

March 8, 1966

I. ZUCKER

3,238,697

BUNDLE WRAPPING APPARATUS

Filed Oct. 26, 1962

8 Sheets-Sheet 1

Fig. 5.

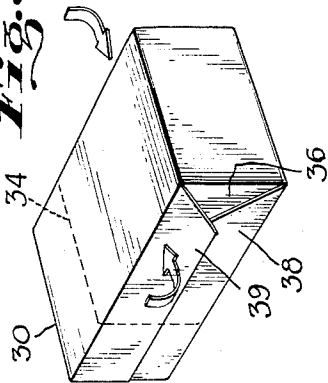


Fig. 4.

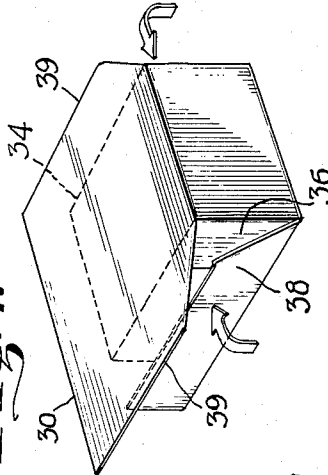


Fig. 3.

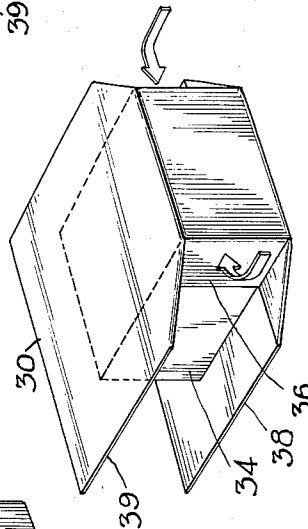


Fig. 1.

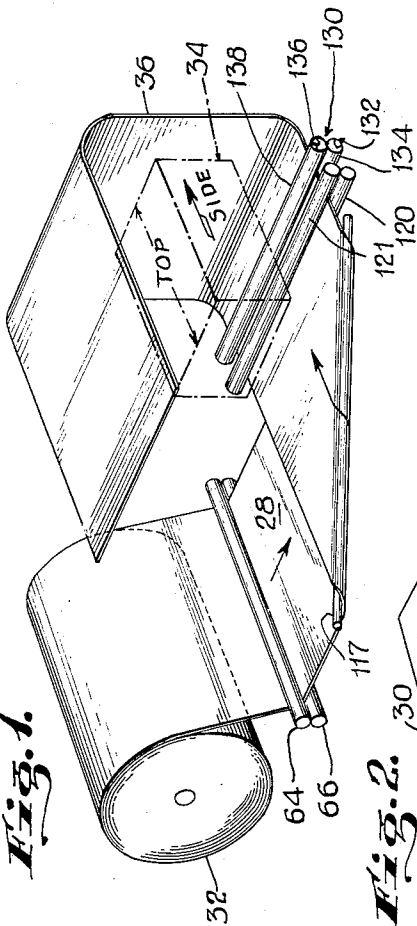
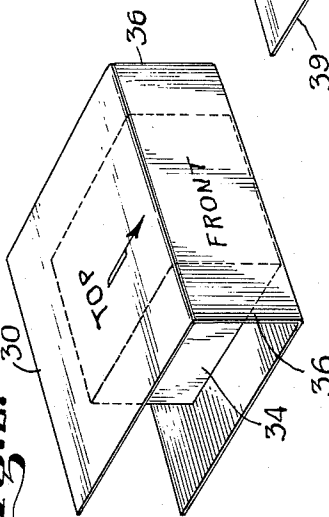


Fig. 2.



INVENTOR.
IRWIN ZUCKER

BY *Blair and Buckles*
ATTORNEYS

March 8, 1966

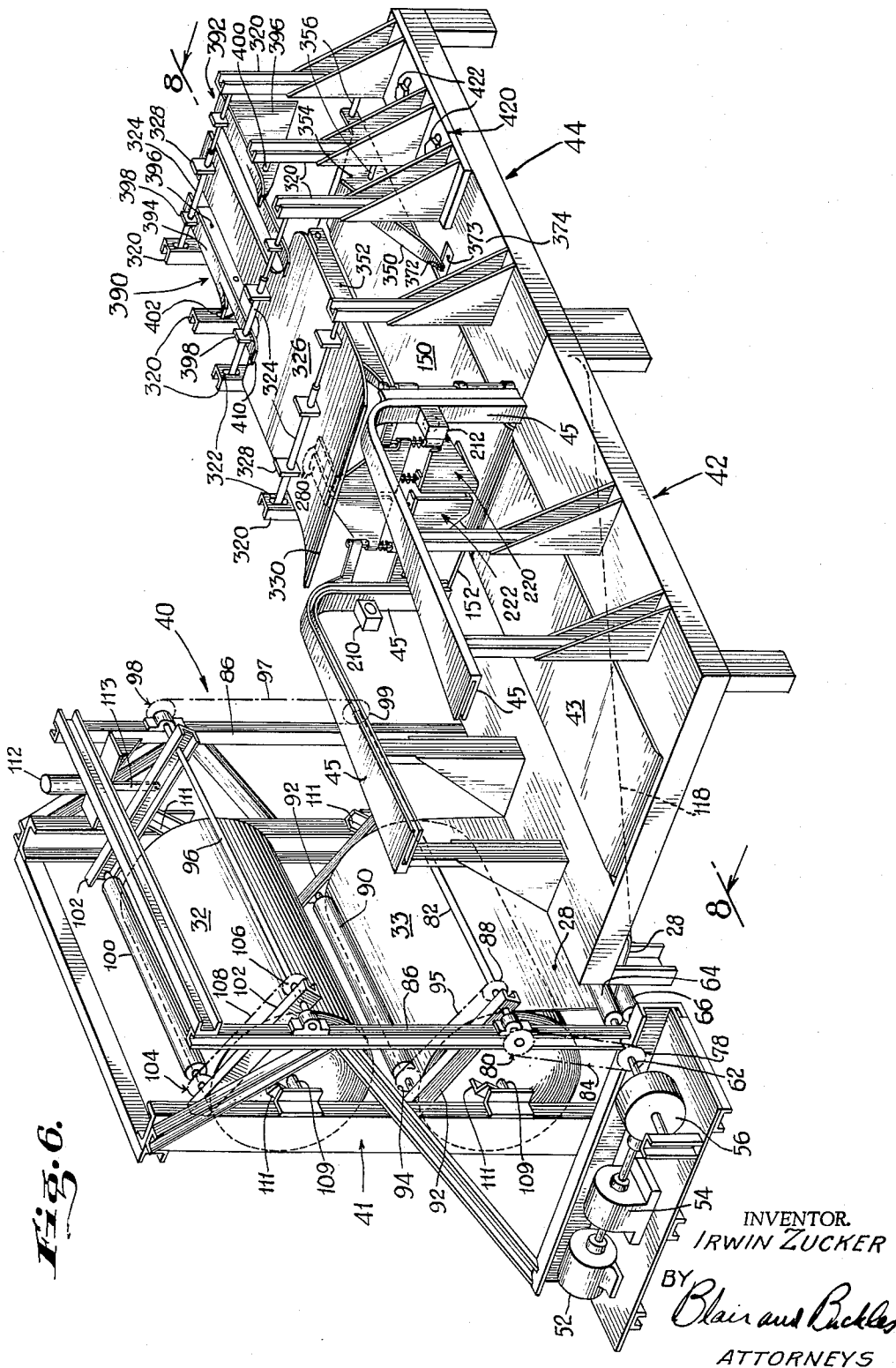
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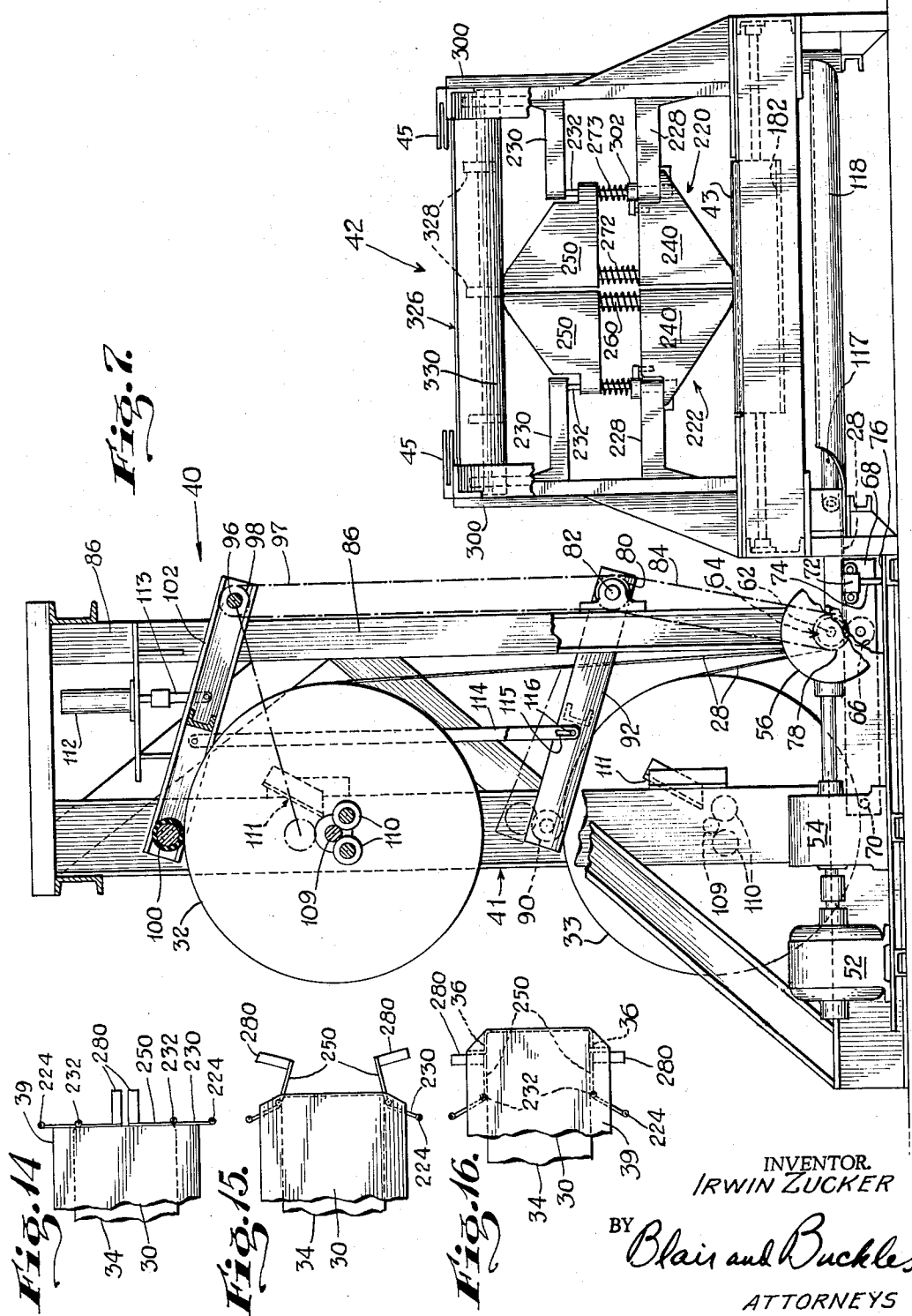
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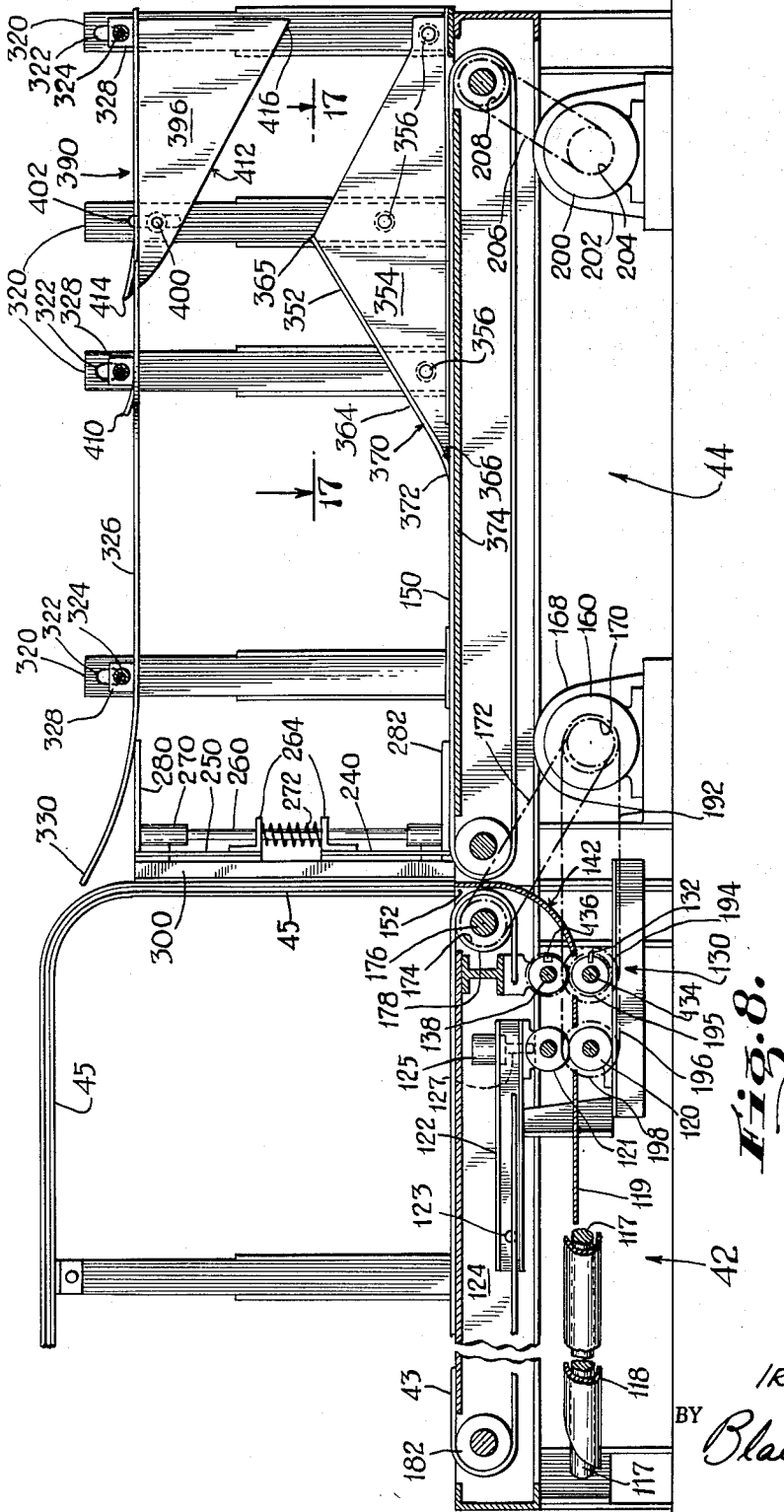
I. ZUCKER

3,238,697

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INVENTOR
IRWIN ZUCKER

BY *Blair and Buckles*
ATTORNEYS

March 8, 1966

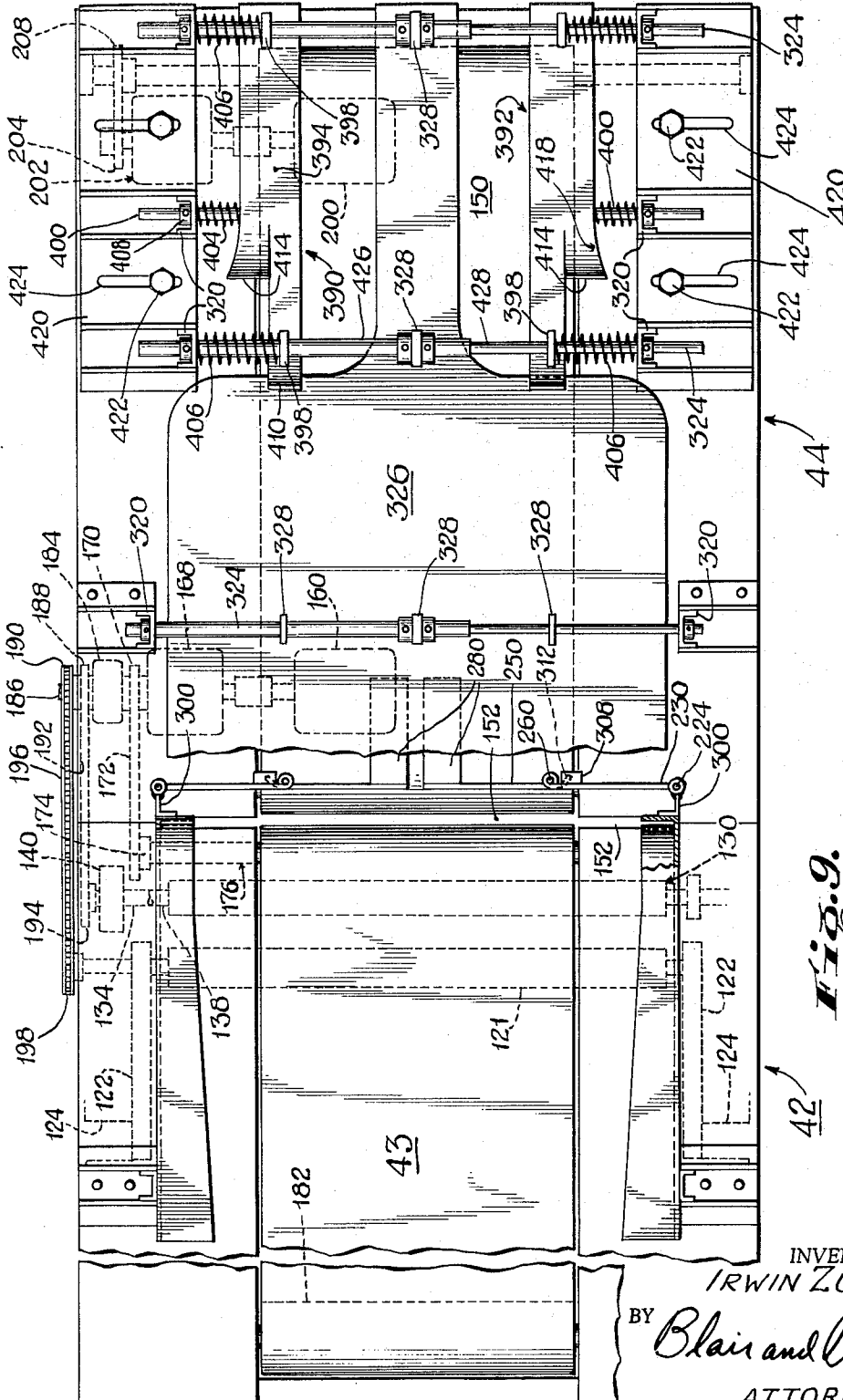
I. ZUCKER

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INVENTOR
IRWIN ZUCKER
BY *Blair and Buckles*
ATTORNEYS

March 8, 1966

I. ZUCKER

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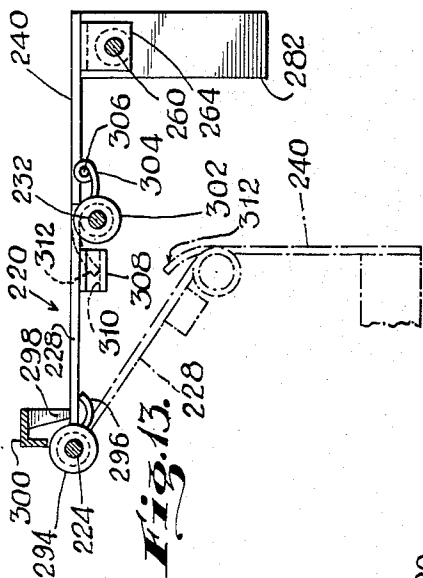


Fig. 10.

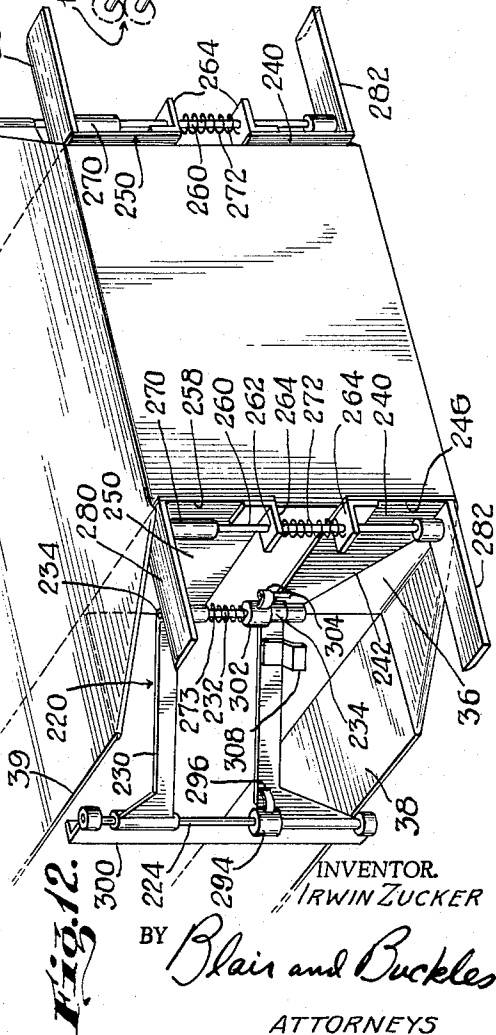
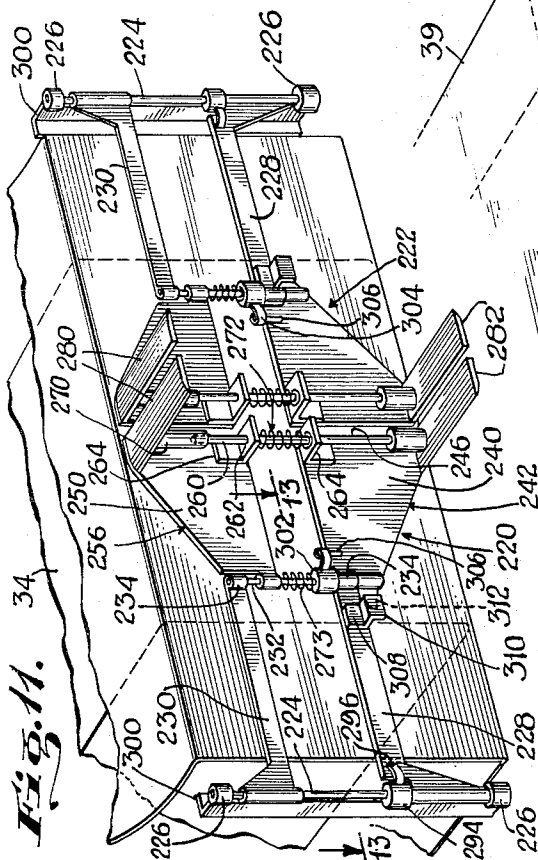
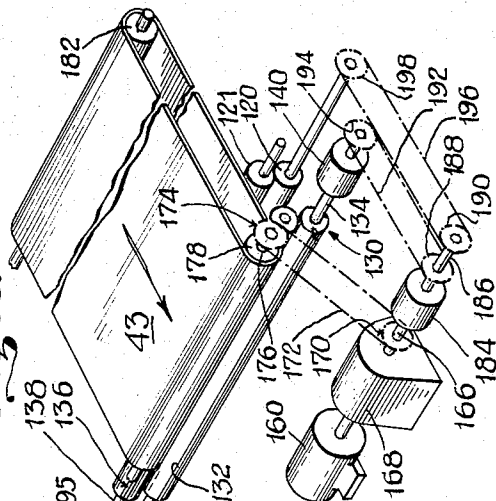


Fig. 12.

INVENTOR
IRWIN ZUCKER
BY *Blair and Buckles*
ATTORNEYS

March 8, 1966

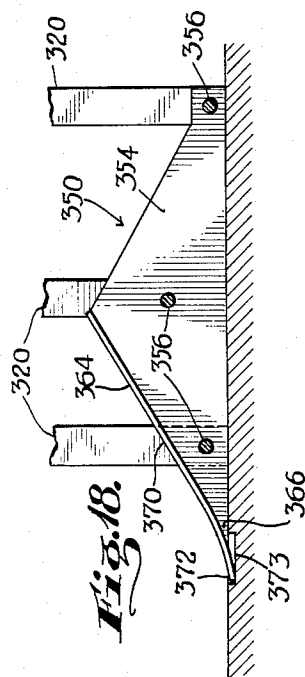
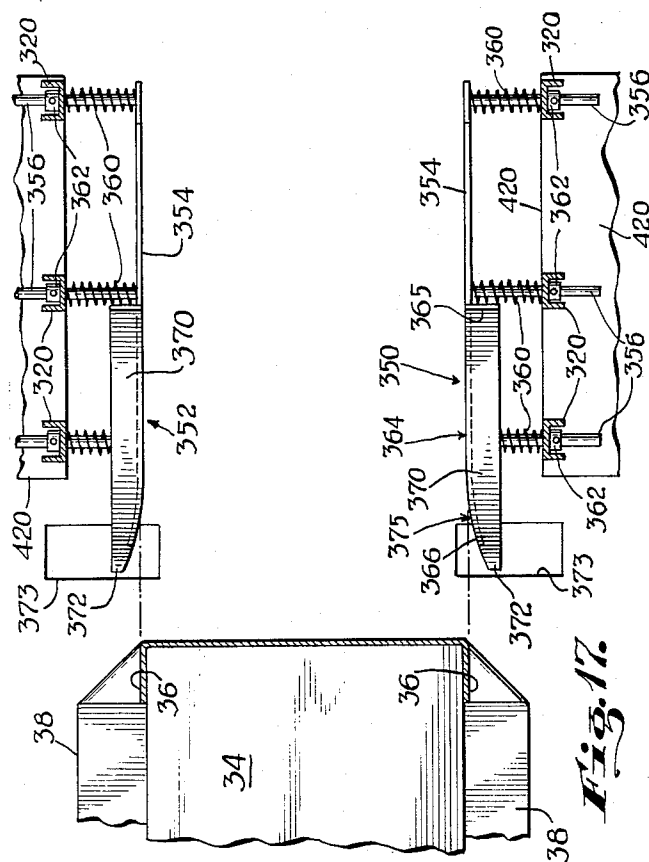
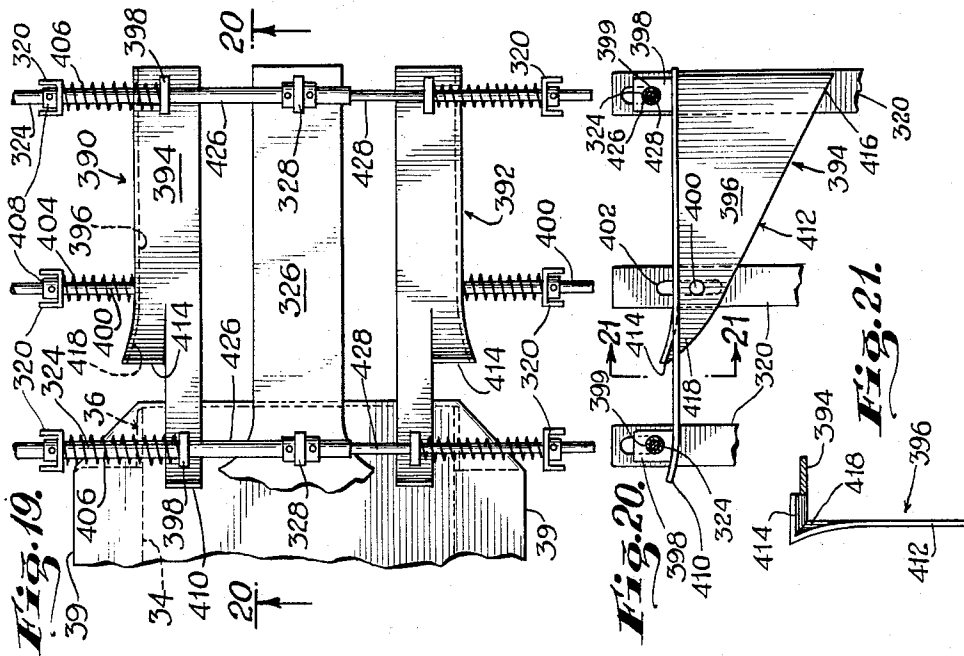
I. ZUCKER

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BUNDLE WRAPPING APPARATUS

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8 Sheets-Sheet 7



INVENTOR
IRWIN ZUCKER

BY *Oliver and Buckles*
ATTORNEYS

March 8, 1966

I. ZUCKER

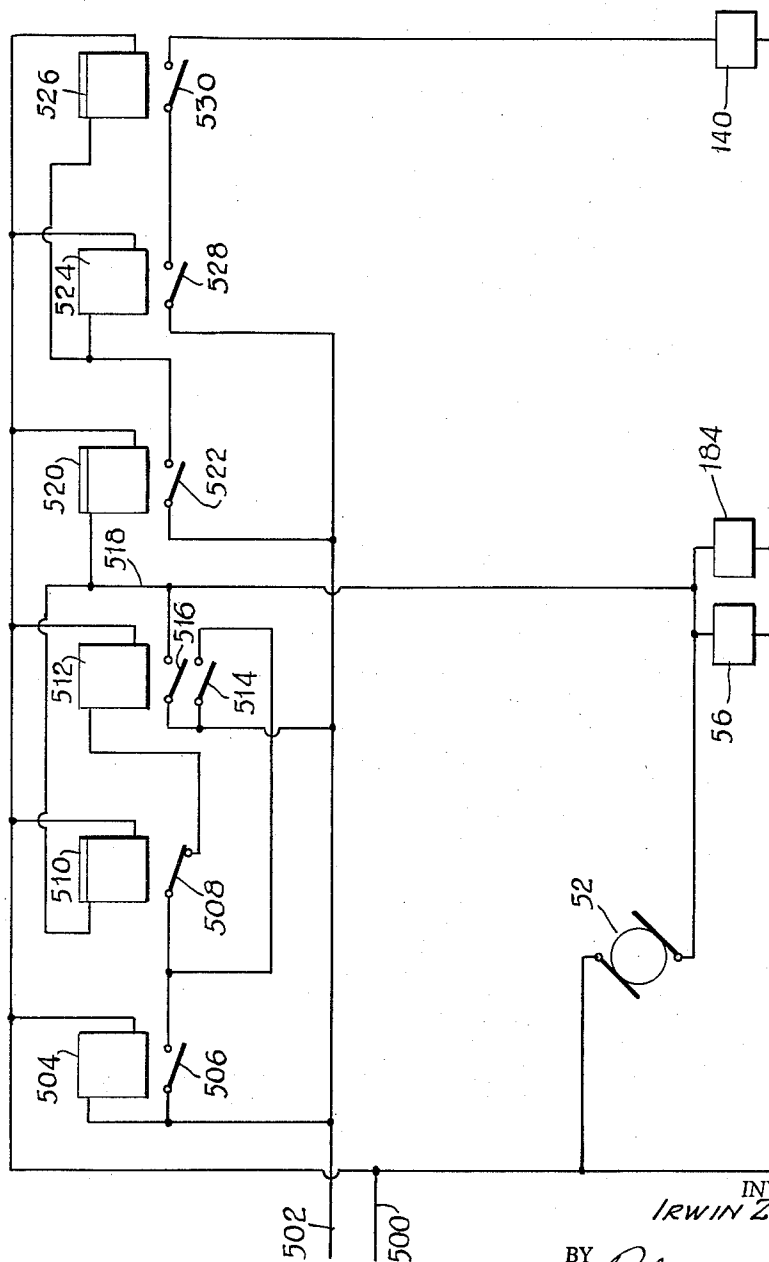
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Fig. 22.



INVENTOR
IRWIN ZUCKER
BY *Blair and Buckles*
ATTORNEYS

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BUNDLE WRAPPING APPARATUS

Irwin Zucker, White Plains, N.Y., assignor to General Strapping Company, New York, N.Y.
Filed Oct. 26, 1962, Ser. No. 233,406
4 Claims. (Cl. 53—230)

The present invention concerns a method and apparatus for wrapping five sides of a moving bundle in a continuous sheet of paper, and more particularly such apparatus which automatically adjusts itself to wrap bundles of varying sizes and proportions.

Many machines have been used in the past for automatically wrapping uniform size bundles or objects, employing a continuous sheet of paper. These machines have, on the whole, been successful for their intended purpose, but have suffered from an inability to receive and wrap consecutive different-sized bundles automatically. For example, bundles of wood pulp formed during paper making processes often vary widely in height and width, making them unusually difficult to wrap in automatic machinery. Such odd sized bundles frequently have had to be wrapped manually, with an attendant increase in expense and waste of human effort.

Accordingly, it is an object of the invention to provide an automatic bundle wrapping apparatus adapted for continuously wrapping bundles.

A further object is to provide apparatus of the above character which automatically adjusts to wrap bundles of differing dimensions.

A further object is to provide apparatus of the above character wherein the bundle may be wrapped in a double sheet of paper.

A further object of the invention is to provide apparatus of the above character wherein the several folding steps are staggered or sequentially performed.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the several steps and the relation of one or more of such steps with respect to each of the others, and the apparatus embodying features of construction, combination of elements and arrangement of parts which are adapted to effect such step, all as exemplified in the following detailed disclosure, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIGURES 1-5 are schematic perspective views of the paper, generally illustrating the sequence of steps performed by the method and apparatus of the present invention.

FIGURE 6 is a perspective view of the complete apparatus of the present invention.

FIGURE 7 is an end elevation view of the apparatus of FIGURE 6, showing the paper feed assembly and the front of the articulated gate assemblies 220 and 222.

FIGURE 8 is a sectional side elevation view taken along line 8—8 of FIGURE 6.

FIGURE 9 is a top plan view, partly broken away, of the apparatus of FIGURE 8.

FIGURE 10 is a schematic perspective view of the apparatus of FIGURES 8 and 9.

FIGURE 11 is a perspective rear view of the articulated gate assemblies shown in FIGURES 7 and 8.

FIGURE 12 is an active perspective view of the rear of the gate assembly of FIGURE 11.

FIGURE 13 is a sectional view of the gate assembly of FIGURE 11 taken along line 13—13 of FIGURE 11.

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FIGURES 14-16 are active top plan schematic views illustrating successive stages in the operation of the articulated gate assembly shown in FIGURE 11.

FIGURE 17 is a top plan view of the lower cam assembly taken along line 17—17 of FIGURE 8.

FIGURE 18 is a side elevation view of one of the lower cams shown in FIGURE 17.

FIGURE 19 is a top plan view of the upper folding cam assembly shown in FIGURE 6.

FIGURE 20 is a side elevation of one of the upper cams shown in FIGURE 19.

FIGURE 21 is a front elevation view of the cam shown in FIGURE 20.

FIGURE 22 is a schematic circuit diagram showing illustrative controls for the wrapping apparatus.

Referring now to the drawings, FIGURES 1-5 generally illustrate the sequence of steps performed by the apparatus of the present invention. As shown in FIGURE 1, a continuous strip 28 of wrapping paper is fed from supply roll 32. The free end of strip 28 is fed upwardly across the path of the bundle 34 which is to be wrapped. Bundle 34 is moved against the vertical portion 36 of strip 28, whereupon sufficient additional paper is fed from roll 32 to cover the bottom surface of the bundle. Sheet 30 is then severed from roll 32. The resulting configuration, illustrated in FIGURE 2, has bundle 34 enfolded in sheet 30, with sheet 30 covering and laterally extending from the bottom, front, and top surfaces of bundle 34.

The vertical portions 36 of sheet 30 extending laterally beyond the sides of bundle 34 are then folded back along the sides as illustrated in FIGURE 3, leaving horizontally extending folded flaps 38 and 39. As shown in FIGURES 4 and 5, flaps 38 and 39 are then sequentially folded against the lateral sides of the bundle (FIGURE 5) with five sides of the bundle covered by the sheet of paper 30. This leaves only the rear surface of bundle 34 which must be covered manually or by other apparatus not the subject of the present invention.

Referring generally now to FIGURE 6, the preferred apparatus for performing the steps illustrated in FIGURES 1-5 includes a paper feed assembly 40, an input conveyor assembly 42, and a wrapping assembly 44.

The paper feed assembly 40 provides for storage of a stock of paper, such as heavy kraft paper or the like, on large storage rolls 32 and 33. These rolls are positioned and drivingly supported on a paper supply rack 41 to supply a single or double continuous strip 28 of paper on demand. The paper feed assembly 40 therefore includes controlled intermittent drive means designed to feed this paper strip 28 to the paper guiding means and cutting and folding mechanisms hereinafter described. Thus the paper strip 28 is moved into position ahead of an approaching bundle, where it waits until the bundle arrives and carries the paper strip forward to the folding operations performed in the wrapping assembly 44.

Input conveyor assembly 42 moves the incoming bundles 34 along an input conveyor belt 43 and delivers them to the wrapping assembly 44. As each bundle 34 reaches the discharge end of conveyor belt 43, it engages the waiting paper strip 28, suspended in its path in the configuration illustrated in FIGURE 1 by the edge guide channels 45 (FIGURE 6). Bundle 34 draws the strip 28 from the guide channels 45 and pushes the strip 28 ahead of the bundle through a pair of articulated gates 220 and 222 as the bundle enters upon wrapping assembly 44.

As bundle 34 moves through articulated gates 220 and 222, additional paper is fed under the bundle by the paper drive mechanism as the bundle enters upon and moves along a wrapping conveyor belt 150. This supplies the

paper covering the bottom of bundle 34, as shown in FIGURES 1 and 2.

After a predetermined amount of paper has been fed under the bundle, a rotary paper knife assembly 130 (see FIGURES 1 and 8) mounted under the input conveyor belt 43 severs an individual sheet 30 from the continuous strip 28. The paper feed assembly 40 continues to feed the strip 28 into the pair of upstanding paper guide channels 45 until a predetermined length has been thus supplied, in preparation for wrapping the next bundle 34.

As bundle 34 moves through the articulated gates 220 and 222, as shown in FIGURES 11-15, the gates swing beside the bundle and fold the laterally extending portions of vertical paper portion 36 backward (FIGURE 3).

As bundle 34 moves further along the wrapping conveyor belt 150, lower folding cams 350 and 352 engage the lower flaps 38 and fold them up along side the bundle to the configuration illustrated in FIGURE 4. A pair of upper folding cams 392 and 394 are positioned above the conveyor belt 150 somewhat nearer the discharge end thereof than lower folding cams 350 and 352, and these upper cams fold the upper flaps 39 down along the sides of the bundle. This provides the completed configuration illustrated in FIGURE 5. Due to the methods employed in handling the wrapped bundle, it may be desirable to reverse the sequence and fold the top flaps down (FIGURE 5) before folding the lower flaps up. This is easily accomplished by reversing the longitudinal positions of lower cams 350 and 352 with upper cams 392 and 394, relative to the conveyor.

THE PAPER FEED ASSEMBLY

Referring to FIGURES 6 and 7, paper supply rack 41 rotatably supports the paper supply rolls 32 and 33 with the axes of the rolls generally parallel to the path of travel of conveyor belt 43.

As best shown in FIGURE 6, a roll drive motor 52 is coupled through a reduction gear box 54 to a clutch-brake mechanism 56. The output shaft 62 of clutch-brake 56 has a paper drive roller 64 mounted thereon. A lower clamping roller 66 (see FIGURE 7) clamps the continuous sheet 28 against drive roller 64, thus providing frictional engagement between drive roller 64 and sheet 28.

As viewed in FIGURE 7, clamping roller 66 is journalled in the ends of a pair of arms 68, the latter being mounted on pivots 70 on frame 41. A pneumatic cylinder 72 is mounted on the end of each arm 68, and each cylinder 72 has its piston 74 extending downwardly and engaging fixed frame member 76. Thus, extension of pistons 74 pivots the arms 68 upwardly about the pivots 70, thus urging roller 66 against drive roller 64, while retraction of pistons 74 lowers rollers 66 away from drive roller 64 in order to provide clearance and facilitate initial threading of paper strip 28 between rollers 64 and 66.

The paper supply rolls 32 and 33 are large and possess considerable inertia. Accordingly, auxiliary drive means are provided to assist drive roller 64 in starting and stopping the paper supply rolls 32 and 33. Referring to FIGURES 6 and 7, a sprocket 78 is rigidly mounted on shaft 62, and drives sprocket 80 keyed on an idler shaft 82, by chain 84. Idler shaft 82 is rotatably mounted on a pair of vertical supporting frame members 86, and has keyed thereon near one end thereof a further sprocket 88. A drive roller 90 is rotatably mounted in one end of each of a pair of arms 92, the other ends of arms 92 being freely pivotally mounted on shaft 82. A sprocket 94 is rigidly mounted on drive roller 90, and is driven by chain 95 from sprocket 88 on idler shaft 82.

Since arms 92 are pivotally mounted on shaft 82, roller 90 is urged downwardly by gravity into frictional contact with the upper surface of roll 33, thus applying

additional torque to aid the paper drive roller 64 in starting and stopping the massive supply roll 33.

A similar additional frictional roll drive is applied to the upper roll 32. Thus, a second idler shaft 96 is rotatably mounted on frame 86 above idler shaft 82, and is driven in synchronism with shaft 82 by chain 97 joining sprockets 98 and 99. An upper drive roller 100 is rotatably mounted in the ends of a pair of arms 102, and has sprocket 104 rigidly affixed thereon. Arms 102 are pivotally mounted on shaft 96, similar to the mounting of arms 92 on shaft 82. A sprocket 106 mounted on shaft 96 drives sprocket 104 by chain 108, thus driving roller 100 synchronously with rollers 90 and 64.

As viewed in FIGURES 6 and 7, rollers 90 and 100 pivot downwardly against the upper surfaces of rolls 32 and 33 under the influence of gravity, and aid in stopping and starting the relatively massive supply rolls. The individual paper strips from rolls 32 and 33 are each fed between rollers 64 and 66 to provide a double strip 28 which will be used to wrap the bundles. Either strip may be fed alone to provide a single strip 28 if desired.

Referring to FIGURES 6 and 7, paper supply rolls 32 and 33 are mounted on shafts 109. Pairs of parallel inwardly directed laterally spaced short rollers 110 are mounted on frame 41 for rotatably supporting each end of each shaft 109. In order to facilitate the loading of the massive paper rolls 32 and 33, for example by a fork lift truck, an inclined guide ramp 111 is rigidly attached to frame 41 above and to the right of each pair of rollers 110 as viewed in FIGURE 7, and ramp 111 inclines downwardly toward the space between rollers 110.

Thus, roll 32 may be lifted by a fork lift truck to a level such that its shaft 109 is above the level of rollers 110, and then moved horizontally into the rack from the left as viewed in FIGURE 7, until its shaft 109 contacts a pair of ramps 111. When the supporting fork is then lowered, roll 32 rolls downwardly with its shaft 109 riding along ramps 111 until it reaches the loaded position illustrated in FIGURE 7. Roll 33 may be similarly loaded in rack 41, using its ramps 111 to guide its shaft 109 downward into position between the supporting rollers 110.

During such loading operation, drive rollers 90 and 100 must be retracted out of the path of movement of rolls 32 and 33. A pneumatic cylinder 112 is vertically mounted on frame 86 (see FIGURE 7) and has its ram 113 attached to one of the arms 102, whereby withdrawal of ram 113 pivots arms 102 and roller 100 upwardly about shaft 96 sufficiently far to permit ready loading of roll 32. A link 114 has its upper end pivotally mounted on one arm 102 and its lower end pivotally mounted on arm 92 to permit simultaneous retraction of roller 90 when roller 100 is retracted by cylinder 112. Preferably some provision is made for lost motion in the retraction linkage so that when ram 113 is extended the rollers 90 and 100 ride independently on the surfaces of rolls 33 and 32 respectively. Such lost motion may be provided, for example, by an elongated slot 115 in link 114 slidably fitting on a pin 116 on arm 92.

As noted above, the individual paper strips from rolls 32 and 33 are fed either alone or together between rollers 64 and 66 to provide a single or double strip 28 which will be used to wrap the bundles. This strip 28, after leaving drive roller 64 and clamping roller 66, is fed under and around a canted roller 117 (FIGURES 1, 7 and 8) under the input conveyor assembly 42, to change the direction of paper movement to a direction parallel to the path of movement of conveyor belt 43. A sheet metal guide 118 (see FIGURES 7 and 8) is wrapped partially around and spaced radially from canted roller 117 to guide strip 28 during threading of the strip around roller 117.

As shown in FIGURES 1 and 8, strip 28 is then fed over a guide tray 119 to a further paper drive roller 120, which is transversely mounted beneath input con-

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veyor belt 43. A clamping idler roller 121 is positioned above and parallel to drive roller 120, and is rotatably mounted in one end of each of a pair of longitudinally extending arms 122. The opposite ends of arms 122 are mounted by pivots 123 on frame member 124. A pneumatic cylinder 125 is mounted on each arm 122, and has its piston 127 bearing on a fixed frame member. Thus, when piston 127 is extended, arms 122 will pivot upwardly about pivots 123, raising idler roller 121 from the surface of strip 28 to permit the strip to be threaded between rollers 120 and 121 in the same manner that roller 66 may be withdrawn from roller 64.

Referring to FIGURES 1, 8, 9 and 10, rotary paper knife assembly 130 is positioned transversely across strip 28 near the output side of drive roller 120, and generally comprises a knife 132 mounted on a rotatable shaft 134 beneath strip 28, together with a mating anvil 136 mounted on a rotatable shaft 138 directly above shaft 134. Shafts 134 and 138 are spaced sufficiently for strip 28 normally to pass freely therebetween, and are driven by the actuation of a single revolution clutch mechanism (see FIGURE 10) of conventional construction. When clutch 140 is actuated, it rotates shaft 134 by 360° in the clockwise direction as viewed in FIGURE 8, and simultaneously through gear set 195 (FIGURE 10) rotates shaft 138 by 360° counter-clockwise as viewed in FIGURE 8. When knife 132 and anvil 136 are rotated into engagement (after occurring at a preselected point in the single revolution of shafts 134 and 138) individual sheet 30 is severed from continuous strip 28.

Just to the right of knife assembly 130 as viewed in FIGURE 8 is a curved chute 142 which guides the strip 28 upwardly between input conveyor belt 43 and wrapping conveyor belt 150 through a slot 152 to a pair of parallel inwardly opposed U-shaped paper-guide channels 45, which are positioned on opposite sides of slot 152.

As shown in FIGURES 8, 9 and 10, a continuously running motor 160 is mounted beneath wrapping assembly 44, and drives conveyor belt 43, drive roller 120, and knife assembly 130 through mechanism to be described. Motor 160 drives an output shaft 166 (FIGURES 9 and 10) through a reduction gear box 168. A sprocket 170, rigidly mounted on output shaft 166, drives chain 172, which in turn drives sprocket 174 rigidly mounted on transverse shaft 176. Input conveyor 42 includes a drive roller 178 rigidly mounted on shaft 176. Conveyor belt 43 is looped over roller 178 and an idler roller 182, and is thus continuously driven by motor 160.

Still referring to FIGURE 10, a clutch assembly 184, when engaged, connects output shaft 166 to a jack shaft 186, to controllably drive the paper drive roller 120 and the knife assembly 130. Jack shaft 186 has mounted thereon a pair of sprockets 188 and 190. A chain 192 connects sprocket 188 to the single revolution clutch 140 by sprocket 194. Clutch 140 drives shaft 134, and through a gear set 195 on the opposite ends of shafts 134 and 138, drives anvil 136 in synchronism with knife 132. A second chain 196 on jack shaft 186 drives roller 120 from jack shaft 186 by sprocket 198.

Thus, input conveyor belt 43 is continuously driven by motor 160, while paper drive roller 120 is driven by motor 160 only when clutch 184 is engaged. Likewise, the paper knife assembly 130 is driven only when single revolution clutch 140 and clutch 184 are both engaged.

Referring to FIGURES 8 and 9, wrapping conveyor belt 150 is driven by continuously running motor 200 through a gear reducer 202 and a suitable chain and sprocket arrangement. As illustrated, a sprocket 204 is mounted on the output shaft of gear reducer 202, and drives wrapping conveyor belt 150 through chain 206 and sprocket 208.

As shown in FIGURE 6, a photocell 210 and light source 212 are mounted beside guide channels 45, and

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detect a bundle on conveyor 43 just before the bundle contacts the waiting strip 28. The resulting signal is used to initiate a sequence of operation, as will be explained below.

THE FOLDING GATE ASSEMBLY

Referring to FIGURES 6, 7 and 11, a pair of identical articulated gates 220 and 222 are mounted near the entrance to conveyor belt 150. The construction of gate 220 will now be described in detail.

As shown in FIGURE 11, gate 220 includes a pivot pin 224 vertically mounted beside the conveyor 150 in suitable brackets 226. A pair of vertically spaced generally horizontal arms 228 and 230 are mounted on pivot pin 224, the lower arm 228 being vertically spaced above conveyor belt 150. A pivot pin 232 is carried in eyes 234 on the outer end of arms 228 and 230.

A lower generally triangular paddle 240 is pivoted on pin 232, from which the lower edge 242 of paddle 240 slopes downwardly and outwardly to its vertical edge 246. An upper generally triangular paddle 250 is likewise pivoted on pin 232, and has an upper edge 256 which slopes upwardly away from pin 232 toward its vertical edge 258. A vertical guide pin 260 extends through apertures 262 in rearwardly extending brackets 264 which are mounted on the rear surfaces of paddles 240 and 250 (FIGURE 11). A sleeve 270 is mounted on the rear surface of the upper paddle 250, and telescopically receives the upper end of guide pin 260. A coil spring 272 is positioned between brackets 264 and around guide pin 260, and a further spring 273 is positioned on pivot pin 232, and both springs urge paddle 250 resiliently upward. Accordingly, upper paddle 250 and lower paddle 240 are mounted for pivotal movement about pin 232, and paddle 250 is mounted for vertical sliding movement guided by pin 232 and pin 260.

A rearwardly extending horizontal creasing plate 280 is rigidly mounted at the extreme upper end of edge 258 on paddle 250, and has its upper left edge (as viewed in FIGURE 11) chamfered to approximately match the slope of edge 256. A similar creasing plate 282 is mounted at the lower extremity of edge 246 of lower paddle 240, and has its lower left edge (as viewed in FIGURE 11) chamfered to match the upwardly sloping edge 242.

As shown in FIGURES 11 and 13, a coiled leaf spring assembly 294 is mounted on the fixed pivot pin 224, and has a spring end 296 bearing resiliently against the rear surface of arm 228. Spring assembly 294 biases arm 228 counterclockwise as viewed in FIGURE 13 against a stop 298 which is mounted on a vertical frame member 300, in which position arm 228 extends across and at right angles to the path of movement of a bundle along conveyor belt 150.

A further spring assembly 302 is rigidly attached to the outer end of arm 228, and has the free end of leaf spring 304 carrying a pin 306 which bears against the upper surface of lower paddle 240. Accordingly, spring assembly 302 biases the lower paddle 240 in the counterclockwise direction about pivot pin 232, as viewed in FIGURE 13. A generally Z-shaped stop member 308 (FIGURE 11) is attached to the rear surface of arm 228, and includes a downwardly depending tab 310 positioned to the rear of and below arm 228. A tab 312 is formed on lower paddle 240, and cooperates with tab 310 to provide a stop or limiting assembly, whereby paddle 240 may rotate counterclockwise with respect to arm 228 only far enough so that arm 228 and paddle 240 lie in the same plane.

Preferably, spring assembly 294 is considerably more rigid than spring assembly 302, whereby when a bundle pushes against gate 220, paddle 240 will more readily pivot about pin 232 than about pin 224. Thus the lateral projecting edges of paper sheet 30 are folded back along the sides of the bundle (FIGURES 2, 3, 14, 15 and 16) and the springs 272, 273, 296 and 304 assure proper fold-

ing action regardless of variations in height or width of the bundle 34.

Articulated gate 222 is a mirror image of gate 220 but is otherwise identical thereto. Accordingly, similar reference characters refer to corresponding parts on both gates.

Referring to FIGURES 6-9, a plurality of vertical posts 320 are provided on each side of output conveyor belt 150, and have formed therein near their upper ends elongated guide slots 322. Transverse guide bars 324 are slidably mounted for vertical movement in slots 322 in opposing posts 320. A generally horizontal backing plate 326 is suspended from bars 324 by suitable brackets 328, and is centered over output conveyor belt 150. The forward portion 330 of backing plate 326 diverges upwardly away from conveyor belt 150 (see FIGURE 8), as hereafter explained. Accordingly, backing plate 326 is suspended from bars 324 above conveyor 150, and since bars 324 are positioned in elongated slots 322, backing plate 326 may move vertically as guided by slots 322 but cannot move horizontally. The lower surface of backing plate 326 rests on the upper surface of creasing plates 280 (FIGURE 8) resiliently urging paddle 250 downwardly against the urging of springs 272, 273 with rods 324 normally resting in the bottom of slots 322 in posts 320.

The upper edge of an incoming bundle will engage the sloping front portion 330 of backing plate 326, camming the plate 326 upwardly as the bundle enters on conveyor belt 150.

As the forward-moving bundle 34 raises backing plate 326, upper paddles 250 slide upwardly on pins 232 and 260, urged by springs 272 and 273, maintaining contact between creasing plates 280 and the lower surface of backing plate 326 and automatically adjusting the height of gate assemblies 220 and 222 to the height of bundle 34.

As illustrated, arms 228 and 230 preferably are sufficiently long to extend nearer the centerline of conveyor belt 150 than the edges of the narrowest anticipated bundle.

Thus, upon initial contact between bundle 34 and gate assemblies 220 and 222, paddles 240 and 250 in each gate assembly remain parallel to the corresponding arms 228 and 230, with the entire gate assemblies rotating about pivot pins 224.

As the gate assemblies 220 and 222 are thus pivoted rearwardly, the vertical laterally extended front portions of sheet 30 (see FIGURES 2 and 11) are gradually folded back toward the lateral sides of bundle 34 by the gate assemblies (FIGURES 3, 14, 15, 16). When the bundle has moved sufficiently far down conveyor 150 so that the vertical front edges thereof slide past pivot pins 232 on the ends of arms 228 and 230, paddles 240 and 250 rotate relative to arms 228 and 230 (see FIGURES 12, 15 and 16) to positions parallel to the lateral sides of bundle 34. Sloping edges 242 and 256 on paddles 240 and 250 gradually guide vertical portions 36 to the folded positions along the lateral sides of bundle 34 (see FIGURES 3, 12 and 15). This articulated action of gate assemblies 220 and 222 permits automatic adjustment or compensation to accommodate various widths of bundles, since the gates are free to swing farther to accommodate a wider bundle while still performing the same folding action. As paddles 240 and 250 pivot to the position illustrated in FIGURE 12, creasing plate 282 begins to crease the lower flap 38 against the conveyor and table with the beveled edge on plate 282 guiding flap 38 down between plate 282 and the folding table 374. Simultaneously, the beveled edge on folding plate 280 guides upper flap 39 against the backing plate 326, which is now riding on top of the bundle. Thus as the bundle leaves the articulated gate assemblies 220 and 222 it is partially wrapped in the configuration illustrated in FIGURE 3.

THE LOWER FOLDING CAM ASSEMBLIES

Referring to FIGURES 6, 8, 17 and 18, a pair of lower folding cam assemblies 350 and 352 are positioned on opposite sides of conveyor belt 150 to the rear of the articulated gate assemblies 220 and 222. Since cam assemblies 350 and 352 are mirror images but are otherwise identical, only cam assembly 350 will be described in detail.

Cam assembly 350 generally comprises a vertical plate 354 supported by three horizontal laterally extending guide pins 356 rigidly attached to the outer surface thereof. Guide pins 356 are loosely received in and extend through corresponding apertures through vertical posts 320. Coil springs 360 are mounted around pins 356 between plate 354 and the adjacent sides of the corresponding posts 320 and resiliently urge plate 354 inwardly toward the center of the folding conveyor belt 150. A nut 362 or similar limiting means is attached to each pin 356 on the opposite side of the corresponding post 320 to limit the inward movement of plate 354. Accordingly plate 354 is mounted for horizontal lateral movement, perpendicular to the path of movement of a bundle moving on conveyor 150.

In order to pick up the lower flap 38 of a bundle (see FIGURE 3) the front upper edge 364 of plate 354 slopes downwardly from an upper level 365 near the center of the plate to a lower point 366 at the front of the plate. A curved sloping flange 370 extends outwardly from the sloping front upper edge of plate 354, and has a lower end 372 positioned in a laterally extending groove 373 in the table 374 adjacent conveyor belt 150. This insures that the approaching lower flap 38 will slide up plate 370 and edge 364, and will not slide under cam assembly 350.

The apparatus is adapted to accommodate bundles of different widths, for plate 354 is flared outwardly near point 366 to provide a camming surface 375 which extends laterally sufficiently far from the centerline of conveyor belt 150 to accommodate the expected variations in width or alignment of bundles being fed on conveyor belt 150. Plate 354 is normally urged by springs 356 to a position sufficiently near the center line of conveyor belt 150 so that its flared camming surface 375 will intercept the nearest front vertical edge of the narrowest anticipated bundle moving down conveyor belt 150. When a front vertical edge of a bundle thus engages flared surface 375, the camming action of this edge along camming surface 375 urges folding plate assembly 350 outwardly against the force of springs 356 until the large flat inner surface of plate 354 bears on the vertical side surface of the bundle. Simultaneously, flap 38 rides up the inclined flange 370 and edge 364, and is thus cammed upwardly along the vertical lateral side of the bundle, and is folded thereagainst by plate 354 under the urging of springs 360.

THE UPPER CAM ASSEMBLIES

In order to prevent interference between the lower flaps 38 and upper flaps 39 during the folding operation, the cam assemblies for folding the upper flaps 39 down are positioned slightly to the rear of the lower cam assemblies 350 and 352, as shown in FIGURE 6. Analogously to the lower cam assemblies, the upper cam assemblies 390 and 392 are mirror images. Accordingly, only cam assembly 390 will be described in detail.

Referring to FIGURES 6 and 19-21, cam 390 generally comprises a horizontal backing plate 394 positioned to ride on top of the bundle, and a vertical triangular plate 396 depending from the outer edge of horizontal plate 390. Plate 394 is suspended by brackets 398 which slidably receive the rear-most pair of transverse guide bars 324 in apertures 399. A guide pin 400 is rigidly attached to the outer surface of triangular plate 396, and extends through a vertical guide slot 402 in one of the vertical posts 320. Since guide bars 324 likewise extend through vertical slots 322 in their corresponding posts 358, the entire cam assembly 390 is mounted for vertical move-

ment while being restrained against longitudinal movement. Coil spring 404 is mounted around guide pin 400 between the corresponding post 320 and triangular plate 396, and further coil springs 406 are mounted around the rear-most pair of bars 324 between the corresponding post 320 and bracket 398. Springs 404 and 406 resiliently urge the entire cam assembly 390 toward the center line of conveyor 150. Suitable nuts 408 or other equivalent means are provided on the telescoping rods 324 as well as on the guide pin 400 to limit the extent of movement of assembly 390 toward the center line of conveyor belt 150 at a point somewhat nearer the center line than the narrowest anticipated bundle.

Plate 394 is normally suspended somewhat nearer conveyor belt 150 than the lowest anticipated bundle, and has its front portion 410 flared upwardly to a height further from conveyor belt 150 than the tallest anticipated bundle. Accordingly, flared portion 410 will be engaged by the front upper edge of an oncoming bundle, and this sliding engagement cams plate 394 upwardly until the moving bundle slides under plate 394.

Depending triangular plate 396 has a downwardly inclined flap-camming edge 412 which extends from a forward apex 414 slightly above the level of plate 394 to a lower point 416.

Plate 396 is flared outwardly in the vicinity of the forward apex 414 to provide a vertical camming portion 418, which extends outwardly further than the widest anticipated bundle. Camming portion 418, when engaged by the edge of a bundle, provides an inclined surface which guides the entire cam assembly 390 laterally against the urging of springs 404 and 406, in order to accommodate the various widths of bundles, while the flap 39 is cammed downward along edge 412 and is creased against the side of the bundle by plate 396.

To provide for bundle widths of different average dimensions, the rear posts 320 associated with and supporting cam assemblies 350, 352, 390 and 392 are mounted for adjustable positioning with respect to the centerline of conveyor belt 150. As illustrated in FIGURES 6 and 9, these rear posts 320 are mounted on plate 420. Plates 420, in turn, rest on folding table 374, and are adjustably clamped thereon by bolts 422 extending upwardly through laterally extending slots 424 in plates 420. The guide bars 324, from which are suspended the backing plate 326 and the upper cam assemblies 390 and 392, are arranged to telescope in order to accommodate adjustment of plates 420. Thus, guide bars 324 may be constructed of tubes 426 telescopically receiving rods 428 (see FIGURE 9). Brackets 328 may then be adjustably fixed to tubes 426 in order to re-center backing plate 326 after plates 420 are adjusted to accommodate a new average bundle size.

THE ELECTRICAL CONTROL CIRCUITRY

Referring to FIGURE 22, a pair of power supply conductors 500 and 502 supply current from a suitable power source (not shown). A photoelectric relay 504 closes its contacts 506 when the light beam to photocell 210 (FIGURE 6) is interrupted by a bundle 34 to be wrapped, and this initiates a cycle of operation controlling the paper feed and cutting operations.

The closing of contacts 506 supplies current through normally closed contacts 508 of a pre-set master time delay relay 510, to energize a cycle relay 512. A holding circuit for relay 512 is completed through contacts 514 thereon and contacts 508, thus retaining relay 512 actuated after photoelectric relay 504 releases until contacts 508 are opened by master relay 510.

A further set of contacts 516 on the cycle relay 512 connects power supply conductor 502 to conductor 518, which simultaneously energizes master relay 510 and a cutter delay relay 520, and which energizes paper supply motor 52, clutch-brake mechanism 56 (see FIGURE 6) and clutch 184 (FIGURES 8 and 10). Thus paper strip

28 is fed forward so long as cycle relay 512 is energized.

After a period of time determined by its delay, cutter delay relay 520 actuates and closes its normally open contacts 522, energizing cutter control relay 524 and a further time-delay relay 526. Relay 524 closes its contacts 528, and connects power supply conductor 502 through normally closed contacts 530 of delay relay 526 to energize the single revolution clutch 140 (FIGURES 8 and 10), actuating the paper cutter assembly 130.

Cutter delay relay 520 prevents actuation of the paper cutter while the proper length of paper strip 28 is being fed under bundle 34 during the entry of bundle 34 onto the wrapping assembly 44. After the proper length of paper has been fed under the bundle, cutter delay relay 520 actuates cutter control relay 524, as noted above. Delay relay 526 has a much shorter time delay than relay 520, and opens its contacts 530 before paper cutter assembly 130 (FIGURE 8) has completed one revolution. Since the opening of contacts 530 de-energizes the single-revolution clutch 140, more than one cutting operation is prevented per cycle, while single-revolution clutch 140 completes the cutting operation, once started, even though electrically de-energized.

After the cutting operation is performed, the paper continues to feed ahead of the next bundle until the pre-set master relay 510 opens its contacts 508, interrupting the holding circuit for relay 512 and de-energizing the control circuitry until the next actuation of photoelectric relay 504.

OPERATION

In its "ready" condition, the bundle wrapping apparatus of the present invention holds the end of paper strip 28 suspended in the guide channels 45 in the configuration illustrated in FIGURE 1. Motor 52 is de-energized, and clutch-brake mechanism 56 is de-energized, applying the brakes to shaft 62 (FIGURES 6 and 7). Motors 160 and 200 are continuously energized, and accordingly input conveyor belt 43 and wrapping conveyor belt 150 are moving. However, clutch 184 is de-energized at this time, and thus paper drive roller 120 mounted under input conveyor belt 43 (see FIGURES 8 and 10) will not be driving paper strip 28.

When a bundle approaching along conveyor belt 43 interrupts the light beam to photocell 210, photoelectric relay 504 closes its contacts 506 as described above. This energizes relay 512 through normally closed contacts 508 of master time delay relay 510. When relay 512 actuates, a holding circuit for relay 512 is completed through its contacts 514, and closure of its contacts 516 energizes conductor 518.

Energization of conductor 518 starts drive roll motor 52 (FIGURE 6), and by energizing clutch-brake mechanism 56 and clutch 184 (FIGURE 10) starts to feed strip 28 upward in channels 45.

Referring to FIGURE 8, bundle 34 as it leaves input conveyor belt 43 engages strip 28, slipping it out of the lateral guide channels 45 and carrying the strip forward as bundle 34 begins to enter the wrapping conveyor belt 150. The front upper edge of bundle 34 engages the inclined cam portion 330 on backing plate 326, camming the plate 326 upward to slide on the top surface of bundle 34. At the same time the front surface of bundle 34 engages articulated gates 220 and 222 (see FIGURES 11 and 14-16), forming the paper strip 28 into the side-folded configuration of FIGURE 3.

Paper strip 28 continues to feed under bundle 34 until the proper length has been fed, at which time cutter delay relay 520 closes its contacts 522, actuating cutter control relay 524. This energizes single revolution clutch 140, which operates knife assembly 130 through a single revolution, severing the sheet 30 from strip 28.

Referring now to FIGURES 17 and 18, bundle 34 next moves along conveyor belt 150 to the lower folding cam assemblies 350 and 352. Flaps 38 are cammed upwardly

against the lateral sides of bundle 34, riding along inclined edges 364 of vertical plates 534 (see FIGURES 17 and 18). As the lower front corners of bundle 34 engage the curved camming surfaces 375 on vertical plates 354, assemblies 350 and 352 are cammed outwardly against the urging of springs 360, which continue to press vertical plates 354 against the sides of bundle 34. This folds flaps 38 tightly up against the lateral sides of bundle 34 to the position illustrated in FIGURE 4.

As partially wrapped bundle 34 illustrated in FIGURE 4 continues to move down conveyor belt 150, the upwardly flared front portions 410 of upper cam assemblies 390 and 392 are engaged by the front upper edge of bundle 34, raising cam assemblies 390 and 392 until horizontal plates 390 slide along the top of the bundle, thus adjusting cam assemblies 390 and 392 to the height of bundle 34. The upper corners of bundle 34, by engaging the outwardly flared camming portions 418, push the triangular folding plates 396 outwardly against the urging of springs 404 and 406, and adjacent cam assemblies 390 and 392 to the width and alignment of bundle 34. Upper flaps 39 are simultaneously cammed downwardly along the lateral sides of bundle 34 by the inclined flap-camming edge 412.

Referring to FIGURES 6, 10 and 22, after the sheet 30 has been severed from the continuous strip 28, strip 28 continues to feed upwardly through chute 142 for a length of time determined by the time delay of master relay 510. When master relay 510 actuates, opening of contacts 508 interrupts the holding circuit for cycle relay 512. When relay 512 de-energizes, its contacts 516 open, de-energizing conductor 518 and the entire control circuitry until the next actuation of photoelectric relay 504.

AUTOMATIC ADJUSTABILITY

Backing plate 326, due to its resiliently suspended mounting, readily moves upwardly as required so as to ride on top of the bundle to be wrapped, and in so moving upwardly, automatically adjusts the height of the articulated gate assemblies 220 and 222 to conform to the height of the bundle.

The articulated gates 220 and 222, in addition to adjusting for the height of the bundle, automatically adjust to the width of the bundle due to the pivotal mounting of paddles 240 and 250 on pivot pins 224 and 232. The lower folding cam assemblies 350 and 352 are urged outwardly automatically to the proper positions for a given bundle by engagement of the curved camming surfaces 375 on the lower front corners of the bundle, pushing assemblies 350 and 352 outwardly against the resilient urging of springs 360. Likewise, the upper cam following assemblies 390 and 392 automatically adjust themselves to accommodate various bundle sizes. As explained above, cam assemblies 390 and 392 move upwardly in a manner similar to the upward movement of backing plate 326, and are adjusted outwardly to the proper positions by engagement of camming portions 418 with the outer edges of the bundles against the urging of the coil springs 404 and 406. The several folding steps are sequentially performed, thus avoiding interference with one another.

Accordingly, there has been disclosed a bundle wrapping apparatus which automatically adjusts itself to wrap irregularly shaped bundles of differing dimensions, and also adjusts itself to compensate for misalignment of such bundles on the wrapping conveyor.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention, which, as a matter of language, might be said to fall therebetween.

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

1. Wrapping apparatus for a bundle previously enfolded in a continuous U-shaped sheet covering its lower, front and upper surfaces and laterally extending beyond said bundle, comprising, in combination,

(a) means for propelling said enfolded bundle longitudinally along a support surface,

(b) a resiliently mounted backing member suspended above said support surface for slidably engaging the upper surface of said bundle,

(c) a paper folding assembly at each side of the path of travel of said bundle, each folding assembly comprising,

(1) a first folding articulated gate having a first outer edge hinged beside said supporting surface, said gate being resiliently urged transverse to the path of travel of said bundle,

(2) a vertical paddle having its innermost edge pivoted on the opposite edge of said gate and resiliently urged parallel to said gate.

2. The combination of claim 1, wherein said paddle comprises two sections vertically spaced and resiliently urged apart, respectively, into contact with said support surface and with said backing member.

3. The combination of claim 1, wherein upper and lower edges of said paddle diverge from the hinged edge thereof to the outer corners thereof.

4. The combination of claim 1, wherein a rearwardly extending creasing member is attached to each outer corner of said paddle, respectively, adjacent to said support surface and to said backing member.

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FRANK E. BAILEY, *Primary Examiner*.

TRAVIS S. McGEHEE, GRANVILLE Y. CUSTER, JR., *Examiners*.

L. S. BOUCHARD, *Assistant Examiner*.