.) In this instance the tail piece 207 can not slip over the stud 205 and as a result the ejector bar 202 is swung to the position indicated in dotted lines in Figure 9. The bar, when so swung, engages the bundle and throws the same from the bundle support 84. I might say that the ejector lever 206 is thrown outwardly a sufficient distance to permit the tail piece 207 to slip past the boss 205. After the tail piece has slipped past the boss, the ejector lever drops back to normal position. The next time the reciprocating bar 73 is lowered, the tail piece again slips over the beveled stud 205 and the operation just described is repeated.

Having now described the details of construction of the several operating parts of the tying machine of my invention, I will proceed to describe a representative cycle of operation, more clearly to point out and reveal how the several parts of the mechanism co-operate to accomplish the objects of my invention. Prior to operating the machine, the free end of the twine is led from the extremity of the wrapping arm 92 to the twine holder 123 and is passed around and clamped behind the latter, as is clearly shown in Figure 9. The switch 53 is now operated to start the motor and the bundle to be tied, represented in the drawings by reference letter B, is placed upon the bundle support 84 and the pivoted supporting plate 98, the disc 104 being used as a gauge to determine how far from the end of the bundle the double wrap or twine shall be placed by the operation of the machine. It will be understood, of course, that the twine is wrapped around that portion of the bundle which lies between the bundle support 84 and the rocking supporting plate 98.

After placing the bundle to be tied in the position just mentioned, the treadle 110 is depressed. Depression of the treadle, of course, acts operatively to connect the continuously rotating gear 55 with the shaft 56 and motion is transmitted from shaft 56 to

large gear 62 through pinion 61. As soon as the gear 62 begins to rotate (its direction of movement is indicated by the arrow in Fig. 2), the cam channel 64 of gear 62 co-operates with the arm 65 to rock the shaft 66 in a clockwise direction (Fig. 2). Rocking of shaft 66 being transmitted to the spring 77 through the arm 78 (Fig. 3) places the spring 77 under tension and causes the arm 67 to be swung in a clockwise direction (Fig. 3). This movement of the arm 67 causes the lowering of the vertically reciprocating rod 73 which carries the bundle clamping plate 81 and continues until the clamping plate has come into contact with the bundle to be tied. After the clamping plate has tightly engaged the bundle, further downward movement of rod 73 ceases. Consequently, further movement of the arm 67 ceases. If the arm 78 continues to turn after the bundle clamping plate has engaged the bundle, this movement is taken up by the spring 77. It will thus be seen that the spring 77 serves securely and yieldingly to hold the clamping plate 81 in engagement with the bundle to be tied and it will appear as this description progresses that the bundle is thus securely and yieldingly held by the clamping plate during practically all of the tying operation.

Shortly after the clamping plate has started down toward the bundle to be tied, the unutilized teeth of the large gear 62 come into engagement with the teeth of the wrapping arm pinion 85. The pinion is caused to rotate in a clockwise direction, as shown in Figure 2. As the pinion rotates, it of course carries with it the wrapping arm 92. In Figures 9 to 19, inclusive, which illustrate very clearly the functions of the wrapping arm and the knotting mechanism, the wrapping arm is to be regarded as rotating in a counter-clockwise direction. As the wrapping arm 92 travels around on its first revolution, the twine is passed around that portion of the bundle which lies between the bundle support 84 and the rocking supporting plate 98. As the wrapping arm comes up for the first time on its first revolution, the twine raises the rocking support 98 and slips between the portion 101 of the rocking support and the abutment 102, whereon the heavier end of the rocking support 98 normally rests. The rocking support yields to permit the passing of the twine during each revolution of the wrapping arm.

Shortly after the wrapping arm passes its uppermost position on the first revolution thereof, the cam 126^a of the cam block 107 (Fig. 3) engages the bell crank 127 to move the sliding plate 132 to the left (Fig. 3). Such movement of the plate 132 is depicted as being from left to right in Figure 9 and succeeding figures. This movement of the plate 132 causes the portion 135 thereof to

take the position shown in Figure 9, and in this position the portion 135 of plate 132 overlies the twine holder and catcher 123 and prevents the latter from engaging the twine as it is carried around the bundle on the first revolution of the wrapping arm. Shortly after the wrapping arm passes the twine holder and catcher on its first revolution, the cam 126^a passes the bell crank 127 and the plate 132 recedes to its normal position. Figure 10 illustrates the position occupied by the wrapping arm 92 just as the wrapping arm is carrying the twine up to the twine holder and catcher during the second revolution of the wrapping arm. It will be noted that this figure illustrates the twine as having been passed once completely around the package and partially around the package a second time. When the wrapping arm has carried the twine to the position shown in Figure 10, the twine slips over the end of the portion 135 of the plate 132 and engages behind and around the twine catcher 123. The wrapping arm has now performed its function and thereafter simply moves from the position shown in Figure 10 to its normal position where it stops, due to the fact that the mutilated teeth of the large gear 62 have again come opposite the wrapping arm operating pinion 85. The operating pinion is, of course, held in this, its normal position, by its rollers 105—105.

Shortly after the twine has been caught by the twine catcher 123 on the second revolution of the wrapping arm, as just explained, the large cam 126^b on the cam block 107 engages the roller of bell crank 127 and moves the plate 132 and the portion 135 thereof in the direction indicated by the arrow in Figure 11. It will thus be seen that both extremities of the twine which has been wrapped around the bundle are brought very closely together when the portion 135 of plate 132 has reached the position illustrated in Figure 11. At the same time, or immediately after portion 135 of plate 132 has reached the position shown in Figure 11, the rocking knotter carrier 148 begins to turn on its horizontal pivot, due to the fact that the roller 151 carried by its arm 150 has entered the inclined channel 152 of the cam block 107. Such movement of the member 148 causes the upper portion thereof to move out toward the twine which has been wrapped around the bundle. When the member 148 is so moved, the upper and lower jaws 159 and 160 of the knotter are forced between the stripping ends of the pivoted strippers 138 and 193, the stripper 193 being turned on its pivot against the tension of its associated spring 198. Simultaneously with this movement of the knotter the lever 189 is swung on its horizontal pivot so that the groove or depression 190 in the widened extremity there-

of is brought immediately adjacent that portion of the twine which was first passed around the bundle. The last mentioned position of the lever 189 is very clearly shown in Figure 12. Further upward movement of the grooved end of the lever 189 causes the twine to be pressed up into immediate proximity to the underside of the bundle. In the meantime, the knotter has come out to a position over the extremity of the portion 135 of the plate 132. Both ends of the twine wrapped around the bundle now lie under the lower jaw of the knotter. As soon as the points of the jaws of the knotter are passed over the twine, as just explained, the plate 132 and its portion 135 move in the direction indicated by the arrow in Figure 13, back to normal position. I have previously mentioned the fact that when the knotter came out between the extremities of the strippers, the stripper 194 was turned in opposition to the tension of its spring 198. When the rocking knotter carrier has almost reached the limit of the movement thereof, which carries the knotter over the twine, the portion 174 thereof engages the lower end of the vertically moving plunger 198 and causes the same to lock the stripper 193 in the position shown in Figure 25.

Simultaneously with the upward movement of the plunger 198 the plunger 142 (Fig. 35) is moved up into engagement with the stripping end of the horizontally pivoted stripper 138. This movement of the plunger 142 is, of course, caused by the engagement of cam 147 of the cam block with the arm 146 of lever 144, all as is clearly illustrated in Figure 8. This upward movement of the plunger 142 not only holds the extremity of the horizontally pivoted stripper 138 out of the path of the knotter, but also serves effectively to compress the bundle at the point where the twine is to be knotted. I have already explained that the metal of the bundle support is sufficiently flexible at this point to permit the bundle to be so compressed when the plunger 142 is brought against the horizontally pivoted stripper 138, as just explained.

As soon as the knotter and associated mechanism has reached the position shown in Figure 12, the gear sector 173 has reached the position shown in Figure 3 and has come into mesh with the spur gear 172 through which rotary movement is imparted to the knotter. It will be understood, of course, that the rocking movement of the knotter support 148 has brought the pinion 172 into position to be engaged by the gear sector 173. As soon as the gear sector has engaged the gear 172, the knotter shaft and the knotter beak begin to turn, due to their mechanical connection with the gear 172, through shaft 170 and beveled pinions 169 and 168. Figure 13 shows the knotter beak

in the position assumed thereby after it has turned through an angle of 90° from the position shown in Figure 12. Shortly after the knotter has moved beyond the position shown in Figure 13, the roller 161 which controls the position of the lower jaw of the knotter rides out on the eccentric portion of the cam 156, with the result that the lower jaw of the knotter is moved out of engagement with the upper jaw. The knotter continues to rotate with the jaws thereof separated until it reaches the position illustrated in Figure 15, at which time the two lengths of twine leading up from the twine catcher 123, which have been turned around the two portions of the twine leading down from the bundle, are engaged under the upper jaw of the knotter. After thus engaging the two portions of the twine leading up from the twine catcher, the knotter continues to rotate from the position shown in Figure 15 to the position shown in Figure 16. When the knotter reaches the position shown in Figure 16, the roller 161 controlling the position of the lower jaw of the knotter has snapped off the point of the cam 156 and the lower jaw of the knotter has closed, as shown in Figure 16. This closing of the knotter has, of course, clamped the two portions of the twine leading up from the twine catcher 123 between the jaws of the knotter. At this point I will refer to Figure 31 and call attention to the fact that when the knotter is in the position shown in Figure 16, the jaws thereof are held closed by the spring 164, which bears against the lever 162 and holds the long arm of said lever firmly in engagement with the roller 161.

When the knotter has reached the position shown in Figure 16, the roller 151 carried by the arm 150 of the knotter beak support 148 is ready to enter the inclined channel 153 of the cam block 107. Immediately after the roller 151 has entered the cam slot 153, the knotter support 148 and all of the parts carried thereby recede toward their normal positions. However, before the knotter begins to recede, the plunger 142 has dropped to permit the stripping end of the horizontally pivoted stripper 138 to drop into engagement with one side of the knotter. Moreover, the plunger 198, which during the rotation of the knotter held the vertically pivoted stripper 193 in the position shown in Figure 5, has dropped to permit the spring 195 of the stripper 193 to move the stripping end thereof into engagement with that side of the knotter opposite the stripping end of the horizontally pivoted stripper 138. Figure 17 shows the relative positions of the knotter and its associated strippers shortly after the knotter has commenced to recede toward its normal position. It is interesting to note in this figure that the

lever 190 has commenced to swing toward its normal position, due to its mechanical connection with the knotter support 148. Furthermore, at this time the cutter support 178 (the details of which are shown in Figures 28 and 29) is moved out toward those portions of the twine which lie between the twine catcher and holder 123 and the knotter. The groove 185 of the portion 184 of the cutter support engages that portion of the twine which was first placed around the twine holder 123. The knife 183 is brought up against the other portion of the twine, as is very clearly illustrated in Figure 28. Figure 17 shows the cutter support 178 and the parts carried thereby coming out to the positions shown in Figure 29. When the cutter support 178 is swung to the position shown in Figure 29, the upper strand of the twine is severed and the other strand is drawn out from behind the twine holder 123. Figures 17 illustrates how the projection 184 of the cutter carrier 178 functions to slip the lower strand out from behind the twine holder.

Figure 18 illustrates the respective position of the knotter and its co-operating strippers shortly before the strippers slip off the pointed end of the knotter. Figure 26 illustrates the knotter and strippers in plan when their several parts are in the positions shown in Figure 18. Figures 19 and 27 illustrate the relative positions of the knotter and its co-operating strippers when the knotter has receded to a position such that the strippers have slipped off the pointed end of the knotter. At this time those portions of the knot which has been effected, which lead back to the knotter, are received in the notches 140 and 197, respectively, of the strippers 138 and 193. As the knotter continues to recede from the position shown in Figures 19 and 27, the strippers function to tighten the knot.

After the knotter, on its receding movement, has moved slightly beyond the position illustrated in Figure 27, the offset portion 166 of the lever 162 (Fig. 31) comes into contact with the set screw 167 (Figs. 7 and 24). This engagement of the portion 166 of lever 162 with the set screw 167 causes the lever 162 to be moved sufficiently against the pressure of spring 164 to permit the lower jaw of the knotter to relieve its pressure upon the portions of the cord which have been grasped between the jaws of the knotter. The tying of the knot has now been completed.

Earlier in this description I pointed out how when the cutter carrier 178 is moved to the position illustrated in Figure 29, the spring 181 was put under tension during the receding movement of the knotter support 148, due to the fact that the pin 175 of the knotter support was engaging in the

notch 186 in the bifurcated offset portion of the cutter support operating arm 176. When, on the receding movement of the knotter support 148 the bifurcated offset portion of the arm 176 engages the bracket 187 carried by the machine frame, the arm 176 is turned sufficiently to permit the shoulder screw 175 to snap out of the notch 186. When this disengagement of the screw and notch is effected, the spring 181 functions quickly to return the cutter support 178 and parts carried thereby to their respective normal positions, shown in Figure 28.

Furthermore, during the receding movement of the knotter support 148 the vertically reciprocating rod 73 and the clamping plate carried thereby begin to move upwardly. This upward movement of the parts last mentioned is caused by engagement of the arm 78^a under the pin 79 of the arm 67. The several parts last mentioned are most clearly shown in Figure 3. The member 67 is, of course, provided with the roller 69 which is engaged by the bifurcated bracket at the lower end of the vertically reciprocating rod 73; hence when the member 67 is raised, the rod 73 and parts carried thereby are also raised. It will, of course, be understood that the raising of the rod 73 is primarily caused by the entry of the roller carrier by arm 65 into that portion of the channel 64 of gear 62 which extends toward the axis of the gear. The movement imparted to arm 65 and thence to shaft 66 causes the tension to be taken off of the spring 77 and results in that movement of the arm 78 which I have just explained moves the lever 67 to elevate the vertically reciprocating rod 73 and parts carried thereby.

As the rod 73 approaches its uppermost position the pin 212 projecting laterally from the clamping plate support 80 engages under the ejector operating lever 206 and moves the latter against the tension of its associated spring 208. Movement is thus imparted to lever 206. The tail piece 207 engaging against the ejector stud 205, swings the ejector to the dotted line position of Figure 9 and causes the bundle to be thrown from the bundle support 84.

When the bundle has been ejected from the bundle support, the cam 108 of the cam block 107 rides against the wedge-shaped extremity of the clutch controlling arm 115 and causes the disengagement of the clutch in the manner heretofore described in connection with the detailed description of the clutch operating mechanism.

The cycle of operations which I have just described are repeated each time the treadle is depressed to close the clutch and initiate the cycle.

It will be noted that all of the operating parts of the apparatus are driven from a

common source of power through a friction clutch. In order to prevent injury to the operator should his or her arm be caught by the wrapping arm, and also to prevent injury to the mechanism in case some part, by getting out of place, should lock the same, the clutch is so adjusted that under such circumstances it will slip, despite the fact that ordinarily the clutch functions without slippage.

In Figures 36 to 38, inclusive, I have illustrated a modified wrapping arm construction which may be used in connection with the machine shown in the preceding figures to render said machine capable of tying bundles considerably larger than those which can be tied when a one-piece wrapping arm is employed. In Figures 36 to 38 I have applied corresponding reference characters to all parts which, in their construction, are in no way different than corresponding parts shown in the preceding figures. The wrapping arm of Figures 36 to 38 consists of two parts 250 and 251 which are collapsible one within the other. The portion 250 is rigidly secured by screws or otherwise to a boss 252 formed integral with the hub of the wrapping arm operating pinion 85. The portion 251 of the wrapping arm is provided with an offset portion 251^a which is not essentially different from the corresponding part of the non-extensible wrapping arm illustrated in the preceding figures. It is clear from the drawings that the portion 250 of the wrapping arm is provided with a channel in which the portion 251 slides and in which it is held by the retaining plate 253. Near its inner end the portion 251 of the wrapping arm is provided with a pin carrying a roller 254, which roller is controlled by the cam structure consisting of two castings 255 and 256, the portion 256 being attached to the portion 255 by a strap 257. The portion 255 is attached to the machine frame by securing devices 258. The portion 256 is also preferably attached to the machine frame at 259. It is the function of the cam structure just described to cause the wrapping arm to be extended during its travel over the top of the bundle to be tied, and to be collapsed when it is traveling under the bundle. The wrapping arm rotates in the direction indicated by the arrow in Figure 36. As the roller 254 moves from the position shown in Figure 36 outwardly along the under-surface of the cam portion 256, the wrapping arm becomes extended. When, in its movement, the wrapping arm reaches the position indicated in dotted lines in Figure 36, the portion 255 of the cam structure engages the roller 254 and causes the same to ride inside of the portion 255, eventually dropping down upon the upper edge of the cam portion 256. As the wrapping arm continues to rotate in the position shown at

256, the portion 255 of the cam structure causes the wrapping arm to collapse.

From the above description it will be seen that the wrapping arm of Figures 36 to 38, inclusive, becomes extended when it is passing through the arc in which it is caused to pass around the side of the bundle being tied. By having the wrapping arm automatically extensible, I am enabled to handle bundles of considerable width and height notwithstanding the fact that the construction of the machines may require that the wrapping arm be comparatively short when passing beneath the bundle.

I have found that in many classes of work it is desirable to wrap and tie twine around both ends of a bundle simultaneously and as the result of a single volitional act on the part of the operator. The machine illustrated in Figure 39 operates in this manner and is moreover arranged so that it may be adjusted most effectively to tie bundles of various lengths.

The machine shown in Figure 39 comprises two tying units, each of which comprises a machine frame 50 which need not differ materially from the similarly designated frame of the machine hereinbefore described. The frames 50—50 of the tying units A and B are mounted upon a common carriage 300. This carriage is made of two parts which are normally rigidly connected by a pair of side plates, one of which is illustrated at 301. By securing these plates at various positions with respect to the two portions of the carriage, the tying units A and B may be adjusted as required. The several operating parts of unit A are substantially the same as the several operating parts of the mechanism shown in Figures 1 to 35. It should be noted, however, that the shaft 63 of unit A extends beyond the right side of the frame thereof to facilitate the mechanical connection of this shaft with the corresponding shaft of the unit B. Unit B differs from unit A in that the unit B comprises no elements corresponding to those devices through which power is applied to the shaft 63 of unit A, these elements being omitted from unit B for the reason that shaft 63 of unit B is driven directly from shaft 63 of unit A through a shaft coupling 302. In so far as concerns the disposition of its several operating parts, unit B may be considered a mere reversal of unit A, this reversal being effected so that a bundle bridging the space between the two units and resting upon the bundle supports of each will have twine wrapped and tied around both of its ends when the two units are simultaneously operated.

The vertical portions of the bundle supports of the two units A and B are preferably so arranged that they will overlap. The horizontal portions of the bundle sup-

ports conveniently terminate at the edges of the machine frames, since any bundle to be tied must necessarily be long enough to bridge the gap between the two units.

The shaft coupling 302 affords a rigid driving connection between the shafts 63 of the two units. It will, of course, be understood that when the spacing of the two units is changed, a different coupling of proper length is substituted for the coupling shown. It will be understood, of course, that the coupling 302 here illustrated is only one of a number of expedients that may be employed for transmitting movement from one unit to another.

In the use of this machine, the bundle to be tied is placed upon the bundle supports of the two units with its ends in proper position to be acted upon by the twine wrapping and tying devices of the two units. When the treadle and clutch mechanism associated with unit A is actuated to initiate a cycle of operation, each of the units functions to wrap and tie twine around one of the ends of the bundle and to eject the bundle from the bundle supports at the conclusion of the tying operations in the same manner as does the machine illustrated in Figures 1 to 35, inclusive.

Having thus described my invention, what I claim as new, is:

1. A machine of the class described comprising a flexible bundle support, means for passing twine around a bundle and means for tying the twine in combination with means for clamping the bundle to be tied upon the support, and means for flexing the bundle support during the tying operation to compress the bundle at and in the region of the point where the knot is tied.

2. A machine of the class described comprising in combination a bundle support on which the bundle to be tied is placed in overlapping relation, means for passing twine around the bundle at a point adjacent one edge of the bundle support, means arranged to tie the twine, means for clamping the bundle upon the bundle support, and devices for flexing the edge of the bundle support during the tying operation to compress the bundle at and in the region of the point where the twine is tied.

3. A machine of the class described comprising a horizontally disposed bundle support having a flexible edge, means for clamping a bundle on said support, means for passing the twine around the portion of the bundle overlapping said flexible edge, devices arranged when operated to knot the twine and means for pressing said flexible edge upwardly during the tying operation to compress the bundle at and in the region of the point where the knot is tied.

4. A machine of the class described comprising a horizontally disposed bundle sup-

port having a flexible edge, means for clamping a bundle on said support, means for passing twine around a portion of the bundle overlapping said flexible edge, knotting devices arranged to operate under the bundle support at a point adjacent the flexible edge aforesaid, and means arranged during the tying operation to press said flexible edge upwardly to compress the bundle at and in the region of the point where the knot is tied.

5. A machine of the class described comprising a horizontally disposed bundle support having a flexible edge, means for clamping a bundle on said support, means for passing twine around a portion of the bundle overlapping said flexible edge, knotting devices arranged to operate under the bundle support at a point adjacent the flexible edge aforesaid, a vertically reciprocating plunger lying under the flexible edge of the bundle support and means arranged to move said plunger upwardly to flex the bundle support and tightly compress the bundle at and in the region of the point where the knot is tied.

6. A machine of the class described comprising in combination with a bundle support and twine wrapping and tying mechanism, vertically reciprocating means arranged to move downwardly to clamp a bundle upon said support, and a device operated by the clamping means arranged to discharge the bundle from the bundle support.

7. A machine of the class described comprising in combination with a bundle support and twine wrapping and tying mechanism a vertical reciprocating plunger arranged to move downwardly to clamp a bundle upon said support and a bundle ejector operated by the plunger on its upward movement arranged to throw the bundle from the bundle support.

8. In an apparatus of the class described, the combination with a support for a bundle to be tied, means for clamping the bundle to said support, twine wrapping mechanism arranged when operated to pass a plurality of continuous parallel wraps of twine around the bundle, tying mechanism arranged to knot the twine after it has been passed a plurality of times around the bundle as aforesaid, and means for compressing the bundle at the place where the knot is tied.

9. In an apparatus of the class described, the combination with a support for a bundle to be tied, means for clamping the bundle to said support, twine wrapping mechanism arranged to carry a plurality of parallel wraps of twine around a bundle, means for compressing the bundle in the region of said wraps, twine catching mechanism arranged to catch the twine after it has been passed around the bundle a predetermined number

of times, means for preventing the twine catching mechanism from catching any of said wraps save the last, and tying mechanism for knotting the twine, substantially as and for the purpose set forth.

10. Means for simultaneously wrapping and tying twine around both ends of a bundle, comprising a pair of twine wrapping and tying mechanisms disposed side by side and spaced apart, means for supporting a bundle so that each of its ends is held in proper position to be acted upon by one of the wrapping and tying mechanisms, and selective means for permitting operation of one of said mechanisms singly or permitting the simultaneous operation of both of said wrapping and tying mechanisms from a single source of power.

11. Means for simultaneously wrapping and tying twine around both ends of a bundle, comprising a pair of twine wrapping and tying mechanisms disposed side by side and spaced apart, means for supporting a bundle so that each of its ends is held in proper position to be acted upon by one of the wrapping and tying mechanisms, and selective means for simultaneously actuating both of said wrapping and tying mechanisms from a single source of power, or actuating only one of said mechanisms from said source of power, together with means for varying the spacing of said wrapping and tying mechanisms.

12. In an apparatus of the class described, a telescopic wrapping arm arranged to revolve around a bundle to carry twine therearound and means for increasing the length of the wrapping arm during its travel around the bundle.

13. In an apparatus of the class described, a telescopic wrapping arm arranged to revolve around a bundle to carry twine therearound, and means for increasing and then decreasing the effective length of the wrapping arm during its travel around the bundle.

14. In an apparatus of the class described, a rotatable wrapping arm arranged to travel around a bundle to carry twine therearound, said wrapping arm comprising telescopic members, and means co-operating with said telescopic members arranged to lengthen and then to shorten the effective length of the wrapping arm as it travels around the bundle.

15. A machine of the class described comprising a bundle support, means for passing twine around a bundle, and means for tying the twine in combination with means for clamping the bundle to be tied upon the support, and means for moving a portion of the support toward said bundle during the tying operation to compress the bundle at and in the region where the knot is tied.

16. A machine of the class described com-

prising a bundle support, means for passing twine around a bundle, and means for tying the twine in combination with means for clamping the bundle to be tied upon the support, and means for moving a portion of the support toward said bundle beyond the normal plane of said support during the tying operation to compress the bundle at and in the region where the knot is tied.

17. A machine of the class described comprising a bundle support, means for clamping a bundle on said support, means for passing twine around the bundle, devices arranged to knot the twine, and means for pressing the bundle inwardly in the region of said twine during the tying operation.

18. A machine of the class described comprising a horizontally disposed bundle support, means for clamping a bundle on said support, means for passing twine around a portion of the bundle, knotting devices arranged to operate under the bundle support, and means operated during the tying operation to press the bundle upwardly in the region of said twine.

19. A machine of the class described comprising a bundle support, means for clamping a bundle on said support, means for passing twine around said bundle, knotting devices arranged under said support, a vertically reciprocating plunger, and means operated thereby arranged to press a portion of the bundle adjacent to said twine upwardly during the tying operation.

20. A machine of the class described comprising a bundle support, means for clamping a bundle on said support, means for passing twine around said bundle, knotting devices for said twine arranged under said support, a vertically reciprocating plunger under said support, and means operated thereby arranged to compress the bundle at and in the region where the knot is tied during the tying operation.

21. Means for simultaneously wrapping and tying twine about a bundle at two separate regions, comprising bundle supports arranged side by side, and mechanism adjacent to each support arranged to wrap and tie twine around its respective section of the bundle, means for simultaneously operating both the wrapping and tying mechanism, and means automatically actuated incident to the wrapping and tying operation for ejecting the bundle from said support.

22. Means for simultaneously wrapping and tying twine around a bundle at remote regions comprising a pair of twine wrapping and tying mechanisms arranged side by side, means for supporting a bundle in a position to be acted upon by each of said wrapping and tying mechanisms, means for simultaneously actuating both of said wrapping and tying mechanisms from a single source of power, and means automatically

actuated incident to the wrapping and tying operation for ejecting the bundle from said supporting means.

23. An apparatus of the class described, a wrapping arm arranged to revolve to carry twine around a bundle, means to compress the bundle in the region engaged by the twine, and means for changing the length of the wrapping arm during its movement around the bundle.

24. In an apparatus of the class described, a wrapping arm arranged to revolve to carry twine around a bundle, means to compress the bundle in the region engaged by the twine, and means for first increasing and then decreasing the effective length of said arm during its movement around the bundle.

25. In a machine of the class described, the combination with a knoter which, prior to engaging the twine, is moved from its normal position to a certain operating position, of a pivoted member having a stripping end which normally lies in the path of the knoter and which is engaged and moved by the knoter when the said knoter moves toward its operating position, together with a spring associated with the pivoted member, said spring yielding when the stripping end of the pivoted member is engaged and moved by the knoter as aforesaid but adapted to hold the stripping end of the pivoted member in engagement with the knoter so that upon recession of the knoter the twine, looped around the knoter jaws, is stripped therefrom.

26. In a machine of the class described, the combination with a knoter which, prior to engaging the twine, is moved from normal to a certain operating position, of a plurality of pivoted members having stripping ends which normally lie in the path of the knoter and which are engaged and moved by the knoter when the latter moves toward its operating position, together with spring means which are adapted to hold the stripping ends of the pivoted members in engagement with the knoter so that upon recession of the knoter, the twine, looped around the jaws of the knoter, is stripped therefrom.

27. In a machine of the class described, the combination with a knoter which, prior to engaging with the twine, is moved from its normal position to a certain operating position, of a plurality of members having stripping ends which normally lie in the path of the knoter and are adapted to be engaged and moved by said knoter when the latter moves toward its operating position, together with spring means adapted to hold the stripping ends of the said members in engagement with the knoter so that upon the return of the knoter to its normal position, the twine looped about the jaws of the knoter is stripped therefrom.

28. In a machine of the class described, the combination with a knotter which, prior to engaging with the twine, is moved from its normal position to a certain operating position, of a pivoted member having a stripping end which normally lies in the path of the knotter, means adapted to hold the stripping end of the pivoted member out of the path of the knotter when the loop of twine is formed upon the jaws thereof, together with spring means adapted to hold the stripping end of the pivoted member in engagement with the knotter when the latter returns to its normal position so that the twine looped around the jaws of the knotter is stripped therefrom.

29. In a machine of the class described, the combination with a knotter adapted to move from a normal to an operating position, of a pivoted member having a stripping end which normally lies in the path of the knotter and is adapted to be moved therefrom when said knotter moves to the operating position, means for locking said stripping end of the pivoted member out of the path of the knotter when the knotter is in its

operating position, together with spring means adapted to hold the said stripping end in engagement with the knotter during the return to the normal position so that the twine, looped around the jaws of the knotter, is stripped therefrom.

30. In a machine of the class described, the combination with a knotter which, prior to engaging the twine, is moved from a normal position to an operating position, of a member having a stripping end which normally lies in the path of the knotter, a pivoted member having an auxiliary stripping end adapted to engage and co-operate with the aforesaid stripping end, together with spring means associated with said pivoted member and adapted to hold the said auxiliary stripping end in engagement with the knotter during the recession of the latter to its normal position so that the twine, looped around the jaws of the knotter, is stripped therefrom.

In witness whereof, I hereunto subscribe my name this 16th day of August, 1920.

BENJAMIN H. BUNN.