Feb. 24, 1953 A. A. NEJA 2,629,503

BOX UNSTACKER

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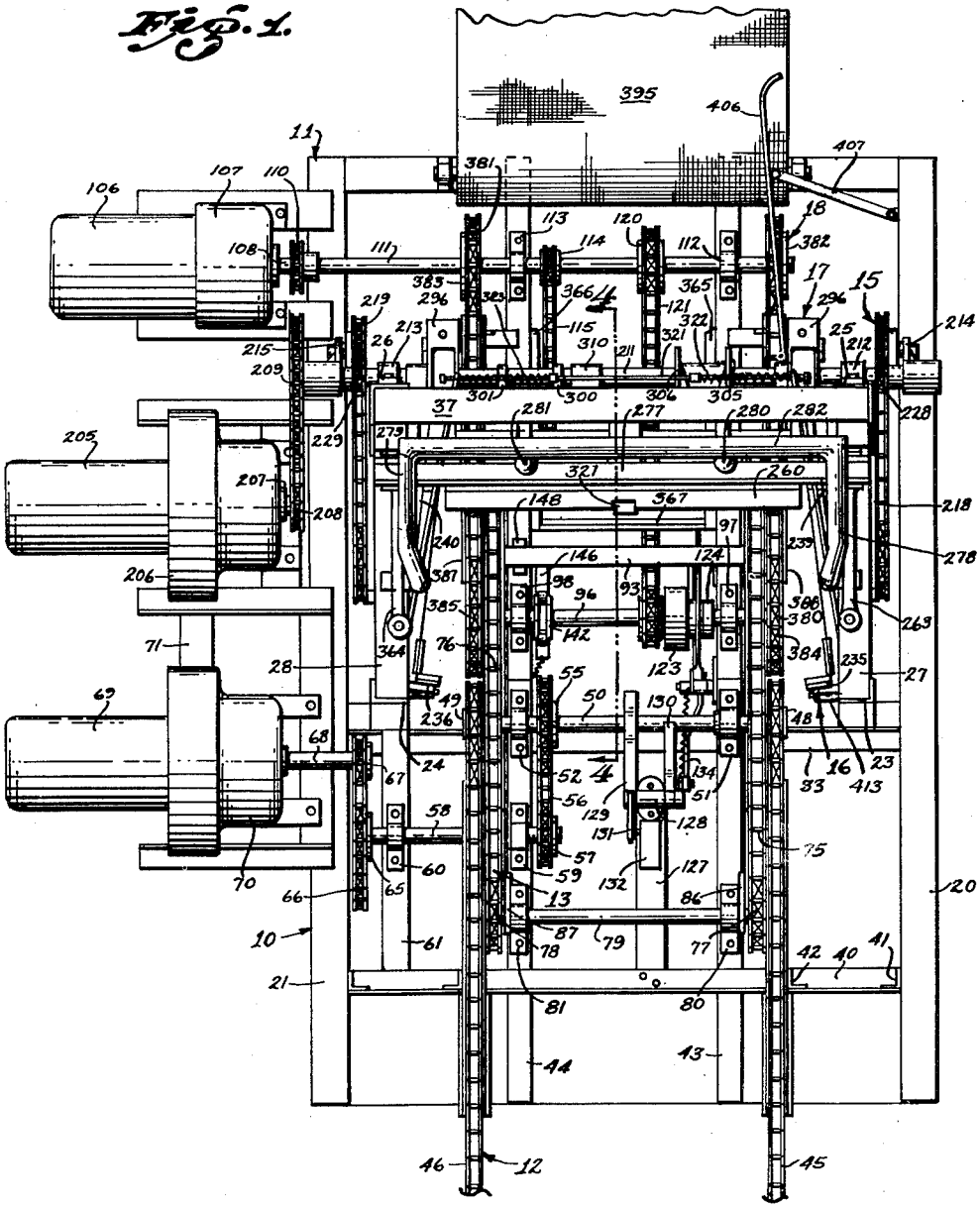
Fig. 1.



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Feb. 24, 1953 A. A. NEJA 2,629,503

BOX UNSTACKER

Filed Dec. 6, 1948 7 Sheets-Sheet 2

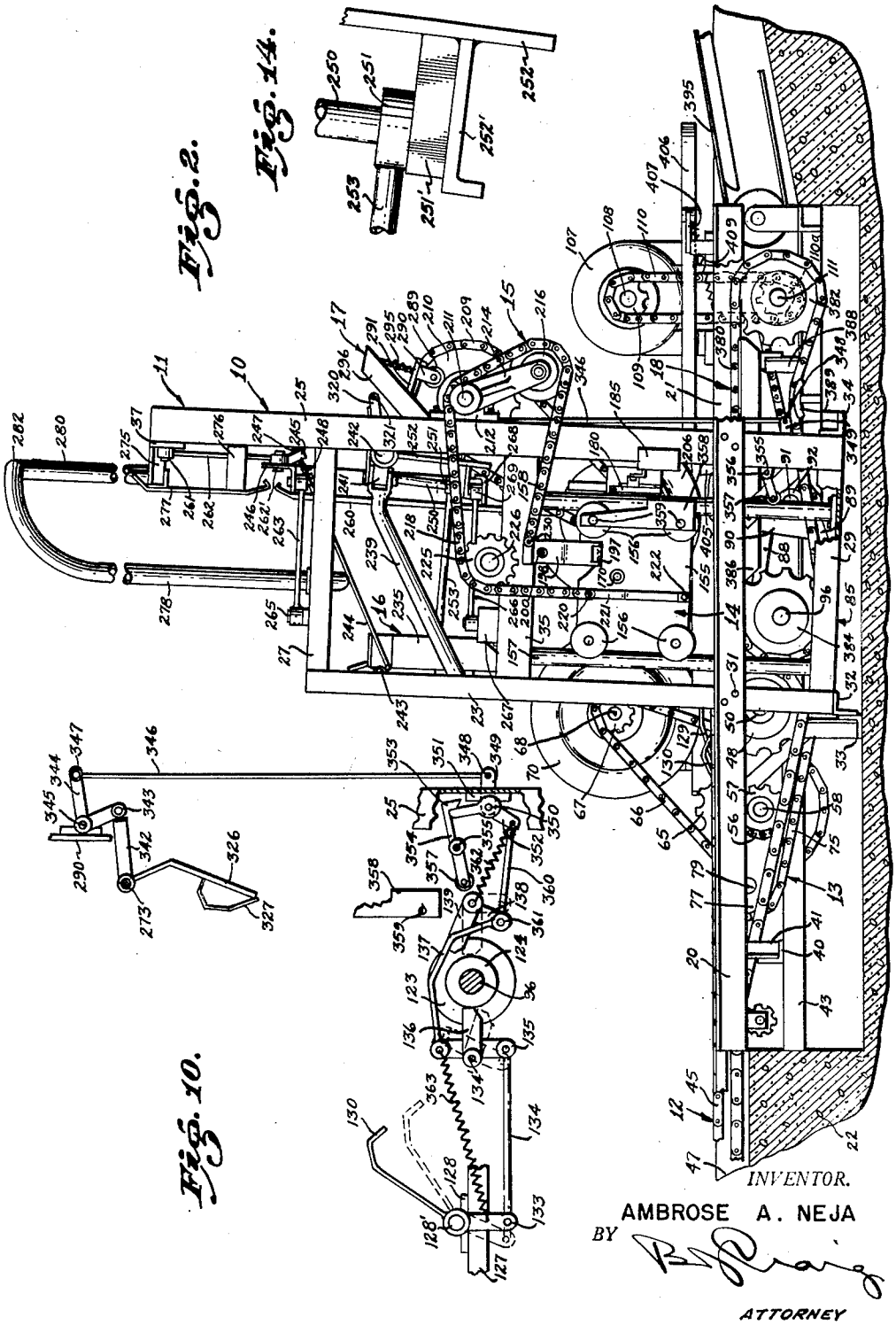

Fig. 2.

Fig. 14.

Fig. 10.

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Feb. 24, 1953 A. A. NEJA 2,629,503

BOX UNSTACKER

Filed Dec. 6, 1948 7 Sheets-Sheet 3

Fig. 3.

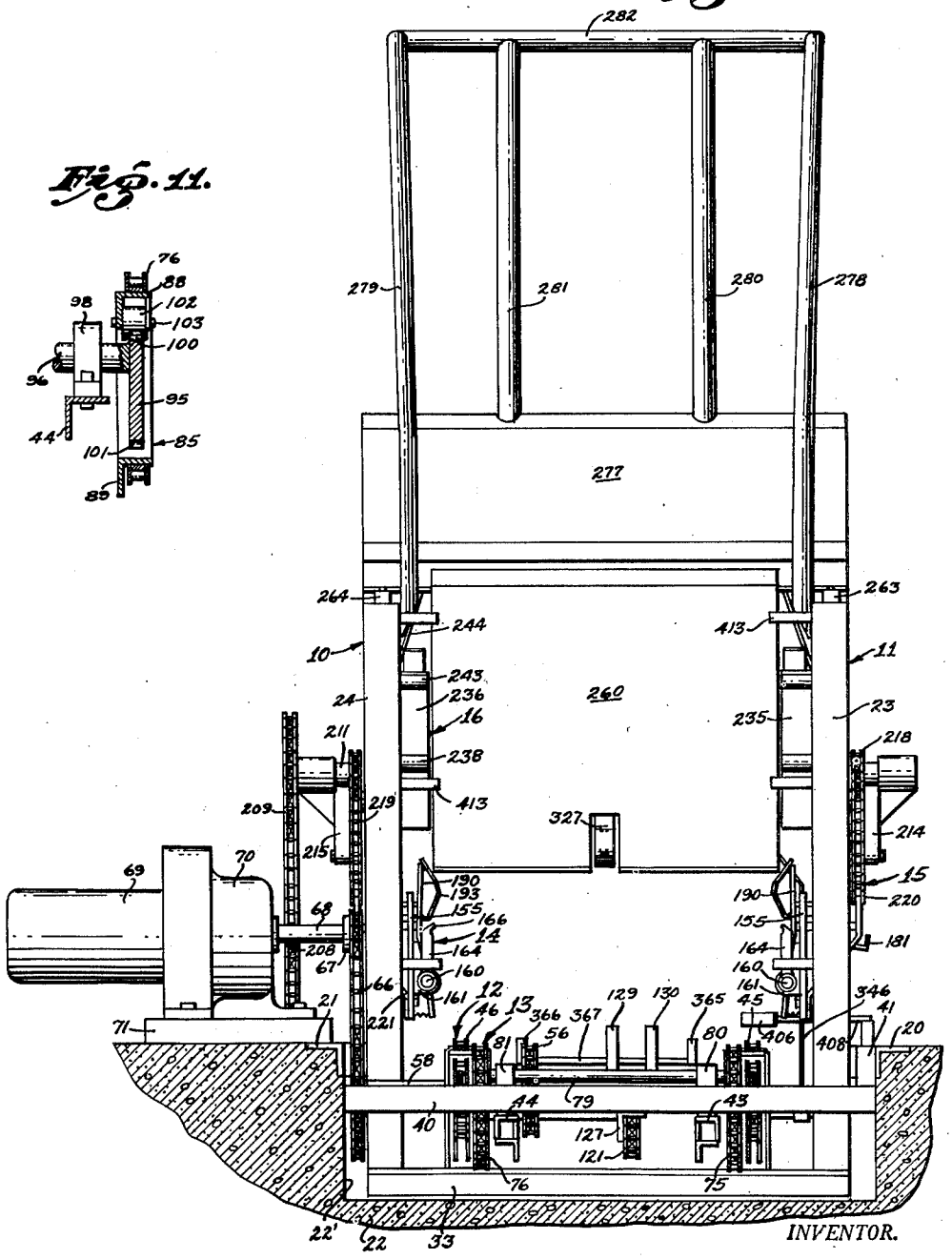

Fig. 11.

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Feb. 24, 1953 A. A. NEJA 2,629,503

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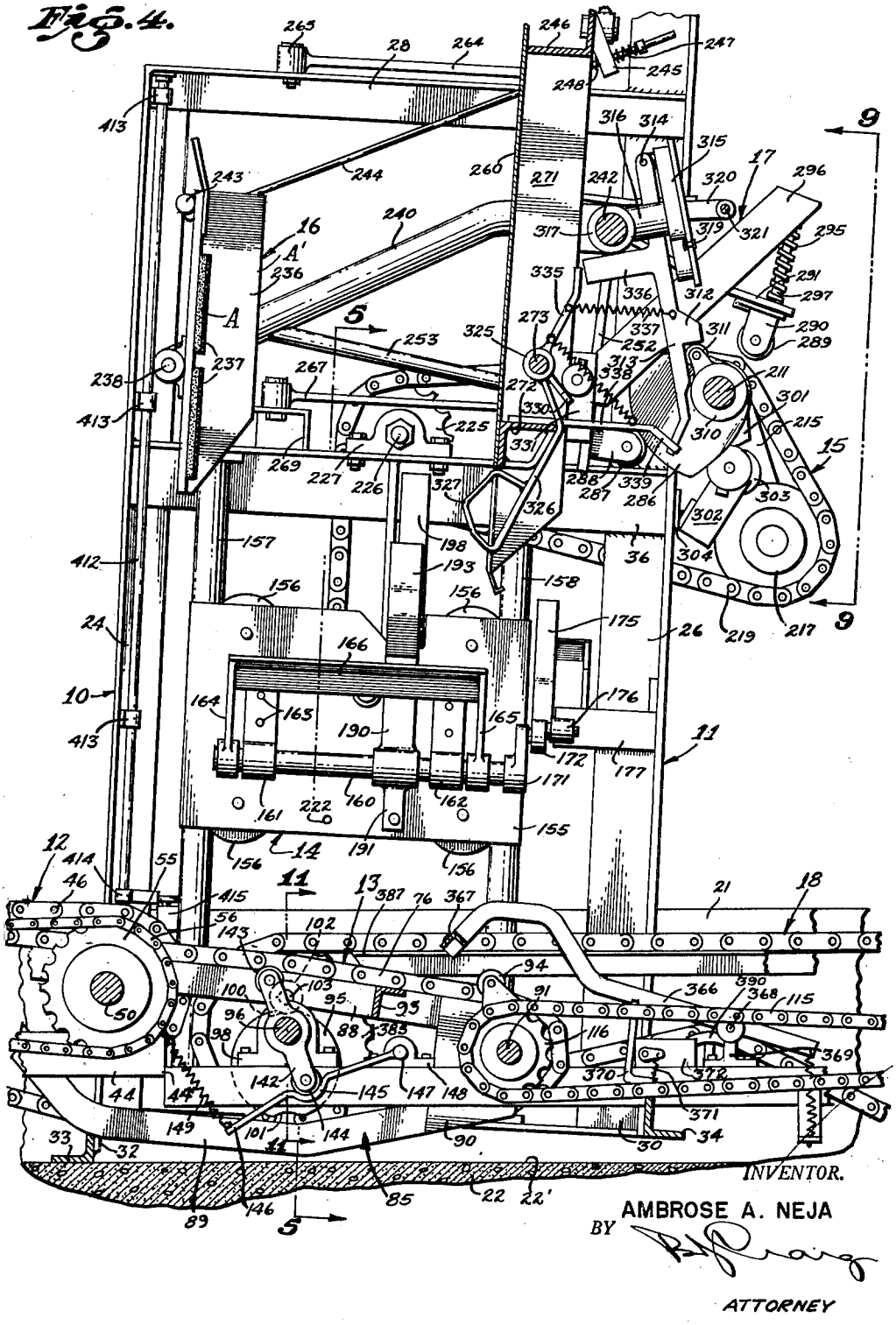
Filed Dec. 6, 1948 7 Sheets-Sheet 4

Fig. 4.



Feb. 24, 1953 A. A. NEJA 2,629,503

BOX UNSTACKER

Filed Dec. 6, 1948 7 Sheets-Sheet 5

Fig. 5.

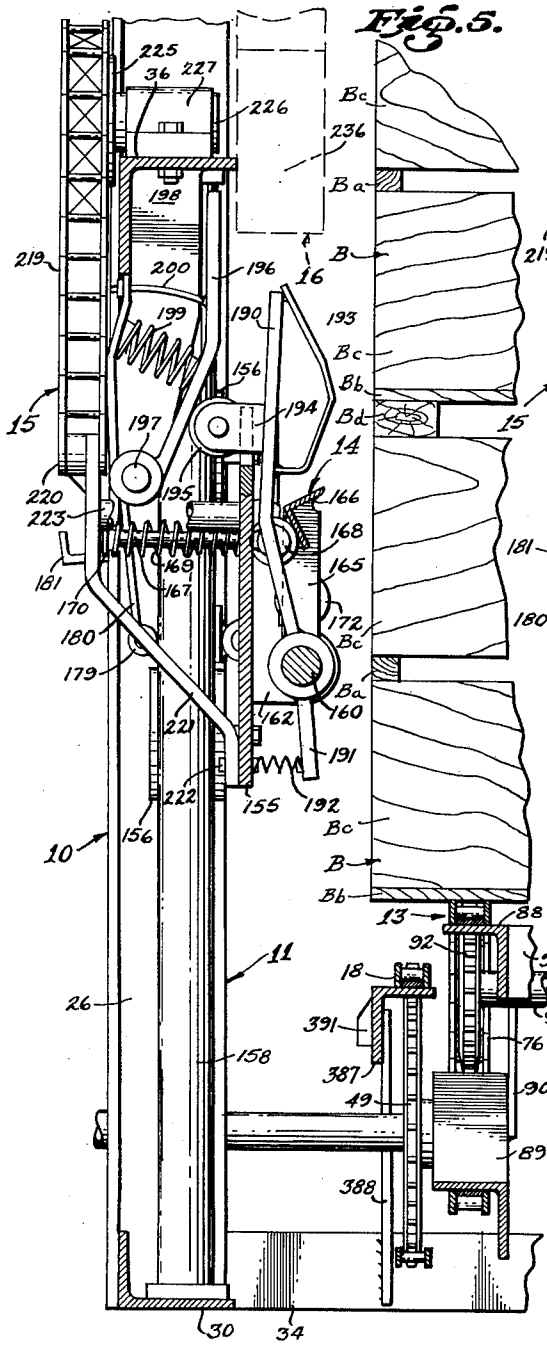
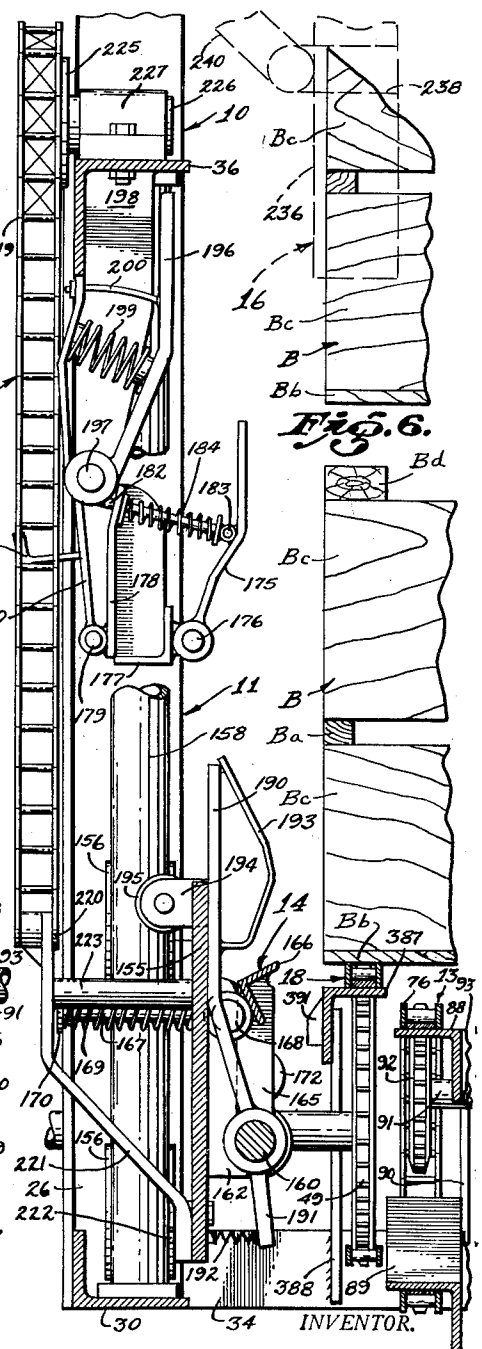


Fig. 6.



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Feb. 24, 1953 A. A. NEJA 2,629,503

BOX UNSTACKER

Filed Dec. 6, 1948 7 Sheets-Sheet 6

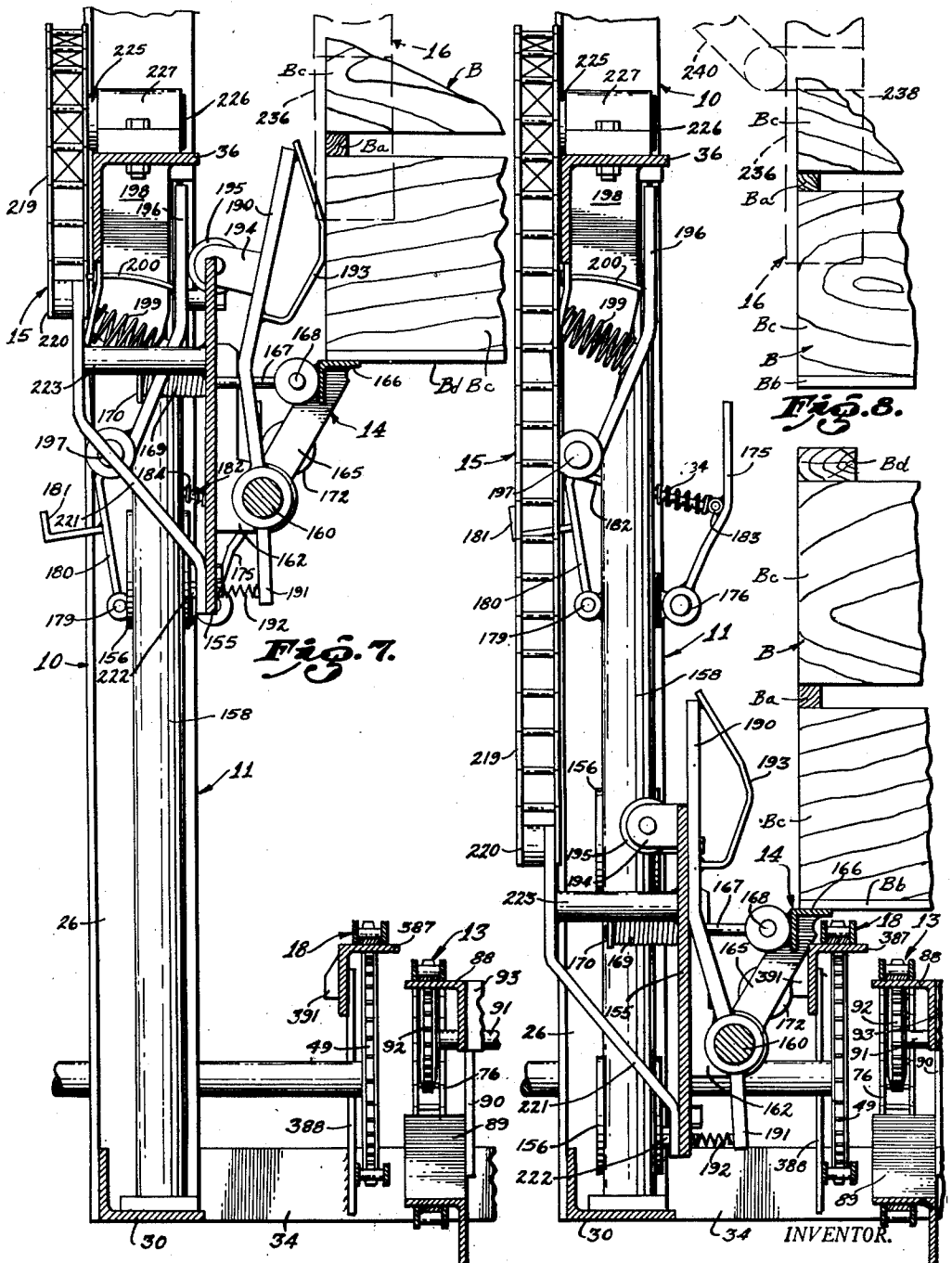

Fig. 7.

Fig. 8.

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Feb. 24, 1953 A. A. NEJA 2,629,503

BOX UNSTACKER

Filed Dec. 6, 1948 7 Sheets-Sheet 7

Fig. 9.

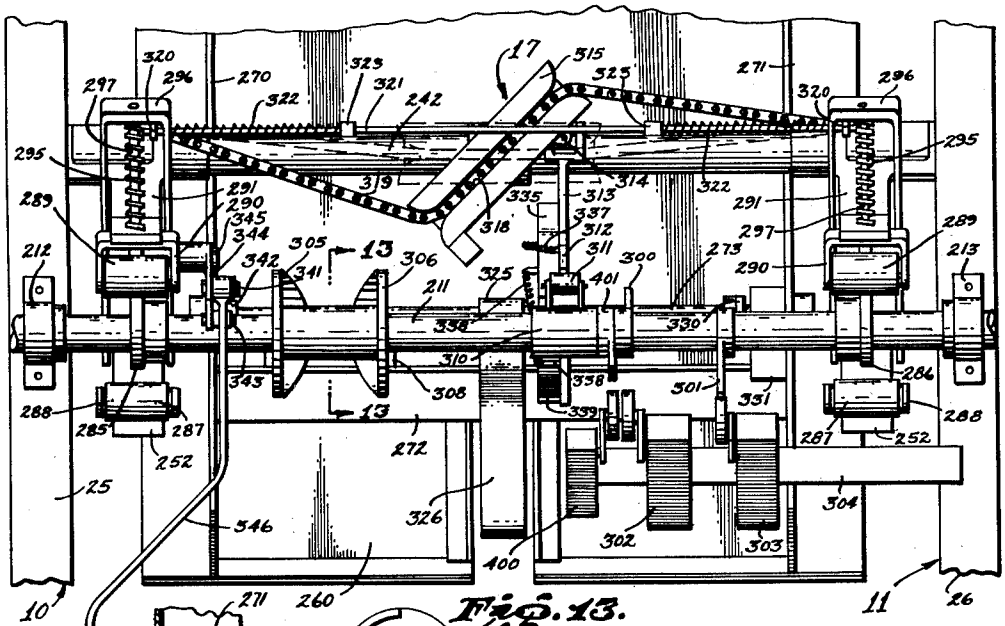


Fig. 13.

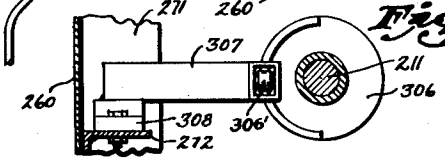
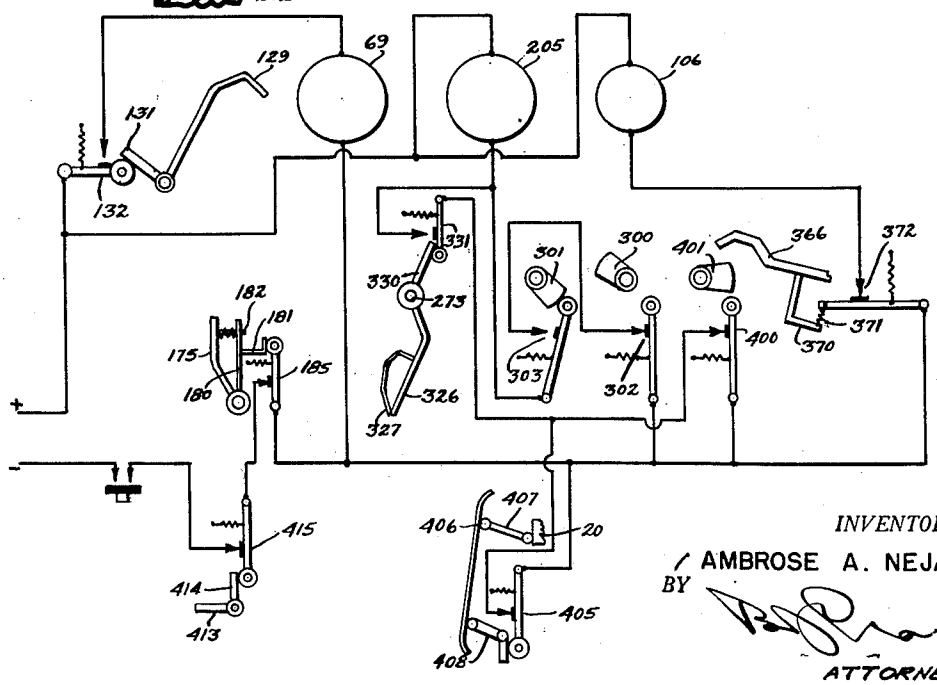


Fig. 12.



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Patented Feb. 24, 1953

2,629,503

UNITED STATES PATENT OFFICE

2,629,503

BOX UNSTACKER

Ambrose A. Neja, Anaheim, Calif.

Application December 6, 1948, Serial No. 63,717

14 Claims. (Cl. 214—8.5)

1

This invention relates to a box unstacking apparatus.

The general object of the invention is to provide a novel apparatus which will operate to remove boxes from a stack and place the removed boxes upon a conveyor.

A further object of the invention is to provide a box unstacker including novel means for removing the lower boxes of a stack one by one.

Another object of the invention is to provide a box unstacking apparatus including novel holding means which serve to engage and support certain boxes of a stack while other boxes of a stack are being removed from the stack.

A further object of the invention is to provide a box unstacking apparatus including novel pivoted holding means in the form of arms which are mounted to move towards and from boxes in a stack to engage and hold certain boxes in the stack.

Another object of the invention is to provide a box stacking apparatus including novel lowerator means for lowering lower boxes of a stack while the upper boxes of the stack are held in stacked condition.

A further object of the invention is to provide a novel lowerator for a box stacking apparatus including novel means for engaging and lowering the lower boxes of a stack.

A further object of the invention is to provide a box stacking apparatus including novel holding means and lowerator means by means of which a stack of boxes may be held and the lower boxes may be removed from the stack.

A further object of the invention is to provide a novel means for operating a box unstacking apparatus.

Another object of the invention is to provide a box handling mechanism including novel means for aligning the boxes.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 is a top plan view of the unstacker in a position to receive a stack of boxes.

Fig. 2 is a side elevational view with the stacker in the same position as shown in Fig. 1.

Fig. 3 is a front view of the unstacker.

Fig. 4 is a fragmentary sectional view taken as indicated by line 4—4 of Fig. 1, with the unstacker in the same position as in Fig. 1.

Fig. 5 is a fragmentary sectional view taken as indicated by line 5—5 of Fig. 4.

Fig. 6 is a view similar to Fig. 5, with parts in

2

different positions and showing the lowerator ready to receive a stack of boxes.

Fig. 7 is a view similar to Fig. 5, with the lowerator in its uppermost position.

Fig. 8 is a view similar to Fig. 5, with the lowerator in position to place an unstacked box on the outgoing conveyor.

Fig. 9 is a fragmentary view taken as indicated by line 9—9 of Fig. 4.

Fig. 10 is a schematic diagram showing the construction and operation of the chain raising and lowering clutch mechanism and safety features associated therewith.

Fig. 11 is a fragmentary sectional view taken substantially as indicated by line 11—11 of Fig. 4.

Fig. 12 is a schematic wiring diagram of the unstacking apparatus.

Fig. 13 is a fragmentary sectional view taken on line 13—13 of Fig. 9, and

Fig. 14 is a fragmentary enlarged side elevation showing the pivot rod and associated parts.

Referring to the drawings by reference characters, I have shown my invention as embodied in a box unstacking apparatus which is indicated generally at 10. As shown the apparatus includes a frame 11, feed chains 12, elevating chains 13, a lowerator apparatus 14, a lowerator driving mechanism 15, a holding mechanism 16 for holding a stack of boxes, controlling means 17 for controlling the holding mechanism 16, and delivery chains 18. The boxes shown at B consist of ends B^a, bottoms B^b, a pair of side boards B^c and top cleats B^d.

The frame 11 comprises a pair of longitudinal, parallel floor support angles 20 and 21, adapted to be fastened to a floor 22, which has a well 22' therein.

Forward vertical support angles 23 and 24 and longer rear vertical support angles 25 and 26 serve to support most of the unstacking apparatus. Supports 23 and 25, 24 and 26 are connected at their tops by angles 27 and 28 and at their bases by angles 29 and 30 and are fixed as at 31 to the floor support angles 20 and 21.

The bases of the forward supports 23 and 24 are further secured in spaced relation by angles 32 and 33, and the rear supports 25 and 26 are secured by an angle 34. Support members 35 and 36 serve to brace the center of the apparatus and an angle 37 braces the upper portion of the rear supports 25 and 26. The angles which compose the frame may be secured to one another as by welding. The entire vertical portion of the frame is disposed at a slight angle to the vertical as shown in Fig. 4 for a purpose to be later described.

At the outer forward ends of the floor members 20 and 21 I arrange a cross member 40 supported from the floor members 20 and 21 by angles 41 and 42. The cross member 40 acts as a forward support for longitudinal bearing supports 43 and 44 (Fig. 3), which make a slight jog downward as at 44' (Fig. 4) and continue rearwardly to the rear end of the well 22' in which the unstacker is placed. The rearward end of the supports 43 and 44 is supported by the angle 34.

The incoming chains 12 consist of a pair of chains 45 and 46 which may extend out in channels 47 in the floor 22 for any desired distance from the unstacker and serve to deliver stacks of boxes to the machine. The inner ends of the chains 45 and 46 terminate at sprockets 48 and 49, mounted on a shaft 50 which is journaled in bearing blocks 51 and 52 fixed to the bearing supports 43 and 44.

Adjacent to bearing block 52 and fixed to the shaft 50, I have arranged a sprocket 55, adapted to receive a drive chain 56, driven by a sprocket 57 mounted on a shaft 58, which is in turn journaled in a bearing block 59 on bearing support 44, and a bearing block 60, fixed to an extension angle 61, arranged between the upright 24 and the cross member 40.

The outer end of the shaft 58 carries a sprocket 65, adapted to receive a primary drive chain 66 connected to a sprocket 67, which is driven by a shaft 68 from a motor 69 through a gear box 70. The motor 69 is supported on a suitable support 71, composed of angles which may be fixed to the frame floor member 22 as by welding.

Thus it may be seen that through the motor 69, chains 66 and 56, with their associated sprockets, incoming floor chains 45 and 46 may be driven to bring a stack of boxes into the machine.

It is customary to stack fruit boxes such as are used for oranges, lemons, grapefruit, et cetera, in stacks of from 6 to 9 boxes. The stacked boxes are permitted to stand for several hours before processing. The chains 45 and 46 serve to bring the stacks of boxes from the place of storage.

The supplemental elevating chains, indicated generally at 13, consist of a pair of chains 75 and 76, supported at their outer end by sprockets 77 and 78, mounted on a shaft 79 journaled in bearing blocks 80 and 81, mounted, respectively, on the bearing support angles 43 and 44.

The shaft 79 also supports the pivotal end of chain support frames, indicated generally at 85 (Fig. 4). The frames 85 are supported by bearing plates 86 and 87. Each frame 85 is composed of two side members. Each side member consists of an upper angle member 88 and a lower angle member 89. At their free ends the angle members 88 and 89 engage a bearing plate 90 in which is journaled a shaft 91, which supports sprockets 92 which, in turn rotatably support the inner ends of the chains 75 and 76. The side members of the frame 85 are held at their inner ends in spaced relation by a cross angle 93. Roller stops 94, fixed to the plates 90, limit the inward movement of the stack.

The frame 85 is adapted to be moved into an upper and lower position and is retained in these positions by the action of cam members 95, as shown in Figs. 4 and 11. The cams 95 are eccentrically supported on a shaft 96 which is journaled in bearing blocks 97 and 98, fixed to bearing support members 43 and 44. The cams 95 are notched as at 100 and 101, these notches being adapted to receive rollers 102, fixed to the upper frame angles 88 by a shaft 103, the outer end of which is journaled in a side plate 104. Thus it may be seen by a rotation of cams 95 in a manner to be later described, the frame 85, together with the chains 75 and 76, may be raised and lowered to position as shown by Figs. 5 and 6.

The drive for the elevating chains 13 consists of a motor 106 and a gear box 107, mounted on the support 71. Through the gear box 107 the motor 106 drives a shaft 108 and a sprocket 109 (Fig. 2). The sprocket 109 receives a chain 110 which passes over a sprocket 110a on a shaft 111. The shaft 111 is journaled in bearing blocks 112 and 113, fixed to bearing supports 43 and 44.

Adjacent to the bearing block 113, the shaft 111 carries a sprocket 114 which supports and drives a chain 115. The chain 115 engages a sprocket 116, fixed to the shaft 91, which, as has been previously mentioned, supports the inner ends of chains 13.

Another sprocket 120, also mounted on the shaft 111, is engaged by clutch drive chain 121. The chain 121 also engages a sprocket 122 on shaft 96 and is adapted to drive the rotating portion 123 of a clutch, the fixed portion of which is indicated at 124.

An angle support 127 (Fig. 10), fixed between the cross member 40 and the bottom frame member 33, supports a bearing block 128 which supports a shaft 123'. The shaft 128' supports levers 129 and 130, so placed as to be rocked by a stack of incoming boxes. The lever 129, through extension 131, Figs. 1 and 2, is adapted to operate an electrical switch 132, the operation of which will be later described.

The lever 130 includes an arm 133 (Fig. 10), connected to a rod 134. The rod 134 is connected to a cross arm 135 mounted on a pivot 134'. The cross arm includes a clutch stopping member 135 rigid on the arm 135. When the cross arm is rocked it releases the member 136 from engagement with the clutch 124. The cross arm 135 at its upper end is connected to a rod 137 which is in turn connected to a lever 138 which has an arm 139 thereon. The arm 139 is a clutch stopping member. This member 139 is positioned to stop the rotation of the shaft after a half turn has been made.

To insure this half rotation, I have arranged on the shaft 96, adjacent to the bearing block 98, an arm 142 (Fig. 4) which carries a pair of rollers 143 and 144 at its outer end. These rollers 143 and 144 are adapted to engage in a notch 145 in an arm 146, pivotally supported as at 147 to a bearing block 148 fixed to the bearing support angle 44.

The notch 145 is held in engagement with either roller 143 or 144 by a tension spring 149, connected at one end to the outer end of the arm 146 and at the other end fixed to the bearing support 44 at its downward jog 45.

The lowerator apparatus, indicated generally at 14, consists of a pair of opposed plates 155 arranged on each side of the aparatus between the upright support members 23 and 25, 24 and 26, respectively. Inasmuch as the two sides of the lowerator mechanism are identical except for being rights and lefts, only one set of reference numerals will be used, thus avoiding unnecessary confusion. For simplicity, the lowerator associated with left plate 155 has been shown in detail and will be dscribed.

The plates 155 rotatably support at their four corners rollers 156 which are adapted to engage and roll against vertical guide shafts 157 and 158 fixed between said supports 35 and 36 at

their tops and lower angles 29 and 30 at their bottoms. The plates are movable from their upper position as shown in Fig. 7 to the extreme lower position as shown in Fig. 6 by means to be later described.

A shaft 160, journaled in bearing blocks 161 and 162 fixed to the plates 155 as at 163, supports a pair of stack supporting arms 164 and 165. The outer ends of the arms are connected by a stack engaging member 166 as by welding. A spring rod 167 pivotally mounted as at 168 on the stack engaging member 166 passes through the plate 155 and is surrounded by a compression spring 169. The inner end of the spring 169 engages the plate 155 and the outer end engages a flange 170 on the spring rod 167, normally urging the stack engaging member 166 to the position shown in Fig. 5.

At the outer end of the shaft 160 I have arranged a crank 171 (Fig. 4) which rotatably supports a roller 172 which, upon upward movement of the plate 155, is adapted to engage a cam lever 175, thus moving the arm 171 and the stack engaging member 166 to the position as shown by Fig. 7 to engage the lower end of a stack of boxes B.

The cam lever 175 is pivotally supported at 176 to a support angle 177 fixed to the frame member 26. Angle 177 also suports a spring backing plate 178, the rearward side of which pivotally supports, as at 179, an emergency switch actuating lever 180 which has a protruding switch actuating arm 181 thereon. A switch actuating rod 182 is slidably mounted in the plate 178, having its outer end fixed to the lever 180 and its inner end rotatably supported as at 183 to the cam lever 175, and is surrounded by a compression spring 184. A switch 185 is fixed to the member 25. Thus it may be seen that if the box engaging arm 166 is unable to engage the lower edge of a stack when the roller 172 strikes the cam lever 175, the rod 182 will be moved, thus moving the lever 180 and the arm 181, opening the switch 185 and stopping the machine in a manner to be later described in detail.

It is often necessary to align the individual boxes in the stack before they are unstacked. To accomplish this action I have arranged arms 190 pivotally supported on the shaft 160 with an extension 191 at their lower end. The extension 191 is engaged by a compression spring 192, arranged between bosses on the plate 155 and the extension arm 191, which normally urges the arm 190 to the position shown in Fig. 6. A box engaging member 193 is fixed to the upper end of the arms 190 as by welding.

A roller support member 194 is fixed on the rear of the arm 190 and rotatably supports a roller 195. Upon upward movement of the plate 155 the roller 195 is adapted to engage a cam lever 196 which is pivotally supported at 197 to an angle frame 198 which in turn is fixed to the mid support member 36. A compression spring 199, arranged between the cam lever 196 and the angle frame 198, normally urges the cam lever 196 to the position shown in Fig. 5, the lever 196 being held against further extension by a limit rod 200.

Thus it may be seen that upon upward movement of the plate 155 the roller 195 will engage the lever 196, moving the arm 190 to the position shown in Fig. 7, thus aligning the lower box in the stack. If, as sometimes happens, the box being aligned is wider than normal, the springs 199 will be compressed, still aligning the box.

The lowerator driving mechanism 15 consists of a motor 205, connected by means of a gear box 206 to a shaft 207, which supports a sprocket 208 and drives a chain 209. The chain drives a sprocket 210 mounted on a shaft 211. The shaft 211 is journaled in bearing blocks 212 and 213 (Fig. 2), fixed to the rear vertical support frame members 25 and 26. Fixed adjacent to the outer ends of the shaft 211, I arrange a pair of rotating arms 214 and 215, the outer ends of which rotatably support chain rollers 216 and 217. The rollers 216 and 217 engage lowerator chains 218 and 219. One end of each of the chains 218 and 219 is fixed as at 220 to arms 221 which are fastened at their lower end to the plates 155 at 222. A spacer 223 (Fig. 5), arranged between the plate 155 and the arm 221, braces the arm 221. Each of the chains 218 and 219 extends upwardly and passes over sprockets 225, mounted on a shaft 226 journaled in bearing blocks 227 fixed to the upper side of the mid angle frame members 35 and 36.

The chains 218 and 219 continue rearward over pulleys 228 and 229 on the shaft 211 and around rollers 216 and 217 and have their inner ends secured as at 230 to the mid angle members 35 and 36. Thus upon rotation of the arms 214 and 215 the chains 218 and 219 will be moved in such a manner as to raise and lower the plates 155 as previously mentioned.

The means indicated generally at 16 for securing and holding a stack of boxes in a raised position includes a pair of angle securing members 235 and 236 arranged between the forward upright frame members 23 and 24. These members 235 and 236 each have a face A to engage the outer face of a box and a face A' to engage the ends of a box. The faces A may be lined with rubber or a like substance, as shown at 237, for greater gripping effect.

The members 235 and 236 are rotatably supported as at 238 by arms 239 and 240 (see Fig. 2). The inner ends of the arms 239 and 240 are rotatably fixed to bearings 241 which have substantially vertical axes. Each bearing 241 is in turn rotatably mounted on a shaft 242 which has a horizontal axis. Thus a substantially universal mounting is provided for the arms 239 and 240. The upper ends of the angles 235 and 236 are supported as at 243 by a rod 244 (see Fig. 4), which is slidably mounted in a boss 245 protruding from an angle 246. The use of the rod 244 will be later described. Springs 247 and 248 normally hold the rod 244 in the position shown in Fig. 4. A pivot rod 250 (Fig. 2) extends downwardly through each bearing 241 at the upper ends of the arms 239 and 240. The rods 250 terminate at the lower end in a boss 251 mounted on a spacer 251' fixed to an angle member 252' secured to an extension arm 252 which latter extends downwardly from the bearing 241. The rod 250 rotatably supports one end of a brace 253, the other end of which is fixed to the arms 239 and 240.

Thus it may be seen that the angle securing members 239 and 240 are adapted to be moved either horizontally or vertically about the vertical shaft 250 and the horizontal shaft 242 to the desired position. It will also be seen that a downward motion of the securing members 239 and 240 will also bring them rearwardly and in close contact with a stack of boxes, retaining

them in a raised position, the purpose of which will be later described.

In order to provide for the lateral movement of the entire stack securing apparatus 16 as a unit to compensate for any misalignment of the boxes in the stack, I have arranged a series of flexible pivots to support a floating backing plate 260. Pivotally supported as at 261 (Fig. 2) to the upper cross angle member 37, I have arranged arms 262, the lower ends of which are pivotally mounted to the angle 246 which forms the upper stiffening member for the plate 260. These arms 262 are in vertical spaced relationship, with only one shown. Pivotally supported by the horizontal edge of angle 246 as at 262', I arrange a second set of braces 263 and 264, the outer ends of which are pivotally mounted as at 265 to the central portion of the upper angle frame members 27 and 28. Another set of braces 266 and 267 (below the braces 263 and 264) are pivoted at 267' to a brace member 268 and at the lower end of plate 260 and to block 269 fixed to the upper surfaces of mid angle members 235 and 236. This movable plate 260 further includes vertical brace angles 270 and 271 and a lower central brace 272. Between the members 270 and 271 I have arranged a shaft 273, the use of which will be later described.

From the upper ends of the vertical frame members 25 and 26, I have arranged braces 275 and 276 which support a fixed guide plate 277. As a further guide I have arranged tubular supports 278 and 279 which extend upward from the horizontal frame members 27 and 28 and tubular members 280 and 281 upward from the braces 275. A horizontal tubular member 282, as shown in Fig. 3, connects the tops of these brace members.

Referring now to the mechanism indicated generally at 17 for controlling the securing mechanism: The shaft 211 acts as a central control from which a pair of cams 285 and 286 (Fig. 4) operate. These cams are adapted to engage rollers 287 journaled in brackets 288, which are in turn fixed to the extension arm 252 depending from the shaft 242 to cause the securing means to move upwardly. The cams 285 and 286 are also adapted to engage a pair of rollers 289 (Figs. 2 and 4) journaled in brackets 290 which are in turn fixed to upper extension arms 291. The arms 291 extend rearwardly from the shaft 242 and are fixed to the journal of the boss 241. Thus it may be seen that engagement of the rollers 285 and 286 with the rollers 289 will cause the securing means 16 to move inwardly to engage and hold a stack of boxes.

Should the lower box in a stack being engaged be slightly wider than normal, I have provided a compression spring 295, positioned between the upper rearward end of the extension arm 291 and the inside center of a U-shaped support 296. The support 296 has its inner lower end fastened as by welding to the lower extension arm 252. A rod 297 retains the spring 295 in the desired position.

Shaft 211 also carries a pair of switch cams 300 and 301 (Fig. 4), adapted to operate switches 302 and 303, the purpose of which will be later described. The switches 302 and 303 are mounted on a bracket 304 which is fixed to the upright frame member 26.

To adjust the securing apparatus 16 so that the bottom box of a stack of boxes is at the center of the unstacker, I have provided an aligning mechanism consisting of a pair of adjusting cams 305 and 306 (Figs. 9 and 13) fixed to the shaft 211. The cams 305 and 306 are adapted to engage a protruding tab 307, carrying a cam 306' and fixed to a bracket 308, which is in turn fastened to the cross member 272 of the floating backing plate 260. As the stack of boxes is unstacked, this aligning mechanism adjusts each lowermost box to a central position in the machine, thus allowing for much misalignment in the original stack.

To provide for the outward movement of the securing angles 235 and 236 after the last box of the stack has left the machine and to clear the way for a new stack, I have mounted a roller bracket 310 (Figs. 4 and 9) on the shaft 211. The bracket supports a roller 311 which may engage a depending section 312 of an actuating lever 313. The lever 313 is pivotally fixed as at 314 to a chain guide 315.

The chain guide 315, through a boss 316, is attached to a collar 317 fixed on the shaft 242. The chain guide 315 has a channel 318 through which a chain 319 passes. Each end of the chain 319 is fixed to an arm 320. The arms 320 are fixed to the arms 239 and 240 of the securing apparatus 16. A rod 321 slidably arranged between the ends of the arms 320 and carrying compression springs 322 terminated against bosses 323 serves to return the securing angles 235 and 236 to their normal closed position. Thus it may be seen that upon engagement of the roller 311 with the member 312 and the lever 313 the chain guide 315 will be turned, tightening the chain 319 and opening the securing angles 235 and 236 to the position shown in Fig. 1.

The shaft 273 arranged between the vertical plate members 270 and 271 carries a collar 325, from which depends a switch lever 326 (Figs. 4, 9 and 10). The lower end of this switch lever is bent back against itself to form a box engaging section 327.

A switch lever 330, also fixed to one end of the shaft 273, is adapted to operate a switch 331 mounted on one of the backing plate stiffening members 271 when the box engaging section 327 of the arm 326 is depressed by the lower box of a stack. The purpose of this switch 331 will be later described.

Another lever 335, mounted on the shaft 273 adjacent to the arm 326, has its upper end in position to contact a stop extension member 336 on the forward side of the lever 313. A tension spring 337, fixed between the lever 335 and the arm 313, normally urges the two together. A second tension spring 338, fixed between the lever 335 and a brace 339, normally urges the lever 329 to the position shown by Fig. 4. The brace 339 is fixed as by welding to the cross stiffening member 272 of the plate 260.

Thus it may be seen that as long as the lever 326 is held in a depressed position, the lever 313 and its depending top 312 will be held out of engagement with the roller 311, thus leaving the securing angles 235 and 236 in their inward position to engage the lower box of a stack.

As a timing mechanism to delay the operation of the clutch 124 and the subsequent lowering of the chains 13, I have provided a stop lever 342 (Fig. 10), adapted to engage a roller 343 journaled in one end of a crank 344 pivotally secured to the brace 290 as at 345. The outer end of the crank 344 is fastened to a push rod 346 at 347. The lower end of the push rod 346 is fixed as at 348 to a lever 349 fixed to a shaft 350 journaled

in a bearing block 351 fixed to the upright frame member 25.

The shaft 350 carries a two-way crank 352. The upper end of the crank 352 engages a lock member 353 of a lever 354, pivotally mounted on a shaft 355 which is journaled in bracket 356 secured to the upright frame member 25. The outer end of the lever 354 carries a roller 357 which is adapted to be engaged by a cam plate 358 (Fig. 2) fixed to the pivotal shafts supporting two of the rollers 156 on the plate 155 as at 359. The lower end of the crank 352 is connected by means of a rod 360 to the lever 138 of the clutch control mechanism as at 361. Tension springs 362 and 363 adjacent the clutch mechanism normally urge this mechanism to the position shown by the solid line of Fig. 10.

Thus it may be seen that even though the lever 342 is moved out of engagement with the roller 343, the clutch mechanism 124 cannot operate until the plate 155 has descended far enough to cause the cam plate 358 to engage the roller 357 to unlock the lock member 353, allowing the clutch mechanism to operate.

As a safety measure, levers 365 and 366 (Fig. 4), connected at the outer ends by a cross member 367 and pivotally connected as at 368 to bearing blocks 369 fixed to the bearing angle member 49, have been placed in such a manner as to intercept an outgoing box. An L-shaped arm 370, dependent from the lower end of the lever 366, engages one end of a spring 371. The other end of the spring is fastened to a switch 372 which is fixed to the bearing support 44. The operation of the switch 372 will be later described.

The outgoing conveyor indicated generally at 18 includes a pair of chains 380 and 381, carried by sprockets 382 and 383 fixed to the shaft 111 and driven by the motor 106. The chains are also carried by sprockets 384 and 385, rotatably supported on the outer ends of the shaft 96. The upper reach of the chains 380 and 381 is somewhat lower than the upper reach of the incoming chains 12 or the supplemental chain 13, as shown in Fig. 4. The upper portion of the chains 380 and 381 is supported by chain guides 386 and 387, fixed by means of brackets 388 (Fig. 2) to the bearing support members 43 and 44. Chain guides 389 and 390, fixed to the bearing support members 43 and 44, support the lower travel of the chains 380 and 381.

Cam members 391, fixed to the outer edges of the supports, serve to cam the levers 165 from beneath the lower box, as will be later described.

An outgoing belt type conveyor 395 may be used to convey the individual boxes from the machine.

Mounted on the bracket 364, I provide a third switch 400, adapted to be actuated by a cam 401 on the shaft 211. This switch 400 is connected in line with a limit switch 405. This limit switch 405 is operable by a pressure lever 406 above the chains 380 and 381 and pivotally mounted by means of levers 407 and 408 to the floor angle 20. A spring 409 normally urges the pressure lever 406 to the position shown in Figs. 1 and 2.

As a safety feature I have provided vertical rods 412 (Fig. 4), fixed between the base angles 29 and 30 and the top frame members 27 and 28. The rods 412 support three box engaging levers 413 in such position as to engage the lower three boxes of a stack. Adjacent to the lower end of the rods 412 I provide a switch lever 414, adapted to actuate a switch 415 mounted on the floor frame member 21. Thus it may be seen that a box too wide or too badly out of line to enter the machine will trip this switch and stop the operation of the entire machine.

In operation, and referring particularly to the wiring diagram of Fig. 12, a stack of boxes from 6 to 9 high is brought into the apparatus on the feed conveyor 12. The lowermost box strikes the switch lever 130 which causes the clutch 124 to operate, thus raising the chains 13 and depressing lever 129, engaging switch 132 to stop the motor 69. The stack continues into the machine until the roller stops 94 are engaged. At this point the second box from the bottom of the stack engages the portion 327 of the lever 326, closing the switch 331 and starting the motor 205, which continues in operation until the last box clears the lever 326, opening the switch 331.

The depressing of lever 326 also moves the arm 335 from engagement with the stop 336, allowing the tab 312 to disengage from the roller 311, causing the securing angles 235 and 236 to engage the second box from the bottom of the stack. The parts are so arranged that the faces A first engage the outer face of the box and pull the box towards the floating plate 260 to align the engaged box. Thereafter further movement of the member 235 and the member 236 causes the faces A' and also the faces A to tightly hold the box which they engage. The cams 285 and 286 engage the rollers 289, further increasing the pressure on the securing apparatus 16. At the time this securing operation takes place, the plates 155 travel downward to the position shown in Fig. 6, allowing the cam plate 358 to engage the roller 357 and, by means of the linkage previously described, lower the chains 13. The lowermost box is thus deposited on the outgoing chains 18 to be conveyed from the machine.

The plates 155 continue upwardly until the outward extension of the arms 164 and the cross members 166 engage the bottom of the lowermost box of the stack, raising it slightly and thus aiding the release of the securing apparatus 16, which is completely accomplished by engagement of the cams 285 and 286 with the rollers 287. The stack is positioned in the center of the machine at this time. This position is illustrated by Fig. 7.

The plates 155 then continue downwardly, carrying the complete stack. At a point near the bottom of the travel, the holding apparatus engages the next to the bottom box to hold that box and those boxes above it while the bottom box continues downwardly to be deposited on the outgoing conveyor 18, the arms 165 being carried out of the path by the cams 391.

This operation continues until all the boxes have been unstacked, whereupon the securing angles 235 and 236 spread apart and the machine comes to rest pending the arrival of a new stack into the unstacker.

Should the boxes fail to clear the machine at a sufficient speed to keep the conveyor 395 full, the switch 405 and the switch 400 will be both opened, causing the machine to be stopped in the position shown by Fig. 8.

The switch 312 is adapted to stop the motor 106 and the outgoing conveyor should a box be broken or be too low to clear the machine.

In the foregoing description I refer to my invention as employed in a manner wherein single boxes are removed one by one from the bottom of a stack and in which the holding means engages the next to the bottom box of the stack. It will be understood, however, that this holding means may engage the third box from the bot-

tom of the stack or other boxes so that the boxes may be discharged from the stack in tiers of two or in any other arrangement desired. Although I have described the apparatus as removing boxes singly, it will be understood that with equal facility the apparatus can remove more than one box from the bottom of a stack.

Having thus described my invention and the present preferred embodiments thereof, I desire to emphasize the fact that many modifications may be resorted to in a manner limited only by a just interpretation of the following claims, wherein:

Having thus described my invention, I claim:

1. In a box unstacking apparatus, an unstacking station, a feed conveyor adapted to feed boxes to the unstacking station, vertical guide members disposed at each side of the station, plates mounted to move up and down on the guide members, a chain connected at one side to each of the plates, a sprocket above each plate and receiving a chain, a crank member at one side of each sprocket, each crank member having a roller thereon, each chain passing one of the rollers, means to anchor the other end of the chains, means to rotate the crank member to raise and lower the plates, and a box supporting member mounted on each plate, each box supporting member having a box engaging part thereon adapted to engage beneath a box at the station.

2. In a box unstacking apparatus, an unstacking station, a feed conveyor adapted to feed boxes to the unstacking station, vertical guide members disposed at each side of the station, plates mounted to move up and down on the guide members, a chain connected at one end to each of the plates, a sprocket above each plate and receiving a chain, a crank member at one side of each sprocket, each crank member having a roller thereon, each chain passing over one of the rollers, means to anchor the other end of the chains, means to rotate the crank member to raise and lower the plates, a box supporting member having a box engaging part thereon adapted to engage beneath a box at the station, and means to move said box engaging parts apart to permit delivery of a stack of boxes to the receiving station.

3. A box unstacking mechanism including a frame, a pair of substantially vertically extending, angle shaped, box securing members, each member having faces adapted to engage the front face and the end face of a box, a support arm pivoted at its outer end on each of the securing members, said arms being rearwardly directed, pivoted supporting means on the frame and supporting the inner ends of said arms, a cam operable to move the securing members towards the ends of boxes in a stack, and a cam operable to move said arms rearwardly against a box in the stack.

4. A box unstacking mechanism including a frame, a backing plate, means mounting the backing plate on the frame for transverse movement in a substantially vertical plane, a pair of substantially vertically extending angle shaped securing members, each member having faces adapted to engage the front face and the end face of a box, a supporting arm pivoted to each of the securing members for movement about a horizontal axis, said arms being upwardly and rearwardly inclined, universal supporting means on the frame and supporting the inner ends of said arms, a lever disposed to be rocked by the second box from the bottom of a stack in the apparatus, cam means operable by said lever to move the securing members towards the ends of boxes in the stack, and other cam means to move said arms downwardly to move a box engaged by the arms rearwardly against the backing plate.

5. A box unstacking mechanism including a frame, a backing plate, means mounting the backing plate on the frame for transverse movement in a substantially vertical plane, a pair of substantially vertically extending angle shaped securing members, each member having faces adapted to engage the front face and end face of a box, a supporting arm pivoted at its outer end on each of the securing members for movement about a horizontal axis, said arms being upwardly and rearwardly inclined and having bearings at their inner ends, said bearings having their axes substantially vertical, a horizontal shaft at the inner end of said arms, each of said bearings being rotatably mounted on the horizontal shaft to provide a substantially universal mounting for the arms, a pivot rod extending downwardly through each of the first mentioned bearings, each pivot rod terminating at its lower end in a boss, an extension arm extending downwardly from each of the second mentioned bearings, an angle member connecting said extension arms, spacers on the connecting angle member, said bosses being mounted on said spacers, upwardly inclined braces each having one end engaging a boss and rotatable with the pivot rod, the other end of each of said last mentioned braces being connected to one of the supporting arms adjacent to the lower end of the latter, a lever disposed to be rocked by the second box from the bottom of a stack in the apparatus, cam means operable by said lever to move the securing members about the axis of the first mentioned bearings towards the boxes in the stack, cam means to move said arms about their horizontal axes downwardly to cause the faces of the supporting members which engage the front face of the box to move an engaged box rearwardly against the backing plate, and other cam means to move said arms towards each other about their vertical pivots to engage and support the box.

6. A box unstacking mechanism including a frame, a backing plate, means mounting the backing plate on the frame for transverse movement in a substantially vertical plane, a pair of substantially vertically extending angle shaped securing members, each member having faces adapted to engage the front face and the end face of a box, a supporting arm pivoted at its outer end on each of the securing members for movement about a horizontal axis, said arms being upwardly and rearwardly inclined and having bearings at their inner ends, said bearings having their axes substantially vertical, a horizontal shaft at the inner end of said arms, each of said bearings being rotatably mounted on the horizontal shaft to provide a substantially universal mounting for the arms, an upwardly and rearwardly inclined supporting rod secured to the upper end of each securing member, a boss on the frame, said boss having an aperture through which said rod extends, resilient means normally urging the rods rearwardly, a pivot rod extending downwardly through each of the first mentioned bearings, each pivot rod terminating at its lower end in a boss, an extension arm extending downwardly from each of the second mentioned bearings, an angle member connecting said extension arms, spacers on the connecting angle member,

said bosses being mounted on said spacers, upwardly inclined braces, each having one end engaging a boss and rotatable with the pivot rod, the other end of each of said last mentioned braces being connected to one of the supporting arms adjacent to the lower end of the latter, a lever disposed to be rocked by the second box from the bottom of a stack in the apparatus, cam means operable by said lever to move the securing members about the axis of the first mentioned bearings towards the boxes in the stack, cam means to move said arms about their horizontal axes downwardly to cause the faces of the supporting members which engage the front face of the box to move an engaged box rearwardly against the backing plate, and cam means to move said arms towards each other about their vertical pivots to engage and support the box.

7. A box unstacker including a frame, a backing plate, support members engaging the backing plate and frame and mounting the backing plate for lateral shifting movement in a substantially vertical plane, a pair of spaced, substantially horizontal, parallel brace members, means pivotally mounting the inner ends of each of the brace members to the backing plate for movement about substantially vertical axes, and means pivotally securing the forward end of each of said brace members to the frame for movement about substantially vertical axes.

8. A box unstacker including a frame, a pair of spaced depending arms, means pivotally mounting the arms on substantially horizontal pivots to the frame, a backing plate, means pivotally mounting the lower ends of said depending arms on the backing plate, a pair of upper, parallel, spaced, substantially horizontal brace members, means pivotally mounting the inner ends of the brace members to the backing plate for movement about substantially vertical axes, means pivotally securing the forward end of said brace members to the frame for movement about substantially vertical axes, a pair of lower, substantially horizontal, parallel brace members, means pivotally connecting the inner ends of the lower pair of brace members to the backing plate for movement about substantially vertical axes, and means pivotally connecting the outer of the lower pair of brace members to the frame for movement about substantially vertical axes.

9. In a box unstacking apparatus, box securing and holding means including a frame, a backing plate, spaced parallel arms mounted on the frame and pivotally secured to the backing plate to permit lateral movement of said backing plate, a pair of spaced shafts on the frame, a pair of spaced arms, means pivotally mounting the arms on the shafts, a box gripping member pivoted on each shaft thereof, a cam operable to cause the gripping members to move towards each other to engage a box, and cam means to cause the gripping members to move towards said backing plate to move a box engaged by the gripping members against the backing plate.

10. A box unstacker including a frame, a horizontal cross member on the frame, a pair of spaced depending arms, means pivotally mounting the arms on substantially horizontal pivots to the cross member, a backing plate having a horizontally disposed stiffening member at its upper end, means pivotally mounting the lower ends of said depending arms on the stiffening member, a pair of upper, parallel, spaced, substantially horizontal brace members, means pivotally mounting the inner ends of the brace members on the stiffening member for movement about substantially vertical axes, the frame including forward extending upper members, means pivotally securing the forward end of said brace members on the upper frame member for movement about substantially vertical axes, a pair of lower, substantially horizontal, parallel brace members, means pivotally connecting the inner ends of the lower pair of brace members to the backing plate for movement about substantially vertical axes and means pivotally connecting the outer of the lower pair of brace members to the frame for movement about substantially vertical axes.

11. In a box unstacking apparatus, holding means, a lowerator movable to engage a box held by the holding means, said lowerator including spaced, opposed, vertical guide members, shafts mounted to move up and down on the guide members, stack supporting arms journaled on said shafts, means to cause said supporting arms to move inwardly and outwardly to engage a box of a stack, means to align the lowermost box in a stack prior to unstacking, said aligning means including pivoted aligning arms, and cams operable to move said aligning arms to box engaging position to align a box in a stack.

12. In a box unstacking apparatus, holding means, means to cause said holding means to engage and support a stack of boxes, a lowerator movable to engage a box held by the holding means, said lowerator including spaced, opposed, vertical guide members, plates mounted to move up and down on the guide members, a chain connected at one end to each of the plates, a sprocket above each plate and receiving a chain, a crank member at one side of each sprocket, each crank member having a roller thereon, each chain passing over one of the rollers, means to anchor the other ends of the chains, means to rotate the crank member to raise and lower the plates, means to release the holding means, a delivery conveyor, means to lower the lowerator until the box held thereby is at a location adjacent to the delivery conveyor, means to cause the holding means to engage a box above the lowermost box of the stack being lowered by the lowerator when the lowermost box in the stack being lowered is at said location, and means to further lower the lowerator while the holding means holds the reduced stack to dispose the lowermost box of the stack being lowered onto the delivery conveyor.

13. In a box unstacking apparatus, holding means, a delivery conveyor, a lowerator movable to engage a box held by the holding means, said lowerator including spaced, opposed, vertical guide members, plates mounted to move up and down on the guide members, horizontal shafts supported by each of said plates, a pair of spaced, upwardly inclined stack supporting arms journaled on each of said shafts, a transverse stack engaging member secured to the upper ends of each pair of supporting arms, means to cause said supporting arms to move inwardly and outwardly to engage a box of a stack, means to align the lowermost box in a stack prior to unstacking, said aligning means including substantially vertically directed aligning arms pivotally arranged on said shafts intermediate said supporting arms, a box engaging and aligning member secured to the upper end of each of said aligning arms, cams operable to move said aligning arms to box engaging position to align a box in a stack, a chain connected at one end of each of said plates,

a sprocket above each plate and adapted to receive a chain, a crank member at one side of, and rotatable with, each sprocket, each crank member having a roller thereon, each chain passing over one of the rollers, means to fixedly anchor the other end of the chains, means to move the holding means to releasing position, and means to rotate the crank to lower the lowerator until the box held thereby is at a location adjacent to the delivery conveyor.

14. In a box unstacking apparatus, holding means, means to cause said holding means to engage and hold a stack of boxes, a delivery conveyor, a lowerator movable to engage a box held by the holding means, said lowerator including spaced, opposed, vertical guide members, plates mounted to move up and down on the guide members, horizontal shafts supported by each of said plates, a pair of spaced, upwardly directed, stack supporting arms journaled on each side of said shafts, a transverse stack engaging member connecting the upper ends of each pair of supporting arms, means to cause said supporting arms to move inwardly and outwardly to engage a box of a stack, means to align the lowermost box in a stack prior to unstacking, said aligning means including substantially vertically directed aligning arms pivotally arranged on said shafts intermediate said supporting arms, a box engaging and aligning member secured to the upper end

of said arms, cams operable to move said aligning arms to box engaging position to align a box in a stack, a chain connected at one end of each of said plates, a sprocket above each plate and adapted to receive a chain, a crank member at one side of, and rotatable with, each sprocket, each crank member having a roller thereon, each chain passing over one of the rollers, means to fixedly anchor the other end of the chains, means to move the holding means to releasing position, and means to rotate the crank to lower the lowerator until the box held thereby is at a location adjacent to the delivery conveyor.

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