United States Patent

[11] 3,557,688

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[21] Appl. No. 678,955
[22] Filed Oct. 30, 1967
[45] Patented Jan. 26, 1971
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[54] **BUNDLE-FORMING APPARATUS**
21 Claims, 22 Drawing Figs.

[52] U.S. Cl. **100/218,**
53/124, 93/93, 100/3, 100/264, 198/106, 214/7
[51] Int. Cl. **B30b 15/32,**
B65b 13/02
[50] Field of Search 100/215,
218, 264, 35, 2, 3; 93/93.1, 93.2, 93.3; 53/124;
198/106, 34; 214/7

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Primary Examiner—Peter Feldman
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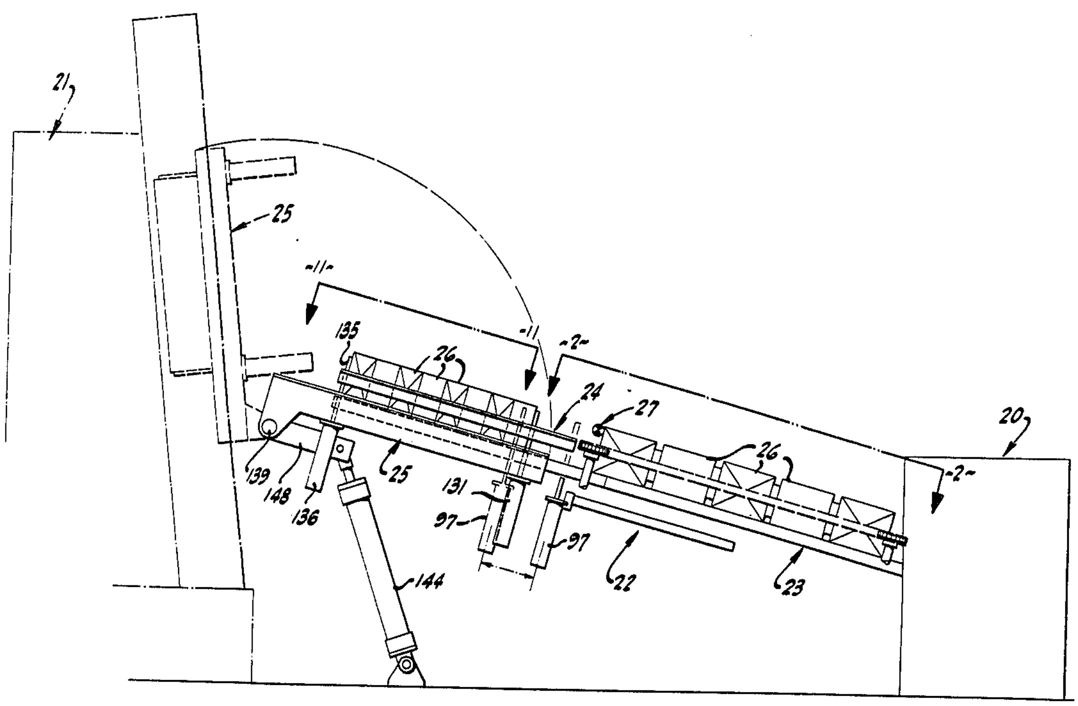
ABSTRACT: A machine for accumulating groups of collated paper grocery bags into bundles, compressing the bundles, and transferring each compressed bundle into a banding mechanism which wraps a securing band about the bundle. The machine includes an accumulator section which receives successive groups of collated bags constituting the discharge from a collating mechanism and organizes such groups into bundles, it also includes a compression section for squeezing each bundle to reduce the plane-to-plane dimension thereof, and it further includes a transfer section which receives the compressed bundles from the compression section and displaces each compressed bundle along an arcuate path and into a banding mechanism.



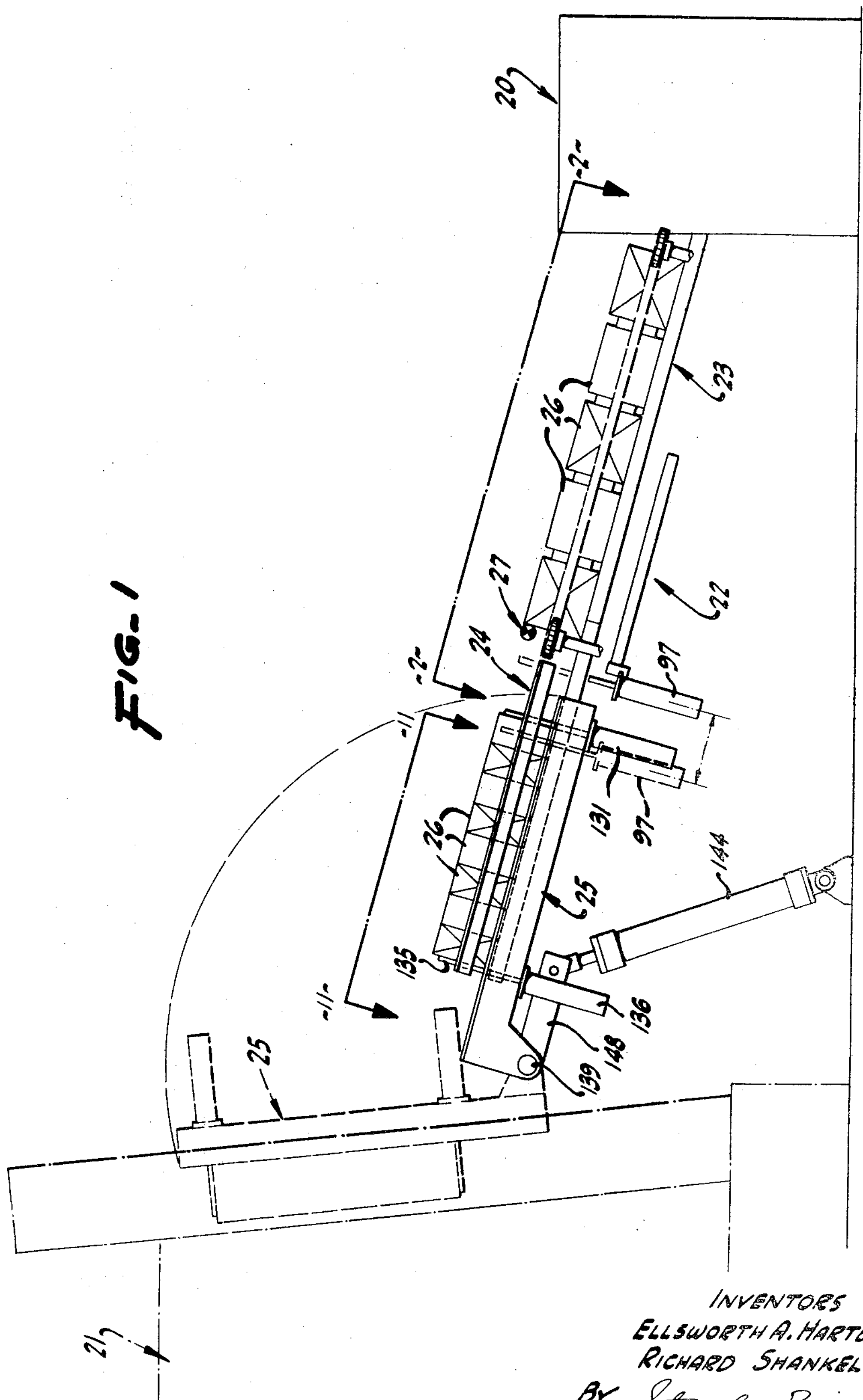


FIG. 1

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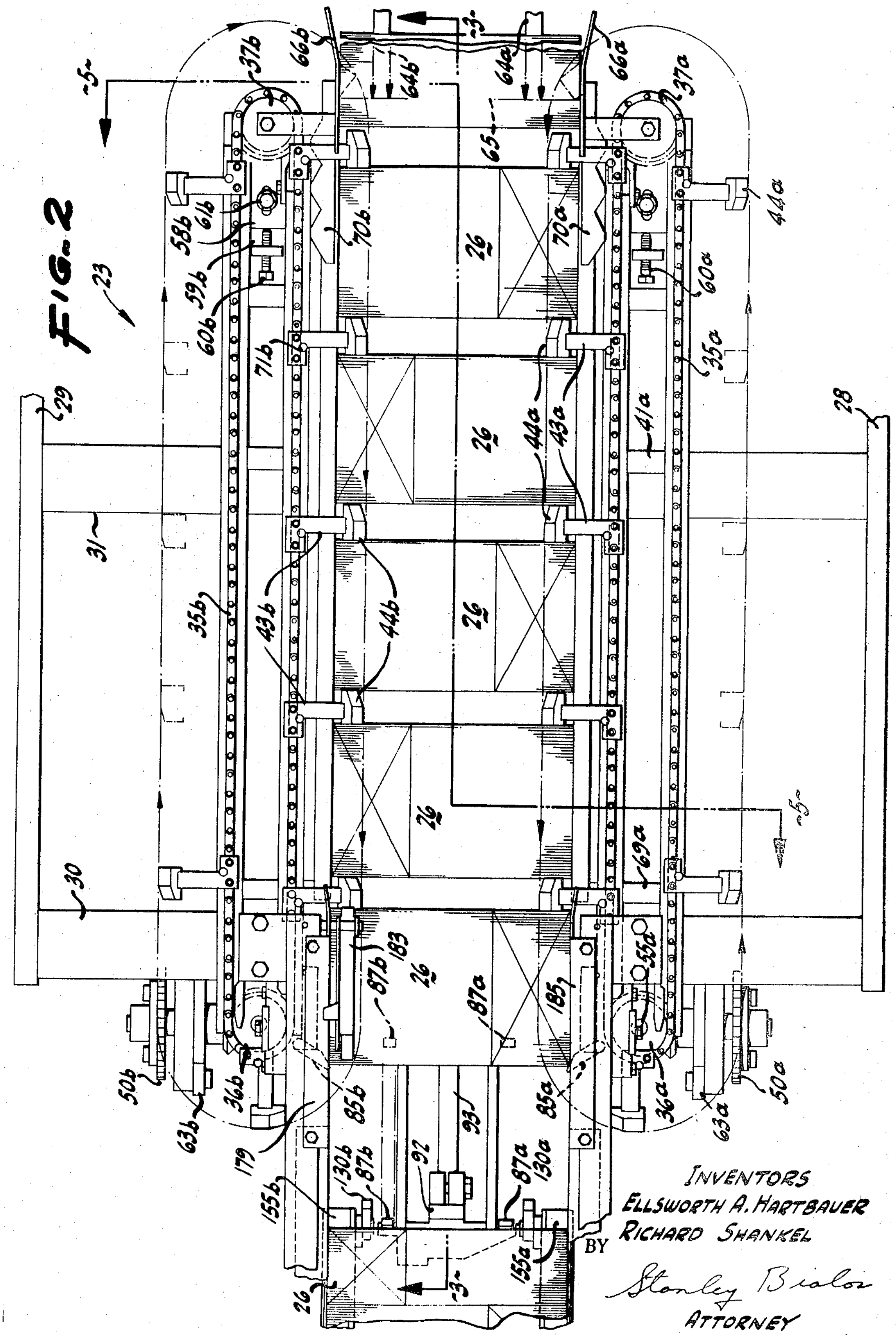

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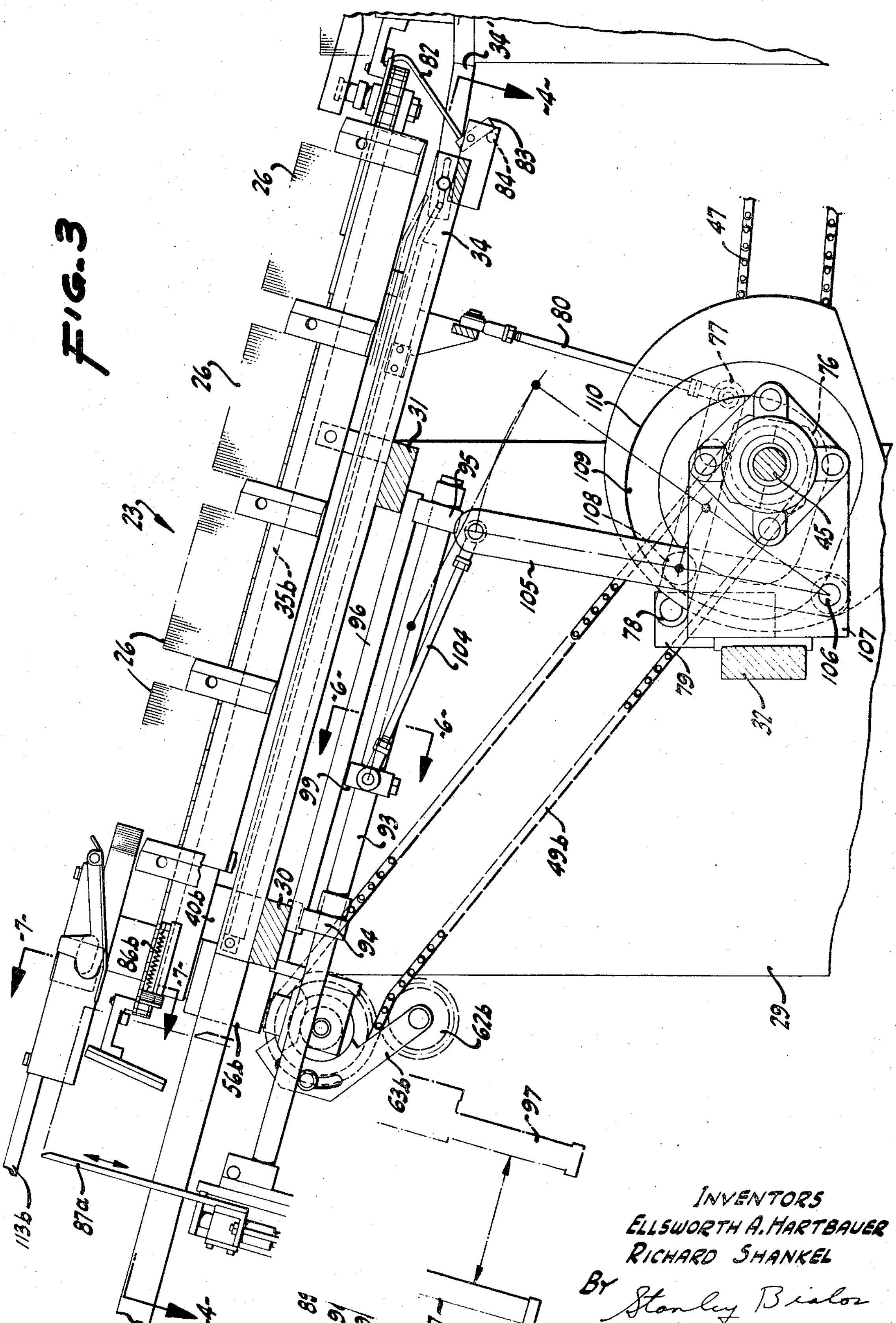
FIG. 3



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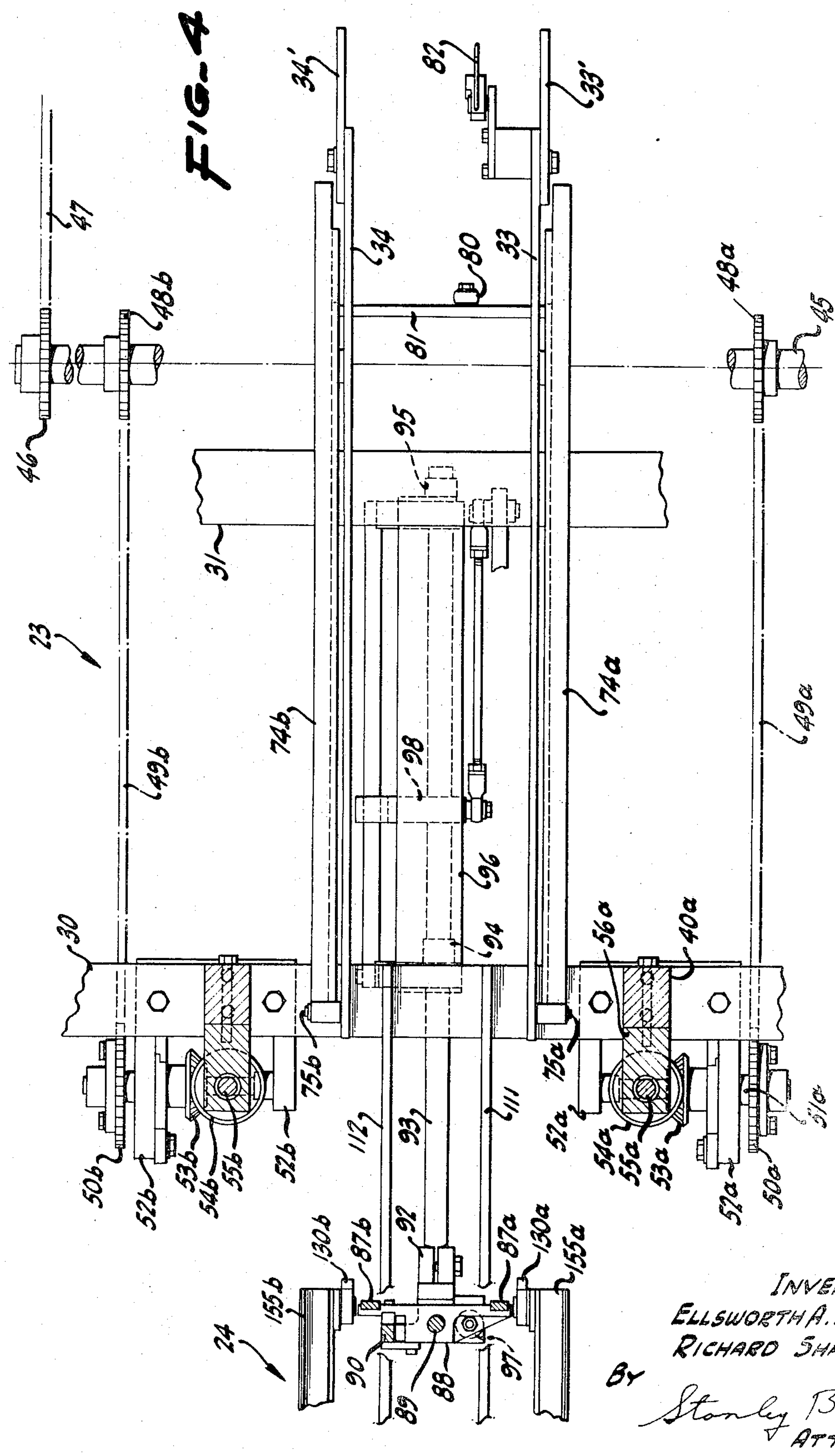

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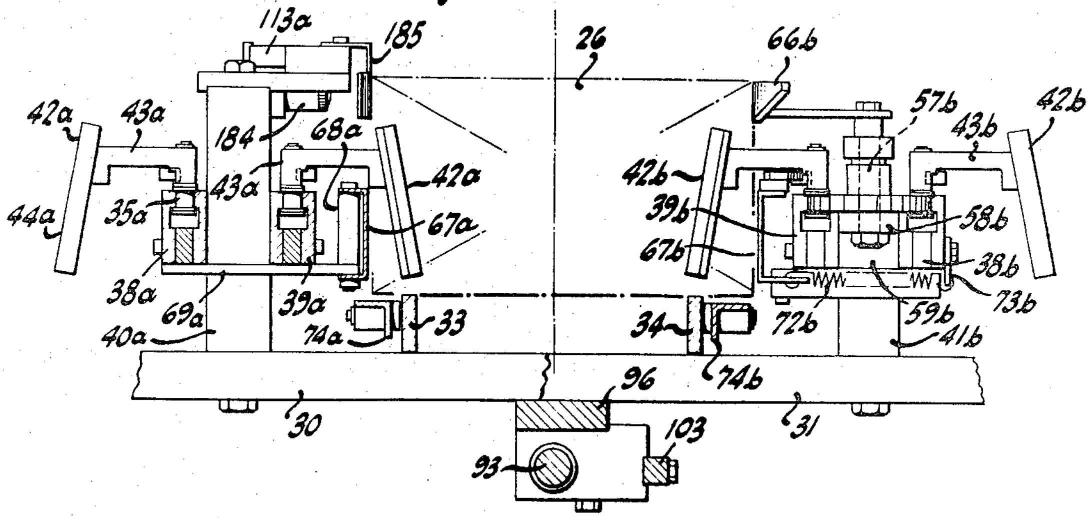
FIG-5



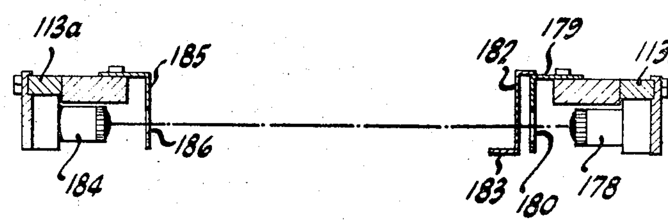


FIG-7

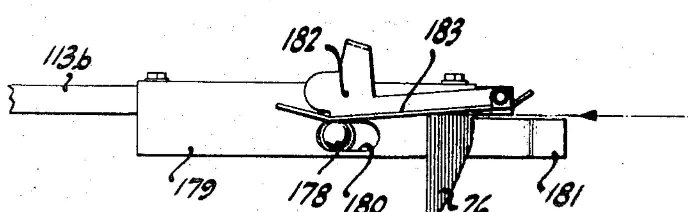


FIG-8

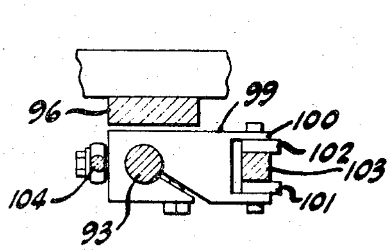


FIG-6

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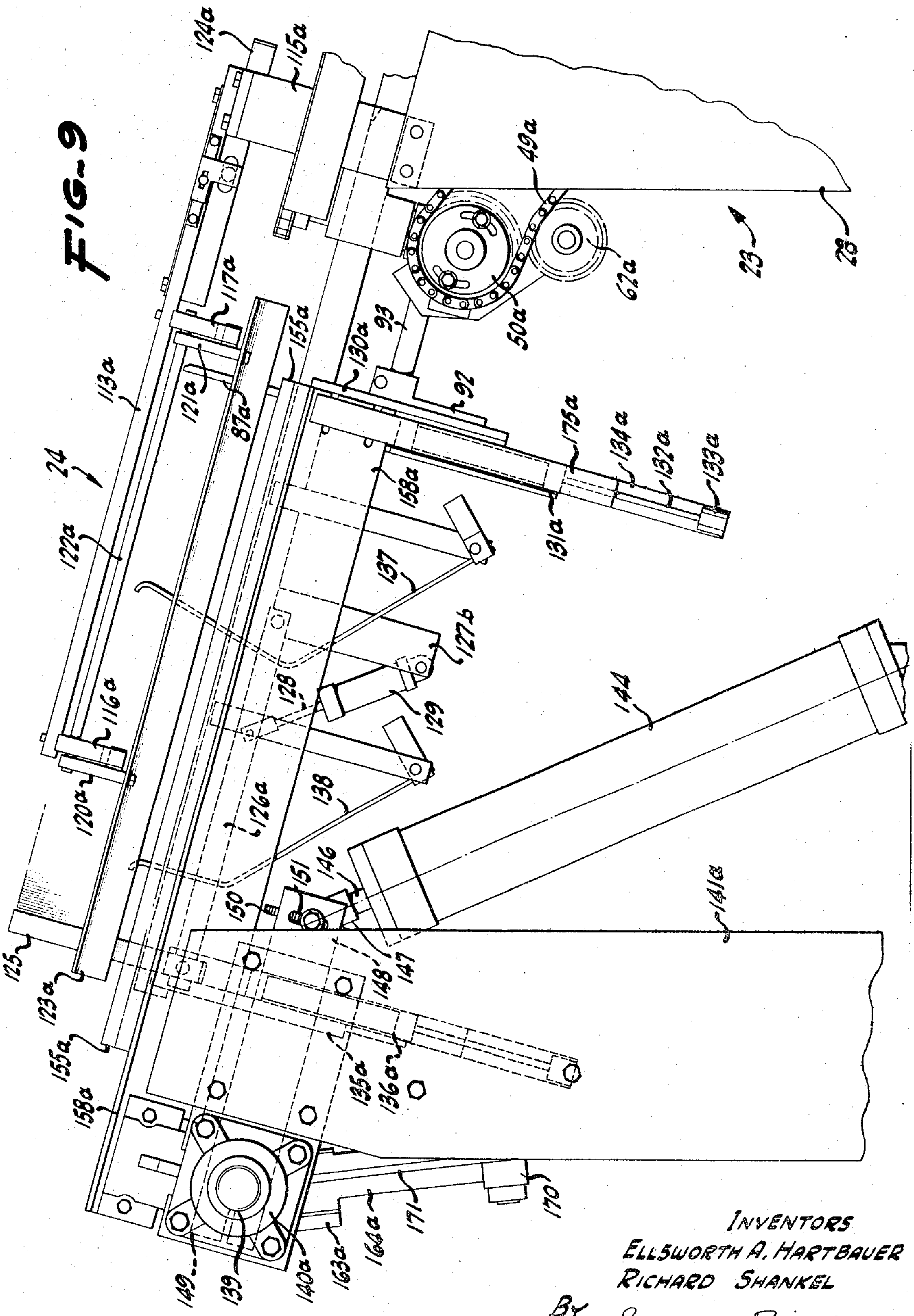

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PATENTED JAN 26 1971 3,557,688

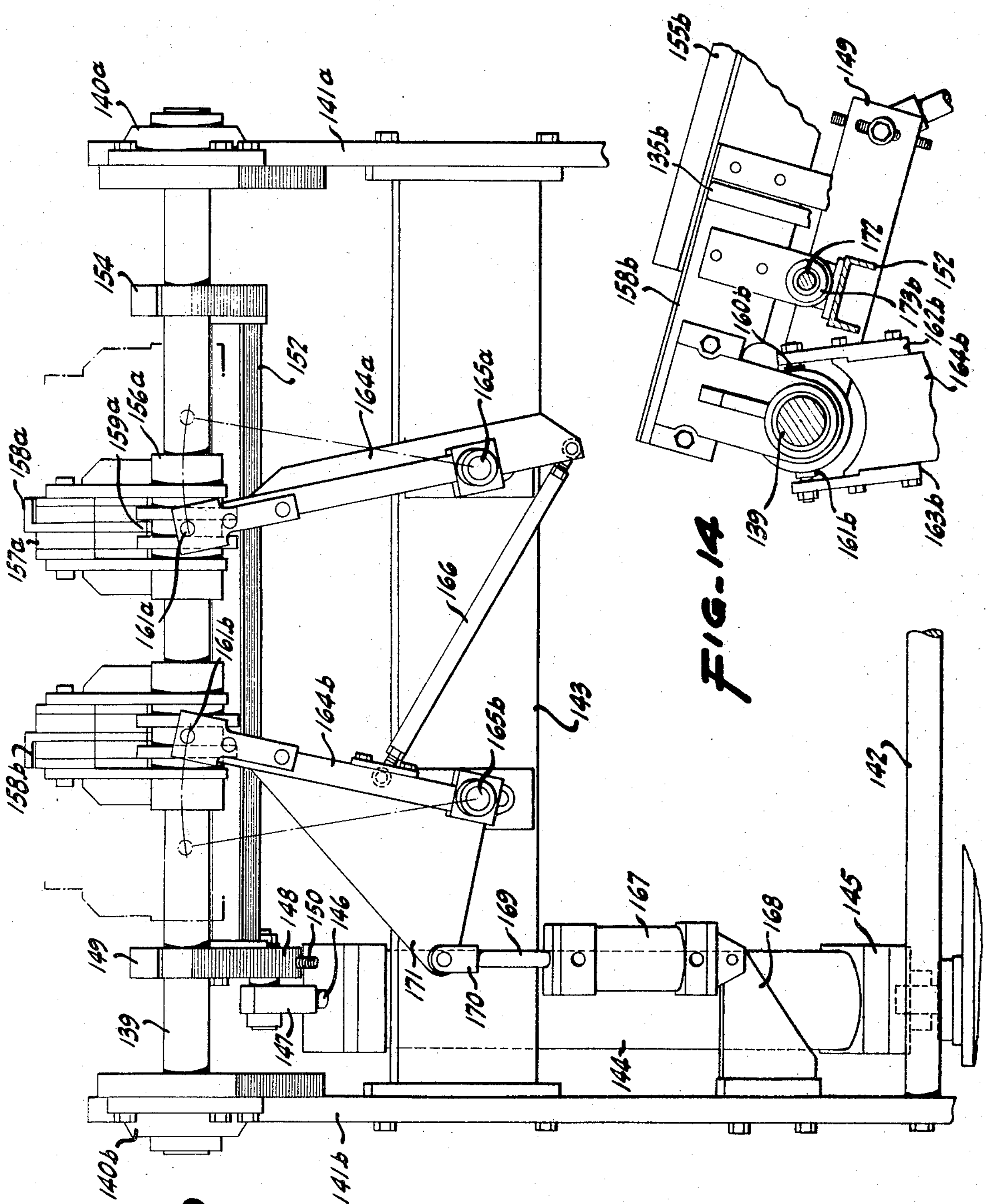

FIG-10

FIG-14

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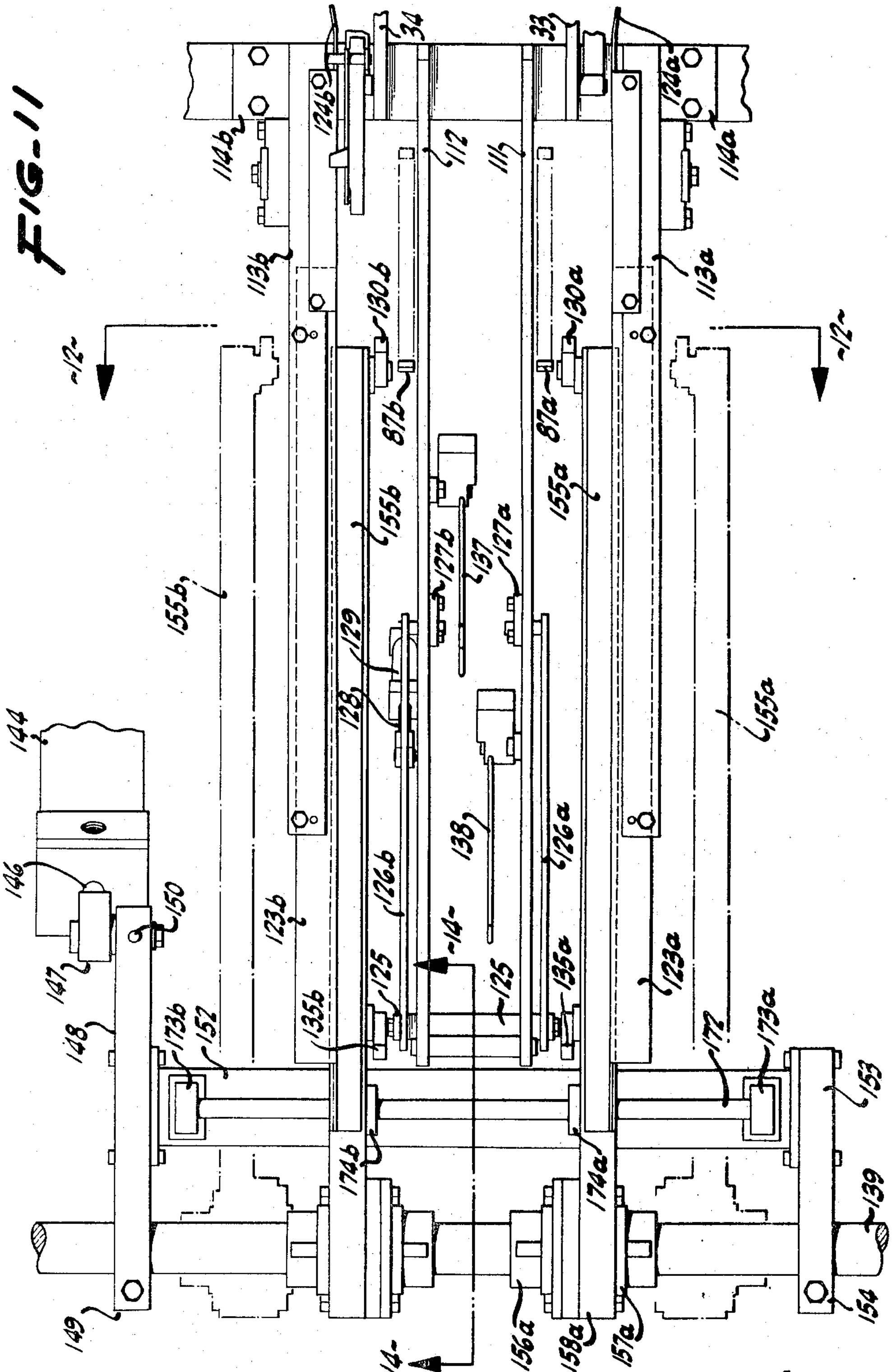
FIG-11



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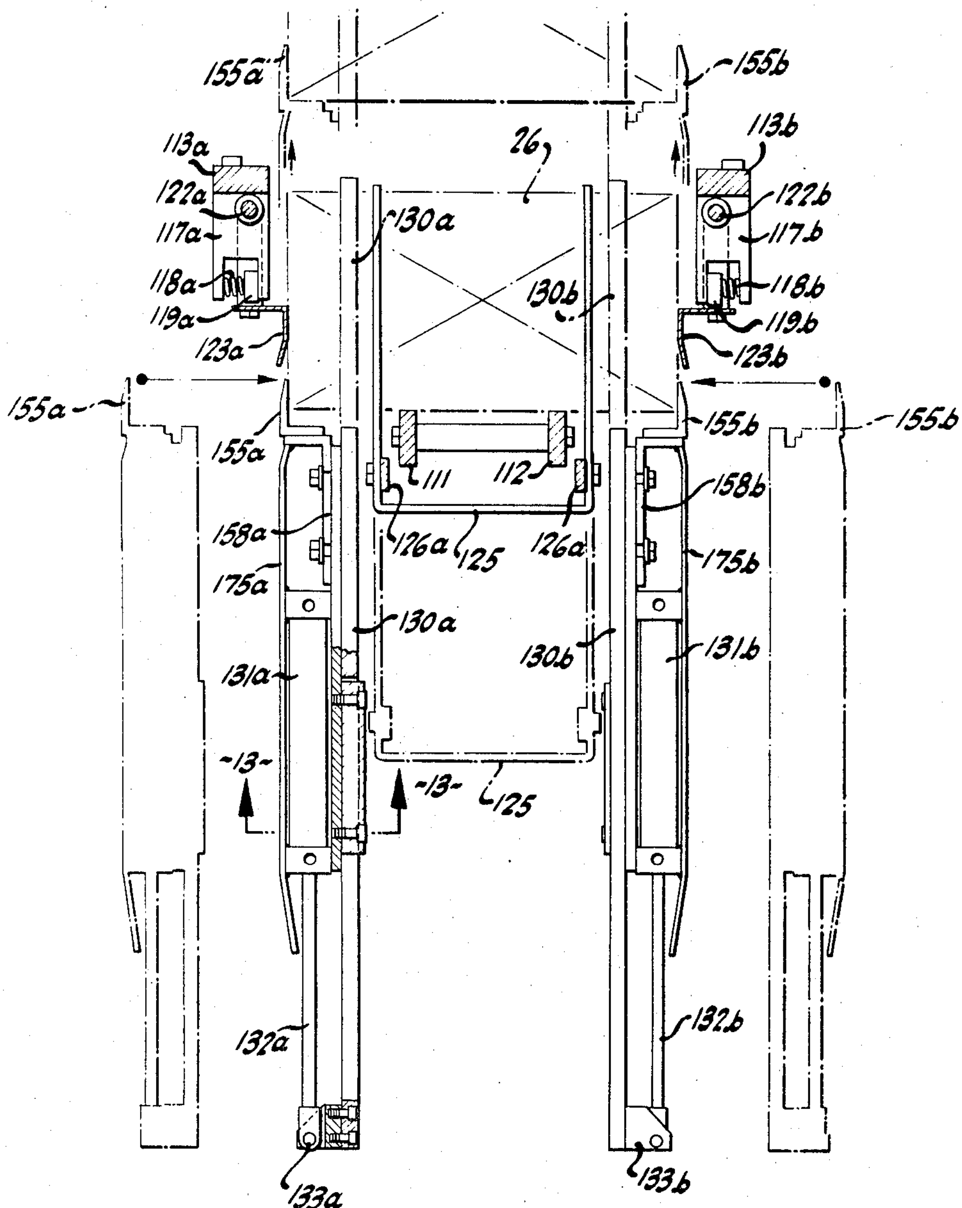

FIG. 12

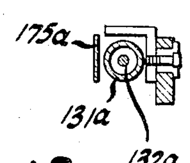

FIG. 13

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FIG. 15

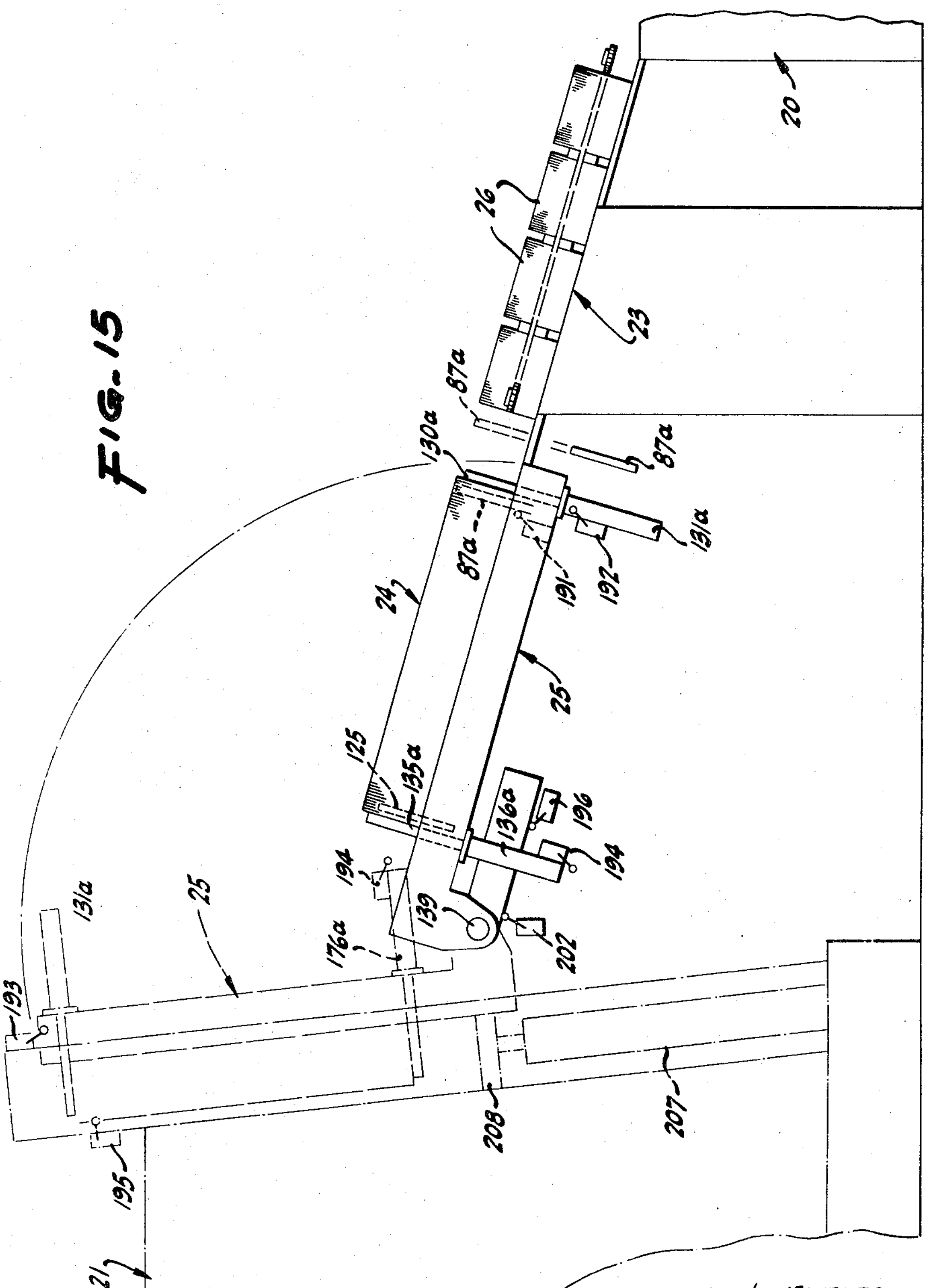

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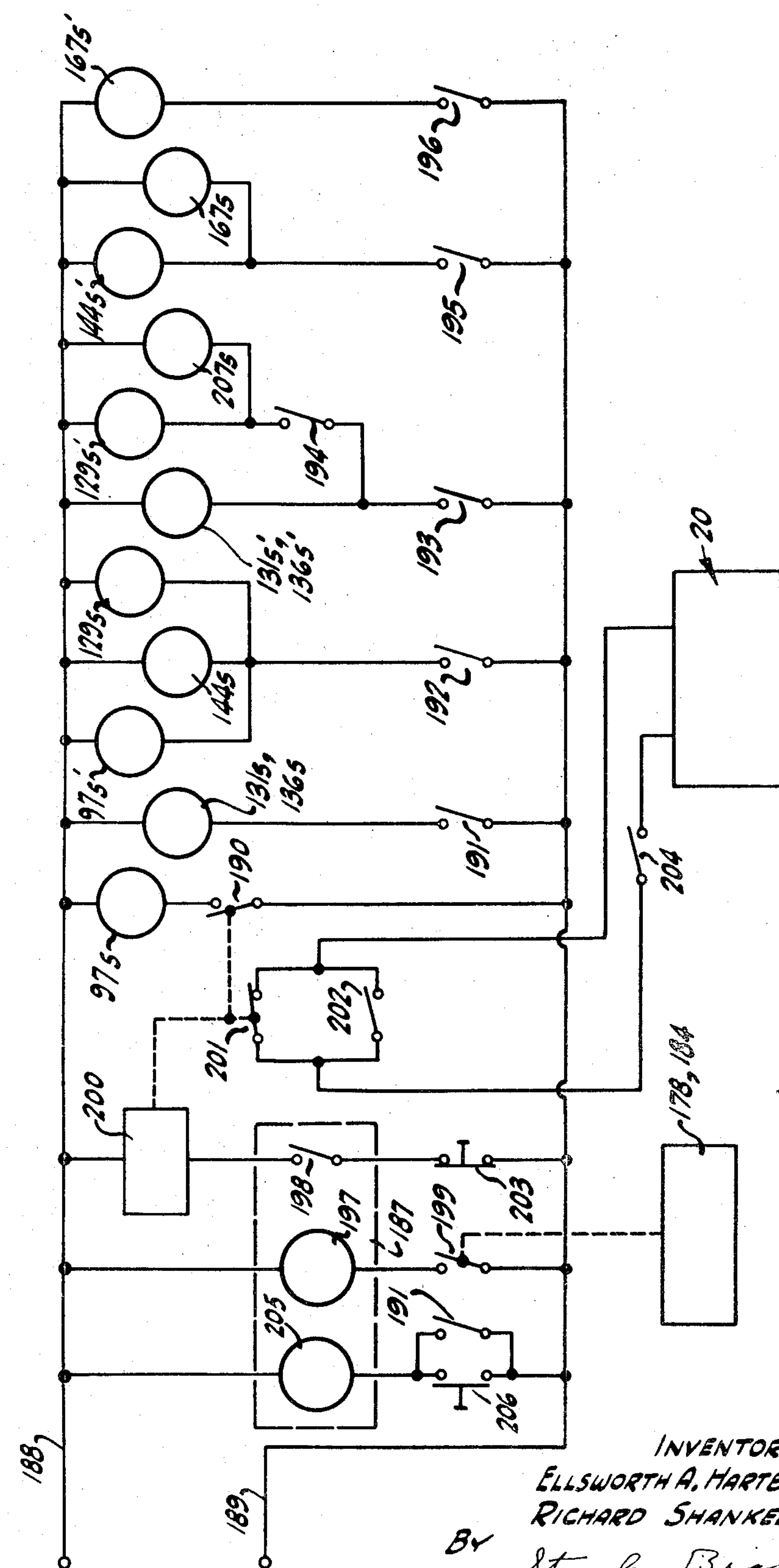
FIG. 16



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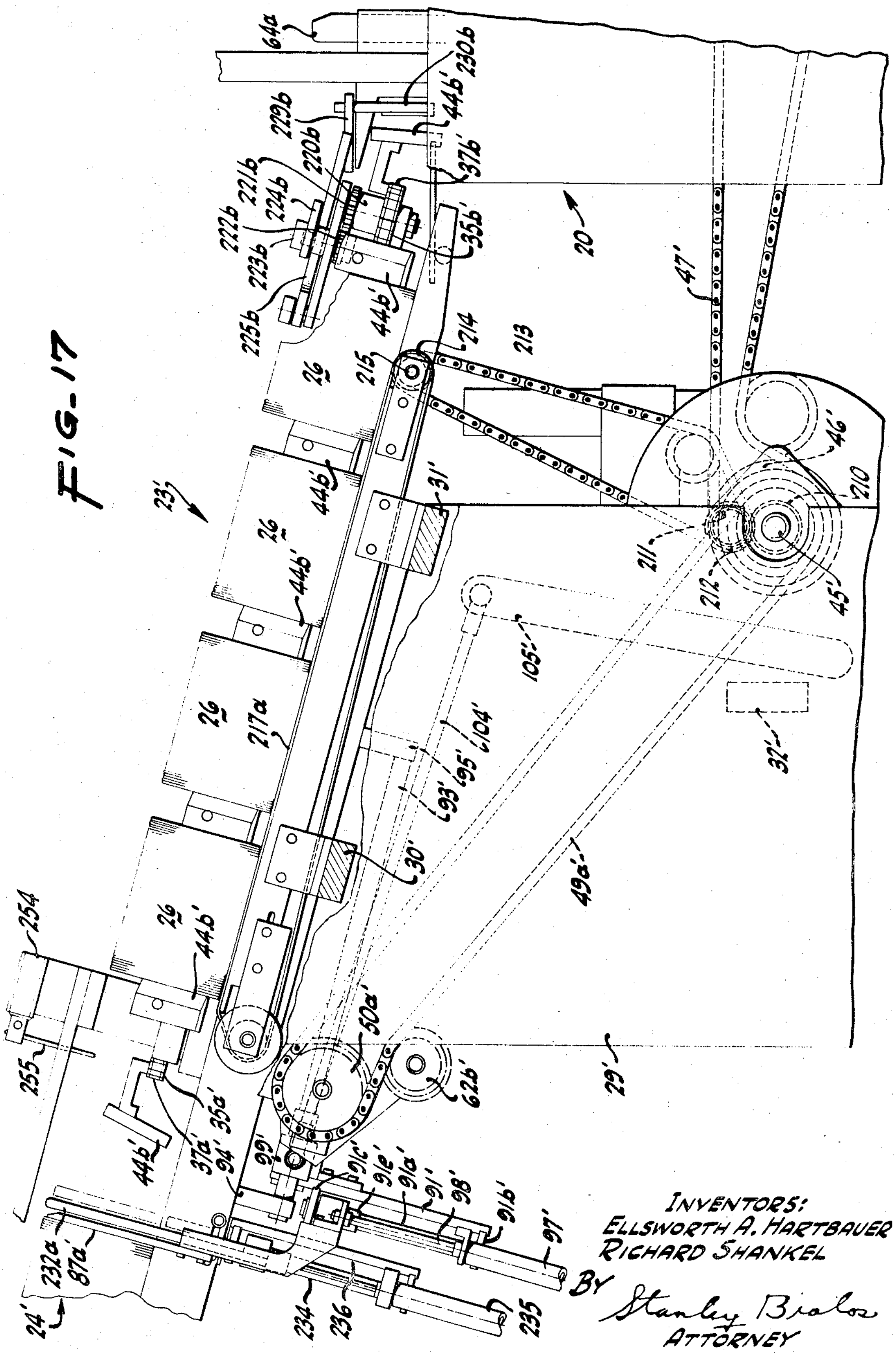

FIG. 17

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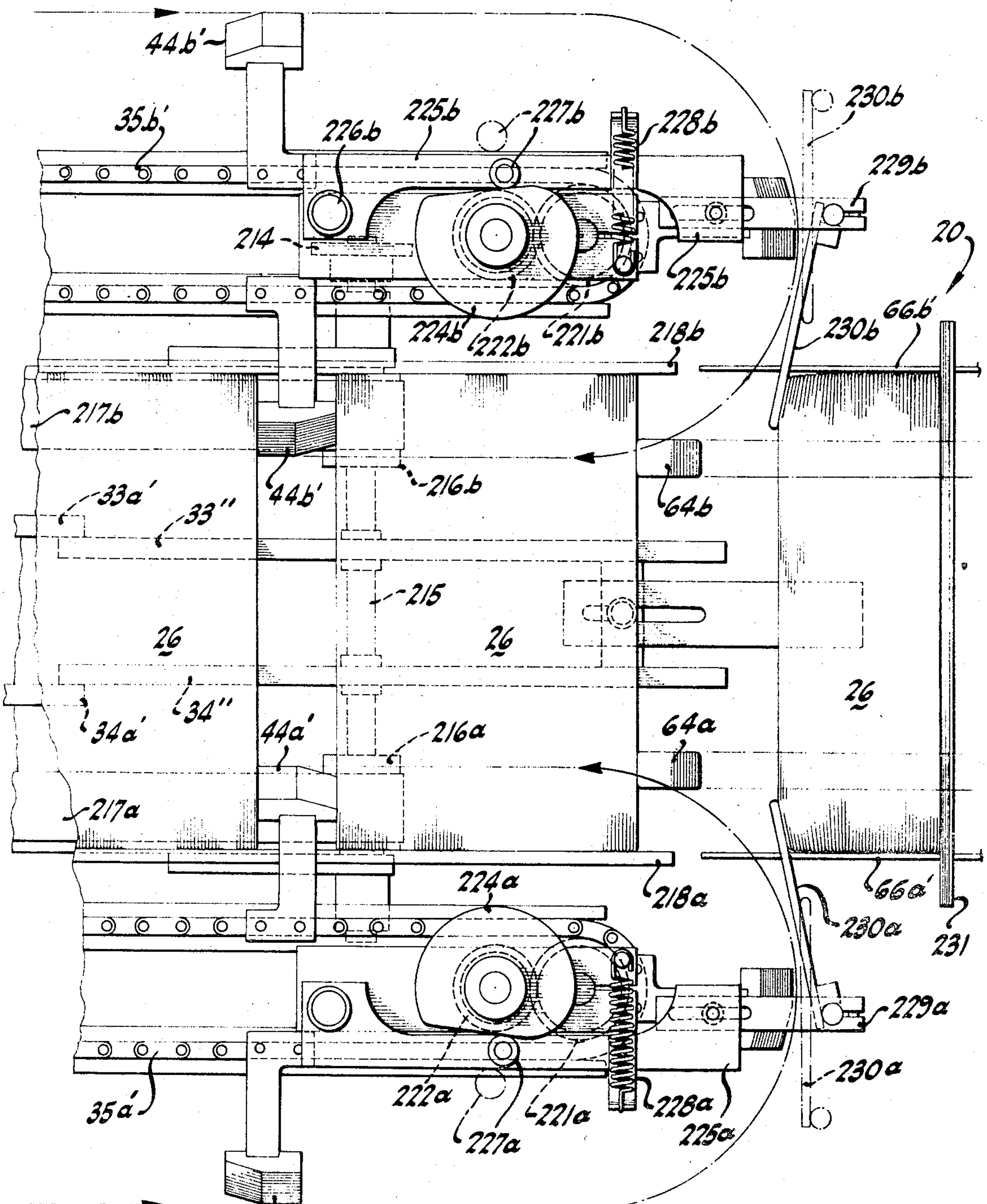

FIG-18

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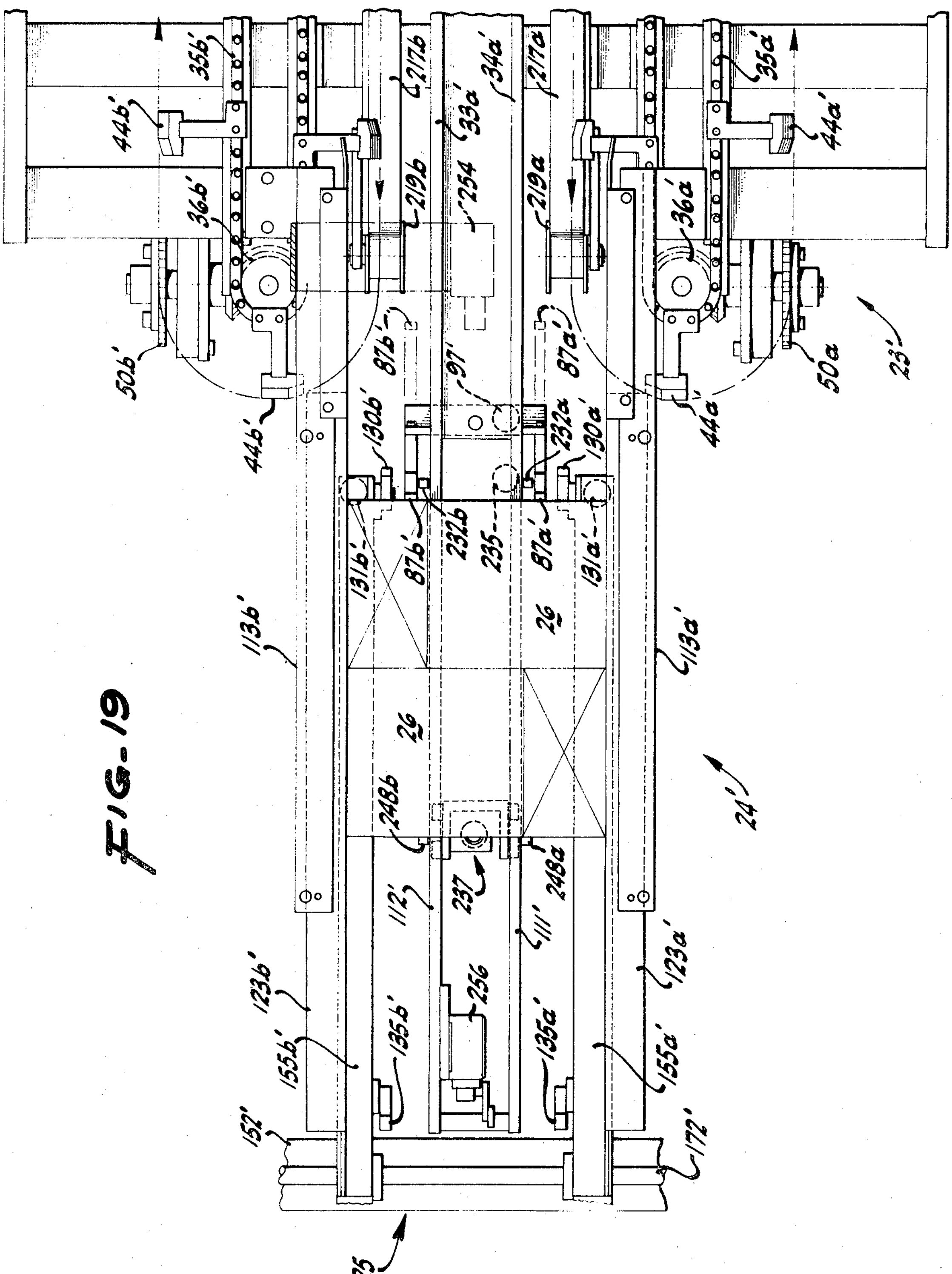

FIG. 19

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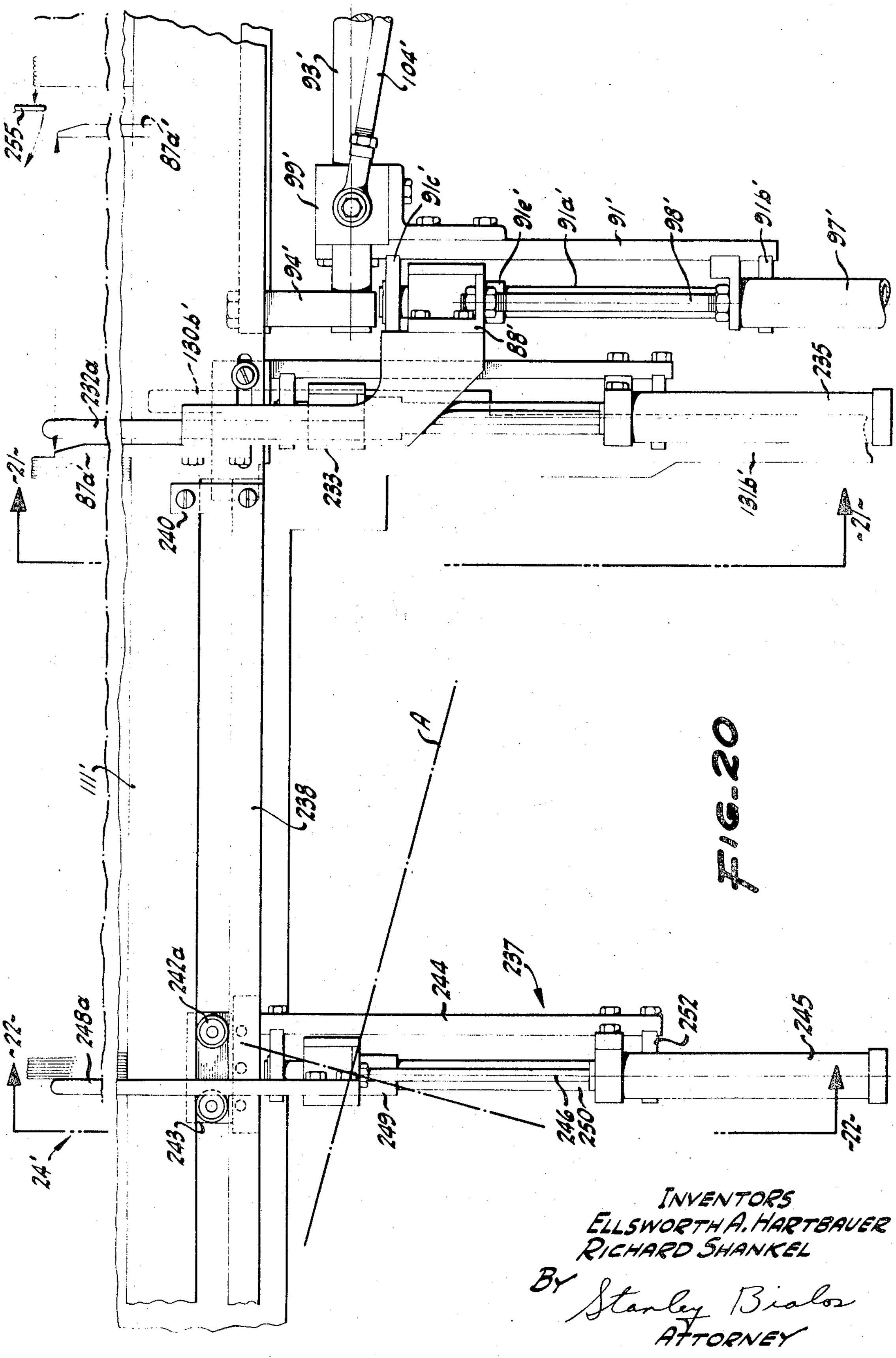

FIG. 20

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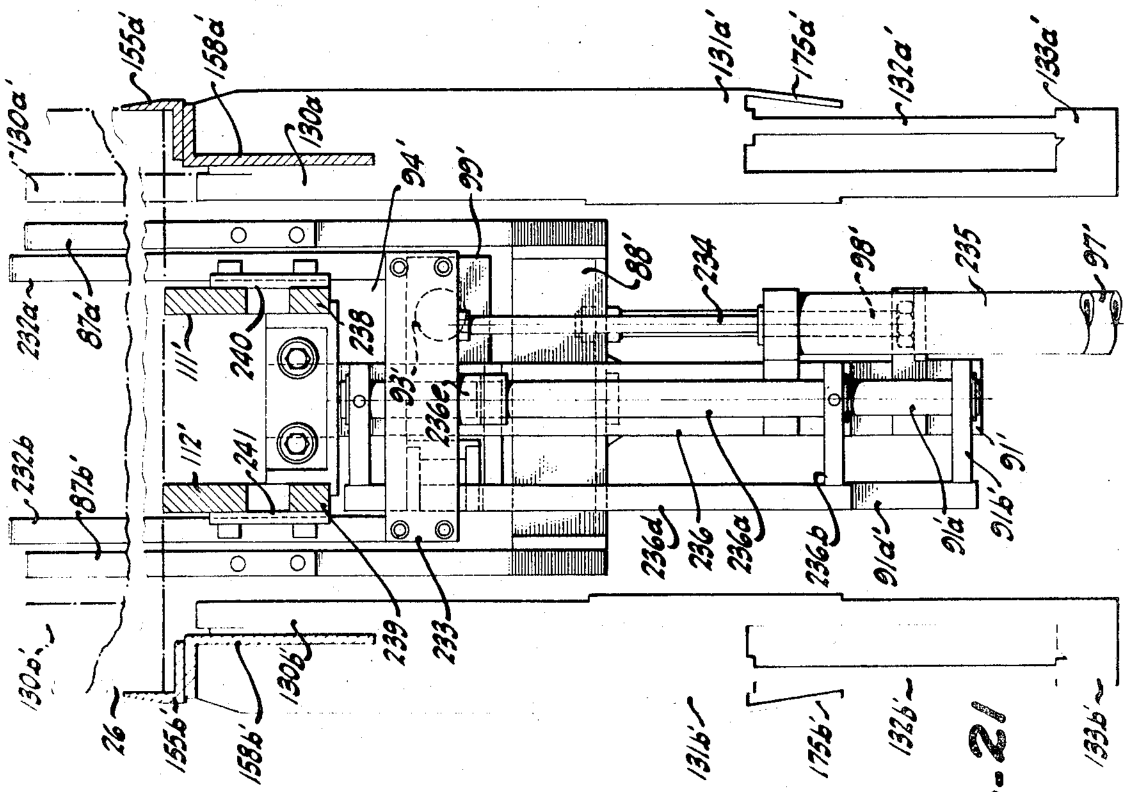

FIG. 21

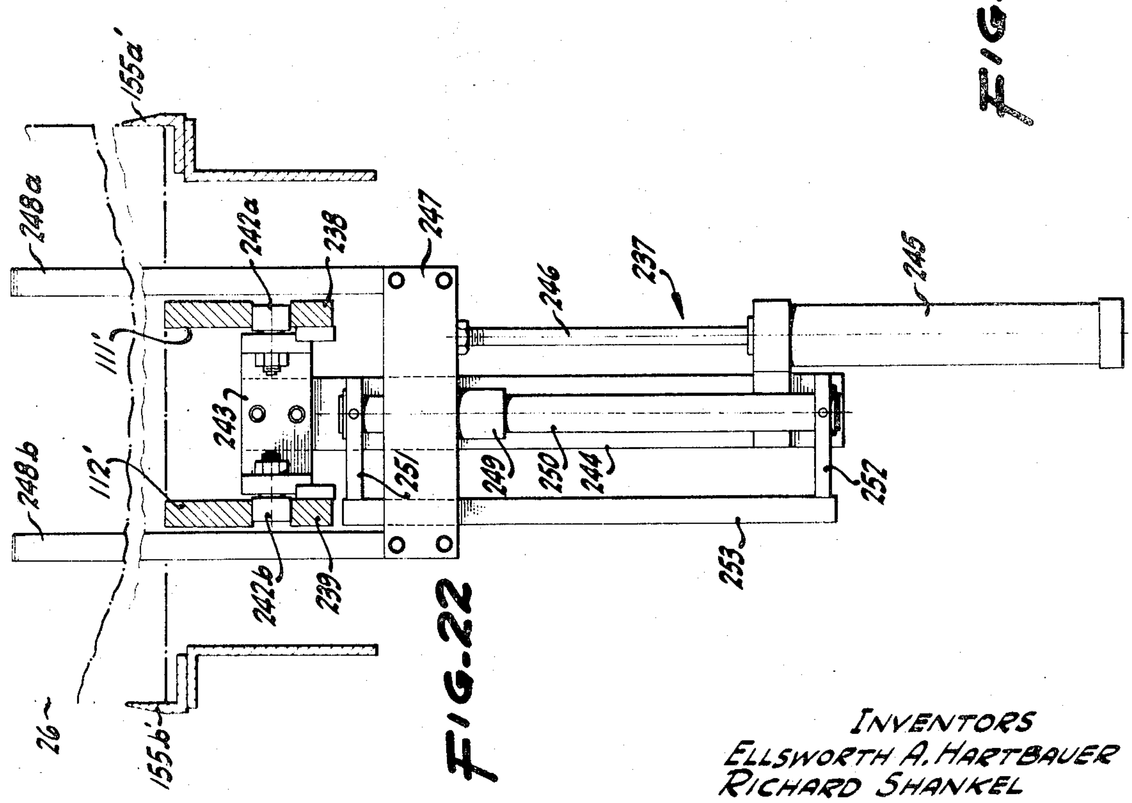

FIG. 22

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BUNDLE-FORMING APPARATUS

This invention relates to apparatus for arranging articles into bundles, and it relates more particularly to bundle-forming apparatus operative to accumulate into bundles articles such as paper grocery bags and the like, which may be collated into groups or hands, and to transfer the accumulated bundles into a banding machine.

The particular embodiments of the invention considered in detail herein are especially adapted for use in processing paper grocery bags which have been collated into groups or hands, each hand of which constitutes a predetermined number of bags which, by way of example, may be taken to be 50 bags. Bags collated into groups or hands of this character usually constitute the discharge of a bag-collating machine, and for information, a specific example of such a machine is disclosed in pending application Ser. No. 494,742, filed Oct. 11, 1965, now U.S. Pat. No. 3,404,609, dated Oct. 8, 1968. The bundle-forming apparatus is operative to accept the group-by-group discharge from such collating machine and to accumulate or collect such groups into bundles, each bundle of which constitutes a predetermined number of groups which, by way of example, may be taken to be 10-bag groups (500 bags).

After a plurality of bag groups have been so accumulated into a bundle, the bundle is compressed to squeeze air therefrom and thereby reduce the plane-to-plane dimension thereof. Thereafter, the bundles are advanced by the apparatus one by one into a banding machine which places a wrapper or securing band about each bundle to maintain the bags therein in a confined or bundled state. Evidently, the bag-collating machine and banding machine must have their operations synchronously related and, accordingly, the bundle-forming apparatus has its operational cycle timed to each since it constitutes an intermediate apparatus with respect to these two machines.

Bundle-forming apparatus of the general type being considered herein has been known heretofore, and an object, among others, of the present invention is to provide an improved bundle-forming apparatus especially suited to processing bags at the relatively high rates of delivery provided by a collating machine of the type noted. The improved bundle-forming apparatus constituting the present invention includes a bundle-forming section which collects into bundles the bag hands or groups continuously discharged by the bag-collating machine, it further includes a compression section in which the collected bundles are reduced in dimension, and it still further includes a transfer section which advances the compressed bundles one by one into a banding machine whereat each bundle is equipped with a wrapper. As concerns specific objects and advantages of the invention, many will become apparent as the various sections of the apparatus are considered in detail hereinafter in the specification.

DRAWING DESCRIPTION

Embodiments of the invention are illustrated in the accompanying drawings, in which:

FIG. 1 is a diagrammatic side view in elevation of apparatus embodying the invention;

FIG. 2 is an enlarged, broken top plan view taken along the plane 2–2 of FIG. 1;

FIG. 3 is a broken longitudinal sectional view taken through the center of the apparatus along the vertical plane 3–3 of FIG. 2;

FIG. 4 is a broken longitudinal sectional view taken along the generally horizontal plane 4–4 of FIG. 3;

FIG. 5 is a broken longitudinal sectional view taken along the line 5–5 of FIG. 2;

FIG. 6 is a broken transverse sectional view taken along the plane 6–6 of FIG. 3;

FIG. 7 is a broken transverse sectional view taken along the plane 7–7 of FIG. 3;

FIG. 8 is a broken vertical sectional view illustrating the shield or shutter used in association with the optical counter;

FIG. 9 is a broken side view in elevation of the compression and transfer sections of the apparatus;

FIG. 10 is an end view in elevation of the compression and transfer sections shown in FIG. 9, the view being taken from the left looking toward the right as the sections are depicted in FIG. 9;

FIG. 11 is an enlarged top plan view of the compression and transfer sections taken along the plane 11–11 of FIG. 1;

FIG. 12 is a transverse sectional view taken along the plane 12–12 of FIG. 11;

FIG. 13 is a broken transverse sectional view taken along the plane 13–13 of FIG. 12;

FIG. 14 is a broken longitudinal sectional view taken along the plane 14–14 of FIG. 11;

FIG. 15 is a diagrammatic side view in elevation somewhat similar to FIG. 1 and illustrating the location of the various switches used to control a cycle of operation of the apparatus;

FIG. 16 is a schematic circuit diagram illustrating the control circuitry of the apparatus;

FIG. 17 is a broken horizontal sectional view taken through the center of a modified embodiment of the apparatus, the view being generally similar to that of FIG. 3;

FIG. 18 is an enlarged broken top plan view of the infeed end portion of the accumulator section of the modified apparatus illustrated in FIG. 17;

FIG. 19 is a broken top plan view illustrating the mergence of the discharge end of the accumulator section and infeed end of the compression section of the modified apparatus;

FIG. 20 is an enlarged broken side view in elevation of the compression section illustrated in FIG. 19 of the modified apparatus, the orientation of the compression section being shifted to a horizontal position for illustrative convenience;

FIG. 21 is an enlarged vertical sectional view taken along the line 21–21 of FIG. 20; and

FIG. 22 is an enlarged vertical sectional view taken along the line 22–22 of FIG. 20.

GENERAL DESCRIPTION

The bundle-forming apparatus is operative to accumulate or collect into bundles of predetermined number, articles delivered thereto in quantities less than such number. In the case of the articles being paper grocery bags, they will be collated so that a bundle of uniform dimensions can be formed; and as a specific example, such bags may be delivered to the apparatus in groups or hands by collating mechanism of the group-processing type as disclosed in pending application, Ser. No. 494,742, filed Oct. 11, 1965, now U.S. Pat. No. 3,404,609, dated Oct. 8, 1968. Such collator mechanism is indicated generally in FIG. 1 by the broken-line block designated in its entirety with the numeral 20, and it is operative to orient bags into groups each of which comprises a predetermined number of bags, 50 for example, with the bottom ends thereof all disposed in the same direction. Alternate groups are oriented with the bag ends in opposite directions so that several groups may be brought into compressed juxtaposition to form a bundle of substantially uniform dimensions. The apparatus of the present invention is operative to accumulate such collated groups, compress or form the same into bundles constituted of a predetermined number of bag groups, 10 groups or hands of 50 bags each for example, and to transfer each compressed bundle into a banding machine operative to wrap a securing band about the bundle. The banding machine may be completely conventional as, for example, the banding press sold by the American Manufacturing Company of Portland, Ore., under the designation "Banding Press, Model APB-3." The banding machine is also illustrated diagrammatically in FIG. 1 by the broken-line block designated with the numeral 21.

The bundle-forming apparatus is disposed intermediate the group collator 20 and bander 21 and is designated in its entirety in the drawings with the numeral 22. For convenience of description, the apparatus may be taken to comprise three separate sections which will be considered in the functional order thereof; and such sections include an accumulator section 23, a compression section 24, and a transfer section 25 operative between the full-line and broken-line positions shown in FIG. 1 to transfer or displace a bundle of compressed groups from the compression section 24 and into the bander 21. A plurality of bag groups 26 are shown in FIG. 1 in association with the apparatus 22, and it will be noted that successive groups 26 disposed along the accumulator section 23 and along the compression section 24 are oppositely oriented so that in one instance the closed bottom ends of the bags face outwardly and in the other instance the open upper ends thereof face outwardly.

Successive bag groups 26 are delivered to the accumulator section 23 in spaced-apart relation, and are maintained in such spaced relation while being advanced by the accumulator section 23 to the compression section 24. The spacing between groups is utilized in controlling the automatic functioning of the apparatus in that each bundle displaced by the transfer section 25 to the bander 21 is intended to be constituted of a fixed or predetermined number of bag groups. In this respect, counter mechanism 27 in the form of an optically actuated system is employed to count the number of groups advanced by the accumulator section 23 into the compression section 24 and to initiate a cycle of operation following the advancement of each such bundle-forming predetermined number of groups into the compression section. In each cycle of operation, a compressed bundle of bag groups is displaced by the transfer section 25 into the bander 21, and after the bander has processed such bundle, the transfer mechanism 25 returns to its starting position which is depicted in full lines in FIG. 1.

ACCUMULATOR SECTION

In describing the details of the accumulator section, reference will be made in particular to FIGS. 1 through 6; and referring thereto the accumulator section 23 is seen to include frame structure in the form of transversely spaced sideplates 28 and 29 which are adapted to be supported upon a suitable pad or floor structure and are tied together in part by a plurality of longitudinally spaced and transversely extending bars 30, 31 and 32. Disposed between the frame plates 28 and 29 and extending longitudinally of the apparatus is a track which supports the bag groups 26 thereon. Such track, as seen best in FIGS. 4 and 5, is defined by a pair of transversely spaced and substantially parallel rails 33 and 34 secured to and carried by the frame bars 30 and 31. Adjacent the entrance end of the accumulator section, the rails 33 and 34 have respectively bolted thereto extensions 33' and 34' which define a transition between the aforementioned group collator 20 and the accumulator section 23 so as to blend the mergence of the horizontally disposed collator track with the angularly oriented accumulator track, which in the particular apparatus being considered has an angular disposition of approximately 15° from the horizontal.

The bag groups 26 are delivered onto the track defined by the rails 33 and 34 in spaced-apart relation and are advanced along the track by conveyor structure in the form of a pair of endless chains respectively disposed along opposite sides of the track and each equipped with lugs or fingers which enter the space between adjacent bag groups and engage the forwardmost group to push the same forwardly. The conveyor structure is symmetrical as respects the centerline of the apparatus; and accordingly, the mechanism on one side is a substantial duplication of that on the other side. Consequently, in the following description, only the conveyor components on one side of the apparatus will be considered in detail, it being understood that the description applies equally to the duplicates of such components; and for purposes of identifying the respectively corresponding parts, the suffixes *a* and *b* will be appropriately added to the parts numerals.

Considering the conveyor component disposed along the rail 33, the endless chain thereof is denoted with the numeral 35 and is entrained at its forward end about a drive sprocket 36 and at its rear end about an idler sprocket 37. Each chain 35, as shown best in FIG. 5, rides between the sprockets 36 and 37 in a pair of stationary guide and support structures 38 and 39 which at one end are bolted to an upwardly extending post 40 bolted to the frame bar 30, and intermediate the ends thereof are bolted to a support block 41 secured to the frame bar 31 and extending upwardly therefrom. Evidently, the support structures 38 and 39 terminate adjacent each end a spaced distance from the sprockets 36 and 37 so as to provide adequate clearance therefor. Also, while the support structures 38 and 39 may be fabricated in any suitable manner, in the form shown they are comprised of three generally planar plates configurated so as to define a channel adjacent the upper ends thereof which receives the associated chain 35 therein and supports the same in a horizontal sense. The three plates forming each support may be affixed to each other as by means of the aforementioned bolts which secure each entity to the support members 40 and 41.

Secured to each chain 35 at spaced-apart locations therealong are a plurality of lugs or flights 42 each of which comprises an inverted, U-shaped bracket 43 bolted or otherwise secured at one end to the chain and extending laterally outwardly therefrom and further comprises a pusher finger 44 affixed to the bracket 43 adjacent its opposite end. Each finger 44 is oriented in a generally vertical plane so as to define a firm engagement with a group of bags to be advanced thereby, which bags are also disposed in a generally vertical direction. As illustrated in FIG. 5, the fingers 44 incline downwardly and outwardly with respect to the associated chain 35 which, as illustrated in FIG. 3, enables such fingers to assist transition of the bag groups 26 from the horizontally disposed discharge end of the collator 20 onto the inclined track of the accumulator apparatus 23.

The conveyor chains 35 are continuously driven in timed relation with the associated collator mechanism, and in the bundle-forming apparatus being illustrated and described, the timed relationship is enforced upon the conveyor chains by driving the same directly from the collator mechanism. In this respect and referring especially to FIGS. 3 and 4, the drive assembly for the conveyor chains includes a main shaft 45 which is transversely disposed with respect to the apparatus and is journaled for rotation adjacent its opposite ends in suitable bearing structure (not shown) mounted on the frame plates 28 and 29. Mounted upon the shaft 45 so as to rotatably drive the same is a sprocket 46 having an endless drive chain 47 entrained thereabout. Such chain is adapted to be driven by suitable sprocket structure provided by the collator apparatus 20, and since the interconnection of such apparatus may be conventional, such drive sprocket is not illustrated.

Mounted upon the drive shaft 45 inwardly of the frame plates 28 and 29 are a pair of sprockets 48*a* and 48*b* respectively associated with the chains 35*a* and 35*b*, and such sprockets are affixed to the shaft 45 so as to be driven thereby. Each of the sprockets 48 has entrained thereabout an endless drive chain 49 which is also entrained about a sprocket 50 mounted upon a stub shaft 51 journaled for rotation in bearing structure provided by the spaced legs of a generally U-shaped bracket 52 bolted to the frame bar 30. Each stub shaft 51 is equipped intermediate the ends thereof with a vertically disposed bevel gear 53*a* which drivingly meshes with a horizontally disposed bevel gear 54 secured to a vertically oriented shaft 55 rotatably supported in a bearing block 56 fixedly secured to the aforementioned post 40. At its upper end, the shaft 55 is equipped with the aforementioned drive sprocket 36 which is keyed or otherwise fixed thereto to constrain the same against relative rotation.

The associated sprocket 37 is mounted upon a stationary shaft or post 57 (FIG. 5) carried by and extending upwardly from a support plate 58 supported for adjustment by a mounting block 59 confined between the associated support guides

38 and 39. The plate 58 serves as a tension adjustment for the associated chain 35 and can be selectively displaced longitudinally with respect to the apparatus by an adjustment screw 60 and then affixed in any position of adjustment by a clamping screw 61. Each of the endless drive chains 49 is also provided with a tension device in the form of a takeup sprocket 62, as shown in FIGS. 3 and 9. Such takeup sprocket 62 is mounted upon a bracket 63 pivotally supported on the associated stub shaft 51 bolted to the associated bracket 52. An elongated arcuate slot formed in the bracket 63 permits angular displacements thereof about the axis defined by the shaft 51 so as to selectively establish the tension imparted to the associated chain 49.

Evidently, the main drive shaft 45 is continuously driven because of its interconnection with the collator and necessarily then is driven in an enforced time relationship therewith. The shaft 45 in turn continuously drives the chains 49*a* and 49*b* which drive the respectively associated sprockets 36*a* and 36*b* through the aforementioned sprockets 50, shaft 51, bevel gears 53 and 54, and shaft 55. Therefore, the conveyor chains 35*a* and 35*b* are continuously driven in an enforced time relationship, and it will be noted especially in FIG. 2 that the flights or lugs 42*a* and 42*b* are arranged in aligned pairs so that each bundle 26 is engaged along the opposite end portions thereof by a pair of flights 42*a* and 42*b* so as to be advanced along the track defined by the rails 33 and 34. As is most evident in FIG. 9, each of the sprockets 50 is angularly adjustable with respect to the associated stub shaft 51 by mounting structure which includes an elongated slot and capscrew arrangement of substantially conventional character, which arrangement permits manual tailoring of the apparatus to enforce a condition of precise alignment as between the paired conveyor lugs or flights 42*a* and 42*b* respectively carried by the endless chains 35*a* and 35*b*.

Considering FIG. 2 in particular, each group 26 is advanced into the accumulator section 23 by mechanism comprising a part of the aforementioned collator 20; and the details of such mechanism may be obtained by reference to the aforementioned Pat. application, Ser. No. 494,742. However, for illustrative purposes, such mechanism is shown in FIG. 2 in largely diagrammatic form as a pair of fingers or holders 64*a* and 64*b* which are cyclically reciprocable longitudinally so as to displace each group of bags in the direction of the arrows into a forwardmost position such that the trailing or rearmost bag in such group is disposed generally along the line 65. At such location of a group 26, the conveyor chains 35*a* and 35*b* are able to advance a pair of lugs or flights 42*a* and 42*b* into engagement with the rearmost bag in such group and thereby initiate continuous movement of the group toward the discharge end of the accumulator apparatus.

To confine each group 26 of bags in a transverse sense and support and guide the same along the ends thereof, a pair of guides 66*a* and 66*b* are provided adjacent the infeed end of the apparatus and are spaced apart by a distance substantially equivalent to the length of the bags comprising a group 26 thereof. The guides may diverge outwardly along the entrance ends thereof to form an enlarged mouth through which the bag groups are advanced. The guides 66 are respectively carried by the adjustable plates 58, and in this respect may be secured to the associated sprocket shafts or posts 57 as by means of capscrews which are received within threaded openings provided therefor in such shafts or posts.

As the groups 26 are advanced along the rails 33 and 34 from the infeed end of the accumulator section to the discharge end thereof, the bags in each group have a vibratory motion imparted thereto both in vertical and transverse directions so as to effect uniformity in the disposition of the bags in each group thereof. That is to say, the intent is to have the bags in each group thereof accurately aligned from end to end and from edge to edge so that a bundle of uniform dimensions can be formed from a plurality of such bag groups; and such alignment of the bags can be effected by imparting motion thereto of a character which will cause relative movement between the bags until a condition of alignment thereof is realized.

In this respect and considering first the mechanism by which a horizontally oriented vibratory motion is imparted to the bags, it is seen especially in FIGS. 2 and 5 that a pair of joggers or vibration-imparting side rails 67*a* and 67*b* are disposed generally along the rails 33 and 34 and at an elevation slightly thereabove. Each of the side rails is substantially U-shaped in cross section with the base thereof being vertically disposed to define the sidewalls along which the bag groups are moved. Each side rail 67 adjacent the forward end thereof is pivotally supported on a post 68 secured to a mounting plate 69 carried by the associated chain guides 38 and 39 in underlying relation therewith. Clearly, such pivotal supports for the side rails 67 are located adjacent the discharge end of the accumulator section (i.e., adjacent the drive sprockets 36) and the side rails are angularly displaceable toward and away from each other about the axes respectively provided by the posts 68.

Although the angle of displacement of the side rails remains the same along the entire lengths thereof, the stroke or magnitude of the arc transversed by the side rails becomes progressively greater as the distance from the pivot axes thereof increases. Thus, and by way of example, if the side rails 67 are displaced inwardly through an angle of a few degrees, the corresponding transverse movement of the rails would be substantially zero at the pivot axes thereof but could increase to a significant amount adjacent the infeed end of the apparatus, depending of course on the precise length of the side rails.

Displacements are imparted to each of the side rails 67 by cam structure in the form of a sawtooth-type cam 70 secured to the side rails and extending therealong adjacent the infeed end of the accumulator section. The precise length of each cam 70 and the depth or magnitude and pitch or frequency of the cam will depend upon any particular installation, and the cam structure illustrated has three rises and four falls along the length thereof. Each cam 70 is actuated by engagement therewith of one of a plurality of cam followers 71 respectively carried by the aforementioned lugs or flights 42. Thus, as each flight traverses the arcuate path of travel defined by the associated sprocket 37, the cam follower 71 carried by such lug is advanced into engagement with the cam 70 and displaces the same in lateral directions as the cam follower rides therealong.

The cam 70 is resiliently biased outwardly by a helical spring 72 (FIG. 5) which at one end thereof is secured to the associated side rail and at its other end is anchored to a clip 73 affixed to the outer chain 38. The spring is effective to enforce engagement between the cam and a cam follower moving therealong and enables each such cam follower to displace the cam inwardly against the biasing force imparted thereto by the spring. Evidently, the vibratory motion imparted to each of the side rails 67 is intermittent in the sense that the flights or lugs 42 are spaced apart and are moved in sequence one after another into engagement with the cam. It will be apparent that as each group 26 moves through the accumulator section 23, the transverse dimension through which the group passes diminishes progressively toward the terminal ends of the side rails 67 so that when each group is adjacent such terminal ends, the bags should be closely aligned in a transverse sense.

As indicated hereinbefore, the bag groups also have a vertically oriented vibratory motion imparted thereto by a pair of vibration-imparting joggers 74*a* and 74*b* which extend generally along the rails 33 and 34 exteriorly thereof. The joggers 74 are pivotally secured by posts 75*a* and 75*b* to the respectively associated rails adjacent the forward ends thereof to enable the joggers to be swung upwardly and downwardly about the axes respectively defined by such posts 75. Vibratory displacements are imparted to the joggers by cam structure which includes a generally square-shaped cam 76 (FIG. 3) mounted upon the drive shaft 45 so as to be rotatably driven thereby.

The corners of the cam 76 may be relieved slightly as shown, and adapted to ride thereon is a cam follower in the form of an elongated link 77 angularly displaceable about an axis defined by a pivot pin 78 by means of which the link is secured to the frame bar 32 through a bracket 79 connected thereto. Adjacent the opposite end thereof, the cam follower link 77 is pivotally connected to one end of a push rod 80, which at its opposite end is pivotally connected to a crossbar 81 rigidly related to the joggers 74 through depending brackets welded thereto. As the drive shaft 45 is rotated, the joggers 74 are reciprocated in generally vertical directions above and below the uppermost surface of the rails 33 and 34 so as to engage bags being advanced therealong and effect relative displacements therebetween as necessary to bring all of the bags into a condition of alignment. The vertical displacements of the joggers 74 have a cycle frequency four times the rate of rotation of the drive shaft 45.

In order to impart transition support to at least certain of the bags being advanced into and through the accumulator section 23, a holder finger 82 is located adjacent the entrance end of the accumulator section and is pivotally supported for movement between an upwardly extending position shown in FIG. 3 in which it is disposed in the path of travel of bag groups 26 being advanced into the apparatus, and a retracted position indicated by the arc in FIG. 3 in which it is located beneath the bag group disposed thereabove. The finger 82 is provided with a weight 83 which urges the same in a clockwise direction (as viewed in FIG. 3) and into the extended position. A stop 84 positively limits rotation of the finger in such clockwise direction. Assuming a condition in which the accumulator section 23 is devoid of bag groups 26 or at least has no bag group in overlying relation with the finger 82, the finger will swing upwardly into the position illustrated and will be effective to prevent the forwardmost bags in a group thereof being advanced into the accumulator section to slide or shingle forwardly which would destroy the continuity of the group and possibly jam the apparatus. The constraint afforded by the finger 82 persists until a pair of flights 42 move into the path of such advancing group to define the forwardmost limit of movement thereof.

For a somewhat analogous purpose, the accumulator section is provided adjacent the discharge end thereof with a pair of constraining fingers 85*a* and 85*b* pivotally movable between an outer position enforced thereon by a group of bags moving therepast and an inner position in which the ends of the fingers project into the path of travel of such bag groups. Each finger is resiliently biased toward the innermost position thereof (i.e., in a clockwise direction as respects the finger 85*a* and a counterclockwise direction as respects the finger 85*b* as viewed in FIG. 2) by a helical spring 86 which at one end is secured to the associated finger and at its other end is fixed to the inner chain guide 39. The fingers 85 pivot inwardly under the biasing force of the associated springs 86 whenever a gap or space between successive bag groups 25 is aligned therewith. Upon such occurrence, the fingers are operative to prevent the rearmost bag in the group that has just passed thereby from falling rearwardly as the lugs 42 that were associated with such bag group are disengaged therefrom. The requirement for such constraint to the rearmost bag is transitory in the sense that the group in its entirety is engaged by and advanced into the compression section 24 by group transfer mechanism which will now be described.

Such group transfer mechanism is seen best in FIGS. 3 and 4, and includes a pair of pusher fingers 87*a* and 87*b*. Such fingers 87 are oriented in transversely spaced, substantially parallel relation and are fixedly secured to a transversely disposed support element, generally denoted 88, constrained for reciprocable displacements in a generally vertical direction by a centrally disposed guide rod 89 that passes therethrough and by a guide block 90 located along one side of the support element. In the uppermost position of the support element 88, the pusher fingers 87 (as shown in FIG. 3) project upwardly above the plane defined by the rails 33 and 34 so as to engage a bag group 26 and displace the same forwardly and into the compression section 24. In the lowermost position of the support element 88, the fingers 87 are beneath the plane defined by the rails 33 and 34 and may be bodily displaced below a bag group disposed thereabove on such rails.

In this respect, the fingers 87 and support element 88 associated therewith are bodily displaceable between the forward position shown by full lines in FIG. 3 and a rearward position illustrated by broken lines. More particularly, the guides 89 and 90 are rigidly related adjacent the upper and lower ends thereof to a carrier plate 91 which has bolted thereto a split collar component 92 adapted to be clamped to one end of a reciprocable rod 93 supported for axial movements therealong by spaced-apart bearings 94 and 95 which, through a spacer 96, are respectively carried by the frame bars 30 and 31 intermediate the rails 33 and 34. The collar 92 rigidly relates the guides 89 and 90 to the reciprocable rod 93 so as to be displaced therewith, and the pusher fingers 87 and support element 88 therefor are vertically movable relative to such guides 89 and 90 but are displaceable bodily therewith as the rod 93 is reciprocated along its longitudinal axis.

The fingers 87 and support element 88 are moved between the upper and lower positions illustrated in FIG. 3 by full lines and broken lines, respectively, by motor means in the form of piston-cylinder structure 97, the cylinder of which is fixedly secured to the carrier plate 91. The piston of such structure 97 is equipped with a rod 98 clamped at its upper end to the support structure 88 so as to enforce movement thereon. The motor means 97, as indicated, may be a fluid-actuated piston-cylinder structure (pneumatically, for example), energized in timed relation with the movement of bag bundles 26 along the accumulator section 23. The control circuitry, which includes the motor means 97 therein, will be described in further detail hereinafter.

The rod 93, as shown most clearly in FIG. 6, has clamped thereto intermediate the bearings 94 and 95 a drive block 99 having a bifurcated end portion 100 which together with bearing blocks 101 and 102 clamped thereto define a way or path that slidably receives an elongated guide or key 103 therebetween. Such structural assemblage enables the rod 93 to be reciprocated axially and stabilizes such movement thereof particularly in a manner preventing angular displacements of the rod relative to the longitudinal axis thereof.

Pivotally secured to the drive block 99 is one end of a push rod 104 which at its other end is pivotally secured to an elongated link 105 supported for angular displacements adjacent the lower end thereof on a pivot pin 106 carried by a bracket 107 fixedly related to the frame bar 32. The link 105 intermediate its ends is equipped with a cam follower 108 that rides within the cam-configurated channel 109 of a box cam 110 mounted upon the drive shaft 45 so as to rotate therewith.

Accordingly, the rod 93 is reciprocated along the longitudinal axis thereof at a rate and to an extent enforced thereon, in each instance, by the cam 110 which is continuously driven by the shaft 45. Therefore, the rod 93 is cyclically displaced in timed relation with the collator apparatus 20 and is operative to engage each group 26 of bags and advance the same from the forward end of the accumulator section 23 and into the compression section 24. In accomplishing such displacement of each bag group, the pusher fingers 87 are cyclically reciprocated between the upper extended and lower retracted positions thereof in an enforced time relation with the reciprocatory displacements of the rod 93. More particularly in this respect, the fingers 87 are retracted just prior to the rod 93 being moved rearwardly into the position illustrated by broken lines in FIG. 3; and following such displacement of the rod 93, the fingers 87 are displaced upwardly to engage the rearmost bag in a group 26 thereof and thereby effect displacement of such group forwardly as the rod 93 is reciprocated into the position thereof illustrated by full lines in FIG. 3. The cycle of operation is then repeated with the fingers 87 being withdrawn and the rod 93 then being moved rearwardly to position the fingers for engagement with a subsequent bag group.

From the foregoing description of the accumulator section it will be evident that in a cycle of operation thereof, bag groups 26 being discharged from the collating mechanism 20 are advanced in succession thereby onto the rails 33 and 34 whereat each such bag group is engaged by a pair of pusher fingers 44a and 44b respectively moved into position therefor by the endless chains 35a and 35b. In that the apparatus is timed with the collator mechanism 20, one of the various pairs of pusher fingers 44 will be advancing into a position to engage each group of bags discharged from the collator mechanism and onto the rails 33 and 34.

Each group of bags fed to the apparatus from the collating mechanism 20 is continuously advanced along the rails 33 and 34 by the associated pusher fingers 44 because the pusher fingers continuously traverse a fixed path of travel as enforced thereon by the endless chains 35. As each group 26 of bags approaches the discharge end of the accumulator section 23, the reciprocable pusher fingers 87 are displaced upwardly from a location below the rails 33 and 34 and into a position behind a group of bags which at about this time are being released by the pusher fingers 44 as a consequence of the outward movement thereof along the arcuate path of travel defined by the drive sprockets 36. When the pusher fingers 87 are in the uppermost group-engaging position thereof, the piston-cylinder structure 97 is energized, whereupon the fingers 87 are bodily displaced forwardly from the position shown by broken lines in FIG. 3 and into the full-line position thereof to advance the bag groups engaged thereby into the compression section 24. The fingers 87 are then retracted and are returned to the starting position by the reverse movement of the piston-cylinder structure 97. Evidently, then, the bag groups 26 being discharged from the collator mechanism 20 are accumulated in successive juxtaposition along the rails 33 and 34 of the accumulator section 23 and are advanced group by group therefrom into the compression section 24 at which they are formed into bundles.

COMPRESSION SECTION

As noted hereinbefore, the bag groups 26 are counted as they are advanced into the compression section 24 from the accumulator section 23, and such count is used to control the cycle of operation of the entire bundle-forming apparatus. The counting mechanism employed will be described in detail hereinafter in conjunction with consideration of a complete cycle of operation of the apparatus, and at this point the discussion will advance to the compression section 24. In this connection, reference will be made in particular to FIGS. 1, 3, 4, 9, 11 and 12.

The compression section 24 is structurally related to the accumulator section 23, and in this respect the compression section includes a pair of rails 111 and 112 located inwardly of the aforementioned rails 33 and 34 and substantially parallel thereto. As is most evident in FIGS. 4 and 11, the rails 33—34 and 111—112 overlap slightly at the discharge end of the accumulator section 23, and at such location each set of rails may be welded or otherwise fixedly secured to the aforementioned transversely extending bar or frame member 30. The rails 111 and 112 extend substantially from end to end of the compression section 24 and are adapted to support each group 26 of bags thereon as the bags in a plurality of groups are compressed into bundles.

The compression section 24 further includes guide structure, as shown most clearly in FIGS. 9 and 12, supported by frame components of the accumulator section 23 and projecting forwardly therefrom in cantilever fashion. Such guide structure includes a pair of elongated carrier bars 113a and 113b oriented a spaced distance above the rails 111 and 112 and extending generally therealong in substantially parallel relation. Adjacent one end, the bars 113 are respectively equipped with laterally projecting mounting flanges 114a and 114b bolted or otherwise rigidly secured to upwardly extending brackets 115a and 115b bolted to the sideplates 28 and 29 of the accumulator section, as shown in FIG. 9. Extending downwardly from the bar 113a in spaced-apart relation along the length thereof are a pair of depending brackets 116a and 117a which are rigidly related to the bar 113a, as by means of the capscrews illustrated.

Referring to FIG. 12 in particular, it is seen that each of the depending brackets 116 and 117 has a bifurcated lower end portion providing spaced arms receiving a helical spring 118 therebetween which at one end seats against the outer arm. Also located within the space defined by the bifurcated end portion of a depending bracket is a bearing ear 119 that is engaged by the associated spring 118 and is biased inwardly thereby toward engagement with the innermost leg of the bifurcated end portion of the depending bracket. Each bearing ear 119 is secured to and carried by a hanger (denoted 120 and 121 to associate the same with the depending brackets 116 and 117) which is supported by an elongated shaft or axle 122 mounted in the depending brackets 116 and 117 and journaled for rotation with respect thereto in appropriate bearing members.

Secured to an associated pair of hangers 120 and 121 is a generally L-shaped guide 123 which is elongated and has a somewhat greater length than that of the shaft 122. Ordinarily each L-shaped guide 123 is disposed in the innermost position thereof shown in FIG. 12 as a consequence of the biasing force imparted thereto by the springs 118, and the spacing between the two guides 123a and 123b is sufficient to accommodate a bag group 26 and permit the same to be advanced while supported upon the rails 111 and 112. As will be explained hereinafter in a discussion of the transfer section 25, the guides 123 are displaceable outwardly against the resilient force of the springs 118, and in furtherance of this movement of the guides, the bottom longitudinal edges thereof are turned outwardly, as seen in FIG. 12. Although each of the guides 123 terminates short of the accumulator section 23, the movement of bag groups into a position between the guides is facilitated by relatively short guide members 124a and 124b (FIGS. 9 and 11) located forwardly of the guides 123 and which are turned outwardly to provide a relatively wide mouth for easy acceptance of each bag group discharged from the accumulator section 23.

The compression section 24 is equipped adjacent the terminal end thereof with a stop 125 selectively movable between an upper bag-engaging position, illustrated by full lines in FIG. 12, and a retracted position depicted by broken lines in this same FIG. The stop 125 when in the upper extended position thereof constitutes an abutment defining the limit of movement of bags along the track formed by the rails 111 and 112, and it is displaced into such extended position when the transfer section 25 is swung toward the banding mechanism 21.

The stop 125 is of generally U-shaped configuration and the upwardly extending legs thereof are respectively connected with one end of a pair of elongated arms 126a and 126b which extend longitudinally along the rails 111 and 112 exteriorly thereof. Adjacent their opposite ends, the arms 126 are pivotally supported by bracket elements 127a and 127b bolted or otherwise fixedly related to the respectively associated rails 111 and 112. The arm 126b intermediate the ends thereof is pivotally connected to the piston rod 128 of a piston-cylinder motor means 129, the cylinder of which is pivotally carried by the bracket 127b. Evidently, energization of the motor means 129 is effective to swing the arms 126 about the pivotal supports thereof so as to reciprocate the stop 125 between the upper and lower positions thereof.

Adjacent the infeed end of the compression section 24, clamp structure is provided for limiting rearward movement of bags advanced into the compression section by the pusher fingers 87. Such clamp structure actually forms a part of the aforementioned transfer section 25 since it is bodily movable therewith, but for convenience of consideration will now be described. Such clamp structure includes a pair of transversely spaced clamping fingers 130a and 130b which, as shown best in FIGS. 9 and 12, are respectively displaceable between the extended and retracted positions thereof by motor means 131a and 131b, each of which is in the form of a piston-cylinder mechanism. More particularly, the piston rod 132 of each such motor means is pivotally secured by a connector 133 with a reciprocable plate 134 which at its upper end terminates in a clamping finger 130. The cylinder of each motor means 131 is bolted or otherwise fixedly related to frame components of the transfer section 25 so that the piston rods 132 are movable with respect thereto, and, accordingly, are effective to reciprocate the clamping fingers between the extended and retracted positions thereof.

Additional clamping fingers 135a and 135b are provided adjacent the terminal end of the compression section 24, which clamping fingers are alternately operative with the stop 125 to confine bag bundles within the compression section. The clamping fingers 135a and 135b are reciprocated between an upper extended position and a lower retracted position by respectively associated motor means 136a and 135b in the form of piston-cylinder structure, the cylinders of which are fixedly related to components of the transfer section and the rod-equipped pistons of which are connected with the clamping fingers. Ordinarily, the clamping fingers 135a and 135b are in the extended position thereof so as to engage the forwardmost bag in the leading group 26 thereof being compressed along the compression section 24, and such clamping fingers remain in engagement with such forwardmost bag while the entire bundle is transferred from the compression section and into the banding mechanism 21.

As shown best in FIGS. 9 and 11, the compression section 24 is equipped with spaced-apart holder fingers 137 and 138 each of which is supported for pivotal movements between an extended position in which it projects upwardly above the plane defined by the rails 111 and 112 and a retracted position beneath the plane of such rails to permit bags to pass thereover. As in the case of the holder finger 82 described hereinbefore, the fingers 137 and 138 are weighted so that they are gravity biased in a clockwise direction, as viewed in FIG. 9, toward their extended positions but are movable in a clockwise direction against the biasing force of such weights by engagement with bags being advanced along the rails 111 and 112. Such rails, it may be noted, are inclined upwardly and, accordingly, such holder fingers 137 and 138 are effective to prevent movement in a rearward direction of any bags engaged thereby.

In a cycle of operation of the bundle-forming apparatus, the compression section 24 accepts each group 26 of bags advanced onto the rails 111 and 112 by the pusher fingers 87a and 87b. Evidently, the cyclic operation of the motor means 131a and 131b is such that the clamping fingers 130a and 130b are first retracted to enable a bag group to be advanced therepast by the pusher fingers 87a and 87b, and following such advancement of a bag group the clamping fingers 130a and 130b are displaced into their extended position to engage the rearmost bag in such group and thereby constrain the same against rearward movement along the rails 111 and 112. As explained heretofore, the pusher fingers 87a and 87b are retractable so as to enable the transfer mechanism comprising such fingers to be returned to the initial position thereof preparatory for a subsequent cycle of operation.

In operation of the compression section 24, successive groups 26 of bags are advanced along the rails 111 and 112 until the forwardmost bag in the leading group thereof engages the clamping fingers 135a and 135b, which fingers ordinarily are extended into the path of movement of the bags for this purpose. Since such fingers 135 prevent further movement of the forwardmost bag in engagement therewith, additional bag groups advanced by the pusher fingers 87a and 87b ultimately fill the compression section and finally all of the groups are compressed into a bundle. This repetitive advancement of bag groups into the compression section 24 continues until a predetermined number of such groups have moved past the counter mechanism 27 (such number being sufficiently great to cause compression of the bags), whereupon the transfer section 25 is energized to transfer the compressed bundle of bags into the banding mechanism 21. When such transfer commences, the stop 125 is actuated into the extended position thereof so as to engage and thereby terminate movement of any bags advanced into adjacency therewith during the period that the transfer section 25 is operative to transfer a bundle of bags to the banding mechanism. After the transfer section has returned to its starting position, the clamping fingers 135 thereof are extended and the stop 125 is retracted, whereupon a cycle of operation has been completed.

TRANSFER SECTION

As indicated hereinbefore, the transfer section 25 of the apparatus is effective to move each bundle of bags from the compression section 24 and into the banding mechanism 21, and to cyclically perform this function as long as the bundle-forming apparatus is in operation. The details of the transfer mechanism 25 will now be described and, in connection therewith, reference will be made in particular to FIG. 1 and 9 through 12.

The transfer section 25 is pivotally movable about a transversely disposed axis defined by a shaft 139 supported for pivotal displacements by bearing structures 140a and 140b respectively carried by upwardly extending frame elements 141a and 141b that are rigidly interconnected by a plurality of transversely extending frame components such as those shown in FIG. 10 and denoted with the numerals 142 and 143. Pivotal displacements are enforced upon the shaft 139 by drive mechanism in the form of a fluid-actuated motor means 144 comprised of piston-cylinder structure, the cylinder of which is pivotally anchored to fixed frame components of the apparatus, as by means of a bifurcated connector 145. The piston-equipped rod 146 of the motor means 144 is pivotally connected by means of a bifurcated coupling 147 to a crank arm 148 clamped to the shaft 139 as by means of a split clamping collar 149.

Evidently, whenever the motor means 144 is energized, the piston rod 146 is displaced outwardly, whereupon the shaft 139 is pivoted in a counterclockwise direction, as viewed in FIGS. 1 and 9, and into bundle-discharging juxtaposition with the banding mechanism 21. Reverse movement of the piston rod 146 causes the transfer section to swing in a clockwise direction to return it to the starting position shown in FIG. 9. For purposes of adjusting the extent of the angular displacement of the transfer section to effect alignment with the banding mechanism 21, an adjusting screw 150 is included in the apparatus to selectively change the precise location of the interconnection of the coupling 147 with the crank arm 148 within the limits established by an elongated slot 151 formed in such crank arm.

In that the load carried by the shaft 139 is relatively heavy, the shaft is positively driven at spaced-apart locations therealong by the motor means 144. In this respect, the crank arm 148 (FIGS. 10 and 11) has fixedly connected thereto one end of a tie bar 152 which extends transversely of the transfer section and at its opposite end is fixedly connected to a crank arm 153 fastened to the shaft 139 by a clamp collar 154. The tie bar 152 is in the form of an inverted U-shaped channel, as seen in FIG. 14, and as a result of the structural arrangement involving the same, whenever angular displacements are enforced on the crank arm 148 by the motor means 144, such displacements are similarly enforced on the crank arm 153 through the tie bar 152. Therefore, the shaft 139 is positively driven at the points of connection thereto of the crank arms 148 and 153.

Carried by the shaft 139 and extending rearwardly therefrom are a pair of transversely spaced and substantially parallel transfer rails 155a and 155b each of which is of generally L-shaped configuration (FIG. 12). The transfer rails 155a are adapted to traverse two separate path movements, one of which is generally along the axis of the shaft 139 between the inner positions illustrated by full lines in FIGS. 11 and 12 and the outer positions shown by broken lines in these same FIGS.; and the other of which is an angular movement about the axis of the shaft 139 between the bundle-receiving and bundle-discharging positions respectively illustrated in FIG. 1 by full and broken lines.

In their innermost position, the transfer rails 155 are located slightly below the aforementioned rails 111 and 112 so that they can be moved inwardly and into the full line position shown in FIG. 12 without resistive interference from one or more bag groups supported at such time upon the rails 111 and 112. In their innermost position the transfer rails 155 substantially abut the respectively adjacent ends of any bags supported along the rails 111 and 112, and subsequent to a bundle of bag groups being formed along such rails 111 and 112 as heretofore described, the transfer rails 155 are swung upwardly (as will be described) to engage the compressed bundle and displace it into cooperative relation with the banding mechanism 21. To facilitate such upward movement of the rails 155 it may be noted that the upper longitudinal edges thereof are beveled inwardly to facilitate movement thereof past the L-shaped guides 123 which, during such movement, are cammed or displaced outwardly by the rails against the resilient force of the springs 118.

The mechanism by which the transfer rails 155 are supported upon the shaft 139 for axial displacements with respect thereto includes (considering in particular the rail 155*a*) an elongated bearing sleeve 156*a* coaxially circumjacent the shaft 139 and of sufficient length to prevent binding when the bearing is slidably displaced along the shaft. Secured to the bearing 156*a* and extending upwardly therefrom is mounting structure generally denoted 157*a* to which is bolted the forward end portion of a carrier 158*a* for the transfer rail 155*a*. As shown most clearly in FIG. 12, the carrier 158*a* is of inverted, L-shaped configuration and defines a relatively flat top wall that seats the rail 155*a* thereon, which rail extends along such top wall and may be welded or otherwise fixedly secured thereto.

The bearing 156*a* is equipped intermediate the ends thereof with outwardly extending annular ribs defining an arcuate channel 159*a* therebetween, and riding in such channel at diametral locations therein are a pair of drive pins 160 and 161 (see FIG. 14) which are provided by a yoke-type component comprising a pair of arms 162 and 163 bolted or otherwise rigidly secured to a base element 164. The pins 160 and 161 are freely movable with respect to the associated channel 159 in an angular sense so as to enable the channel-carrying 156 to move angularly with respect to the shaft 139 while the pins and the yoke carrying the same remain substantially fixed against corresponding angular displacements. However, the pins 160 and 161 are cooperative with the ribs defining the associated channel 159 so as to reciprocably displace the bearing 156 axially along the shaft 139.

As shown most clearly in FIG. 10, the base element 164*a* is an elongated member pivotally supported intermediate the ends thereof by pivot-pin structure 165*a* carried by the stationary frame component 143. Similarly, the base element 164*b* is an elongated member pivotally connected adjacent the lower end thereof by pivot-pin structure 165*b* to the stationary frame component 143. Intermediate its ends, the base element 164*b* is pivotally secured to one end of a connecting rod 166 which at its opposite end is pivotally secured to the lower end portion of the base element 164*a*. Evidently, then, the two base elements 164*a* and 164*b* are angularly displaceable about the respectively associated pivot-pin structures 165 but are forced to move angularly in opposite directions as a consequence of the interconnection thereof through the connecting rod 166. In this respect, the base elements 164*a* and 164*b* are movable concurrently in enforced synchronism between the inner positions thereof shown by full lines in FIG. 10 and the outer positions indicated by broken lines in the same FIG.

Such pivotal movements are imparted to the base elements 164 as a result of the driving interconnection of the base element 164*b* with a motor means 167 in the form of a piston-cylinder structure. The cylinder of the motor means 167 is pivotally connected to the aforementioned frame element 141*b* by a purchase platform 168, and the piston-equipped rod 169 of the motor means is pivotally connected at its outer end by a bifurcated coupling 170 to a crank arm 171 which is generally triangular in plan view and is rigidly affixed to the base element 164*b*.

In the position of the mechanism as it is shown in FIG. 10, the piston rod 169 of the motor means 167 is retracted and the base element 164*a* therefore has been pivoted in a counterclockwise direction with respect to the pivot-pin structure 165*a* and the base element 164*b* pivoted in a clockwise direction with respect to the pivot-pin structure 165*b*. Consequently, the bearing sleeves 156*a* and 156*b* are in their innermost position, whereupon the transfer rails 155*a* and 155*b* are conditioned for acceptance of a compressed bundle of bags. After such a compressed bundle has been transferred by the rails 155*a* and 155*b* into bundle discharge relationship with the banding device 21, the motor means 167 will be energized to displace the piston rod 169 outwardly and the base elements 164*a* and 164*b* will be rotated in clockwise and counterclockwise directions, respectively, to move the bearing sleeves 156*a* and 156*b* and the transfer rails 155*a* and 155*b* carried thereby into their outermost position for return movement from the banding mechanism 21 to the compression section 24.

Clearly, the bearing sleeves 156*a* and 156*b* are freely slidable axially along the shaft 139 and they are also freely rotatable with respect thereto. Accordingly, structure is required to enforce swinging movements upon the transfer section 25 in both clockwise and counterclockwise directions, as viewed in FIG. 1, between the two alternate positions of cooperative association with the compression section 24 and cooperative association with the banding mechanism 21. Such structure includes a transversely extending drive rod 172 substantially coextensive in length with the tie bar 152, as is most evident in FIG. 11, and fixedly related thereto adjacent the opposite end portions thereof by mounting blocks 173*a* and 173*b* which are respectively connected to the carriers 158*a* and 158*b*.

As explained hereinbefore, such carriers are respectively connected with the bearing sleeves 156*a* and 156*b* so as to move axially therewith, and the bearing structures 174*a* and 174*b* permit such movement of the carriers because the bearing structures are slidable along the drive rod 172. Since the drive rod 172 is mechanically connected with the tie bar 152, it must move therewith whenever such bar is angularly displaced by energization of the motor means 144; and, accordingly, energization of the motor means 144 not only enforces angular displacements upon the shaft 139 but it also enforces corresponding angular displacements about the shaft 139 upon the carriers 158*a* and 158*b* and, therefore, upon the transfer rails 155*a* and 155*b* respectively carried thereby.

As explained hereinbefore, the transfer rails 155 have inwardly inclined wall portions adjacent the upper edges thereof to facilitate movement past the L-shaped guides 123 which have outwardly inclined wall portions adjacent the lower edges thereof for this same purpose. In order to further facilitate movement of the transfer section from the bundle-receiving position thereof toward the banding mechanism 21, the aforementioned motor means 131 respectively carry along the outer surfaces thereof cover plates 175*a* and 175*b*, as shown best in FIGS. 9 and 12, which cover plates provide smooth wall portions readily slidable along and past the L-shaped guides 123.

The forward clamping fingers 135*a* and 135*b* are reciprocated between the extended and retracted positions thereof in much the same manner as the clamping fingers 130*a* and 130*b* and, accordingly, are respectively equipped with fluid motor means 136*a* and 136*b* to effect such reciprocable displacements thereof, as described hereinbefore. One such motor means is indicated by broken lines in FIG. 9 and such motor means are in the form of piston-cylinder structure. In order to facilitate movement of such motor means associated with the clamping fingers 135 along and past the L-shaped guide 123, cover plates similar to the aforedescribed cover plates 175 are provided.

In operation of the transfer section 25, the initial position thereof may be taken to be the one illustrated by full lines in the drawings (see, for example, FIG. 1, 9 and 12) in which it is in cooperative adjacency with the compression section 24 and is ready to engage a plurality of bags supported upon the stationary rails 111 and 112 of the compression section. Considering the position of the transfer section 25 as shown in FIG. 12, bag groups 26 are supported upon the rails 111 and 112 and the lower edges of the bags are located slightly above the generally horizontal surfaces of the transfer rails 155. Such relative disposition of the bags and the transfer rails enables the transfer rails to be moved inwardly to the full line position shown in FIG. 12 so that such horizontal surfaces of the transfer rails are disposed beneath the bags. During such inward movement of the transfer rails, the clamping fingers 130 and 135 are in their retracted positions so that they can move under the L-shaped guides 123. When the clamping fingers are retracted, the stop 125 will be extended so as to limit forward movement of bags along the rails 111 and 112 beyond the location of such stop.

After the transfer section 25 has assumed the full line position shown in FIG. 12, the forward motor means 176 are energized to extend the clamping fingers 135 which permits the stop 125 to be withdrawn into the retracted position thereof by energization of the motor means 129 therefor. The rearward clamping fingers 130 are cyclically raised and lowered in timed relation with the movement of the pusher fingers 87 to enable each successive group of bags to be displaced from the accumulator section 23 and onto the rails 111 and 112 of the compression section 24. After a sufficient number of bag groups have been advanced onto the rails 111 and 112 and have been compressed by the pusher fingers 87 against the forward clamping fingers 135, the rear clamping fingers 130 are extended, whereupon a compressed bundle of bag groups is confined between the front and rear clamping fingers.

Since a bundle is now ready to be transferred to the banding mechanism 21, the motor means 144 is energized and as the piston-equipped rod 146 thereof is extended, the shaft 139 is rotated in a counterclockwise direction, as viewed in FIGS. 1 and 9, as are the bearing sleeves 156, carriers 158, and transfer rails 155, whereupon such compressed bundle is bodily displaced from the compression section and into cooperative engagement with the banding mechanism 21. Appropriate operation of such banding mechanism removes the bundle of bags from the transfer section 25, and the motor means 167 can then be energized to reciprocate the bearing sleeves 156 outwardly along the shaft 139 into the broken-line positions illustrated in FIG. 10. At about this time, the motor means 144 is reversely energized so as to return the transfer rails 155 and associated components into the broken-line position thereof depicted in FIG. 12.

Thereafter, the motor means 167 is reversely energized so as to return the transfer rails 155 to the starting positions thereof shown by full lines in FIG. 12; and, evidently, the rear clamping fingers 130 are retracted and the front clamping fingers 135 extended during this final stage of return movement of the transfer rails. In the usual case, such clamping fingers will be retracted when the compressed bundle of bags is removed from the transfer section while located at the banding mechanism 21 (in a typical instance the banding mechanism comprises a reciprocable ram that moves into engagement with a bundle of bags and displaces the same upwardly along the upright transfer rails 155 when the transfer section 25 is in the position shown by broken lines in FIG. 1). Thus, a cycle of operation of the transfer section 25 has been completed and the apparatus is conditioned for a subsequent cycle.

CONTROL CIRCUITRY AND OPERATIONAL CYCLE

As explained hereinbefore, the bag groups displaced from the accumulator section 23 into the compression section 24 are tallied by the aforementioned counter mechanism 27 and the count recorded thereby is used to control an operational cycle of the transfer section 25. The counter mechanism, as indicated diagrammatically in FIG. 1, is located adjacent the mergence of the accumulator and compression sections, and the particular mechanism employed herein is of optical character and includes a light source and a photosensitive device used in association therewith. The details of such counting mechanism 27 are shown most clearly in FIGS. 3, 7, 8 and 9, to which reference will now be made in particular.

The light source is illustrated in FIG. 7 and is designated with the numeral 178. Any conventional light source can be employed, such as an incandescent bulb, and an appropriate electric circuit, not shown in FIG. 7, will necessarily be employed to energize such source. The light source is supported on the carrier bar 113*b* and is oriented with respect thereto so that the transmitted light beam projects transversely across the apparatus at an elevation enabling it to be interrupted by bag groups moving into the compression section. In order to focus or restrict somewhat the area of the light energy emitted by the source 178, a light shield 179 is located in front of the source and is provided with an elongated aperture 180 that permits light energy to pass therethrough. The aperture 180 is elongated so as to enable the shield to be adjustably positioned along the carrier bar 113*b* to which it is secured. The shield 179 is located along the path traversed by the bag groups, and adjacent its entrance end the shield has an outwardly turned end portion 181 to facilitate movement of the bags therepast. Supported by the shield 179 for pivotal movement between open and closed positions, is a shutter 182 which is gravity biased downwardly into the lower aperture-closing position thereof shown in FIG. 3. The shutter is provided with an inclined edge portion defining a cam 183 adapted to be engaged by and ride along the upper edge portions of bag groups being advanced therepast.

Located opposite the light source 178 is a photosensitive device 184 supported upon the carrier bar 113*a*. A light shield 185 is disposed forwardly of the device 184 and is provided with an aperture 186 permitting light energy from the source 178 to impinge upon the photosensitive elements of the device 184. The shield 185 may be adjustably positioned along the carrier bar 113*b* and, as in the case of the light source 178, the device 184 may be conventional and can be one of the well-known solid-state photosensitive components or, for example, it could be a multiplier phototube. In any event, a suitable circuit (not shown) for such light-sensitive device must be provided. In that the transfer mechanism 25 is actuated after a predetermined number of bag groups have been tallied by the counter mechanism 27, means are provided in association with the device 184 to record the bag groups counted thereby, and such counter may be conventional and, in FIG. 16, is denoted generally with the numeral 187.

As explained heretofore, the bundle-forming apparatus is arranged to operate in synchronism with the collator 20, but the mechanism enforced synchronism therewith is largely confined to the accumulator section 23 and results from the driving interconnection of the conveyors (chains 35*a* and 35*b*) with the collator drive via the sprocket 46 and drive chain 47 (FIG. 4). Such mechanical interconnection of the accumulator section with the collator also includes the translational displacements of the pusher fingers 87 since such displacements thereof are transmitted thereto through a continuously driven cam, as explained heretofore. Apart from these components, the operational phases of the apparatus are controlled by means including the aforementioned counting mechanism 27, the various motor means, and by a plurality of switches strategically positioned so as to be actuated in response to predetermined movements of certain components of the apparatus. The circuit embodying such motor means, switches and counting mechanism will now be considered and in conjunction therewith, reference will be made in particular to FIGS. 15 16.

The various motor means are in the form of fluid-actuated piston-cylinder structures and are arranged with conventional solenoid-controlled valves which permit fluid, usually compressed air, to be delivered to the motor means through conduits appropriate to effect movement of the motor means in the proper direction. The motor means and solenoid-controlled valves therefor may be completely conventional devices and, accordingly, only the solenoid-controlled valves are included in the circuit of FIG. 16 and even then are diagrammatically depicted. For purposes of positive identification and for convenience of description, in FIG. 16 the numerals applied to the solenoid-controlled valve structures are those which have been used hereinbefore to identify the motor means respectively associated therewith except that the suffix *s* has been added thereto. As a cautionary observation it should be noted that in certain instances separate solenoid-controlled valves are used to effect energization of the motor means in the opposite directions of movement thereof; and where this occurs, the primed forms of the same numerals are used in one instance for purposes of differentiation.

As it is evident in FIG. 16, the various solenoid-controlled valves for the most part are connected through on-off switches (conventional limit switches for example) between a pair of conductors 188 and 189 establishing a power circuit, and which conductors are connected to a suitable and conventional power source. More particularly, the solenoid-controlled valve 97*s* associated with the motor means 97 has a normally open switch 190 (provided by a control relay described hereinafter) connected in series therewith and similarly the solenoid-controlled valve 131*s*, 136*s* has a normally open switch 191 in series therewith. The solenoid-controlled valves 97*a* 144*s* and 129*s* are connected in parallel, and in series therewith is a normally open switch 192. The solenoid-controlled valve 131*s* 136: has a normally open switch 193 in series therewith, and also in series with such switch is a circuit branch comprising a parallel connection of the solenoid-controlled valves 129*s*' n d 207*s* which have arranged in series therewith a normally open switch 194. The solenoid-controlled valves 144*s*' n d 167*s* are arranged in shunt connection and have in series therewith a normally open switch 195. Finally, the solenoid-controlled valve 167*s*' is connected between the conductors 188 and 189 through a normally open switch 196.

Also connected between the conductors 188 and 189 is the aforementioned counter mechanism 187 which in the diagrammatic form shown in FIG. 16 is seen to include a counting coil or inductance element 197 and a normally open switch 198. The counting coil 197 is connected in series between the conductors 188 and 189 through a normally open switch 199 responsive to the aforementioned optical system and especially the photosensitive device 184 thereof. The switch 198 is connected to the conductor 188 through a control relay 200, and it should be noted that the aforementioned switch 190 comprises a component of such relay 200 and is operated thereby. The control relay 200 also includes a normally closed switch or switch contacts 201, and arranged in parallel with the switch 201 is a normally open switch 202.

Returning to the switch 198, it is also connected to the conductor 189 through a manually operable switch 203 which is normally maintained in the closed position thereof. The shunt-connected control relay contacts 201 and switch 202 are connected in the energizing circuit of the collator 20, which circuit also includes a safety interlock switch 204. The counter 187 also includes a clutch 205, one side of which is connected directly to the conductor 188 and the other side of which is connected to the conductor 189 through a parallel switch arrangement constituting a normally open, manually operable switch 206 and the aforementioned switch 191.

Following through a cycle of operation in terms of the control components illustrated in FIGS. 15 and 16, the apparatus and such components may have the conditions shown in FIGS. 15 and 16, and in this connection the transfer section 25 is conditioned to engage a compressed bundle of bags that have been advanced into the compression section 24 by the pusher fingers 87. As such pusher fingers 87 advance into the compression section the final bag group to complete a bundle thereof, the switch 191 is triggered by one of the fingers 87 and such triggering of the switch closes the same to energize the solenoid-controlled valve 131*s*, 136*s* with the result that the clamping fingers 130 and 135 are displaced upwardly into the extended positions thereof. Such upward displacement of the clamping fingers 130 causes the switch 192 to be closed, whereupon the solenoid-controlled valve 97*s*' is actuated thereby to cause the pusher fingers 87 to be retracted, the solenoid-controlled valve 129*s* is actuated thereby to retract the bag stop 125 downwardly, and the solenoid-controlled valve 144*s* is actuated thereby to energize the motor means 144 and cause the transfer section 25 to be displaced toward the banding mechanism 21.

As the transfer section 25 moves into operative relation with the banding mechanism 21, it trips the switch 193, whereupon the solenoid-controlled valve 131*s* 136: is energized with the result that the clamping fingers 130 and 135 are retracted. Such retraction of the clamping fingers 135 causes the switch 194 to be closed, whereupon the solenoid-controlled valve 129*s*' is energized to cause the bag stop 125 to be displaced into the extended position thereof. At the same time, closing of the switch 194 results in the solenoid-controlled valve 207*s* being energized and, as a consequence thereof, the ram platen 208 of the banding mechanism 21 is energized to displace the bundle of bags upwardly to remove the same from the transfer section 25.

As the ram platen 208 moves into its terminal position, at which time the bag bundle has been displaced from the transfer section, the ram platen actuates the switch 195 which causes each of the solenoid-controlled valves 144*s* and 167*s* to be energized, whereupon the motor means 144 is reversely energized to return the transfer section 25 toward its starting position and whereupon the motor means 167 is energized to displace the transfer rails 155 and associated components outwardly along the axis of the shaft 139. As the transfer section 25 approaches the downmost position thereof shown in FIG. 15, it actuates the switch 196, with the result that the solenoid-controlled valve 167*s*' is energized to cause the motor means 167 to be reversely energized and thereby return the transfer rails 155 and associated components into the innermost position thereof, shown in FIG. 10.

The counting mechanism 27 is operative to tally the number of bag groups displaced from the accumulator section 23 into the compression section 24 and to commence a cycle of operation after a predetermined number of groups have been so advanced—such number being sufficient in quantity to form a bundle. The counting mechanism may be conventional and, as illustrative of such a mechanism, reference may be made to the diagrammatic illustration thereof presented in FIG. 16. As shown in this FIG., the counting mechanism is energized each time a bag group is displaced past the light source 178 and photosensitive device 184, and the circuit arrangement is such that the switch 199 is closed each time a bag group is displaced past the sensing or counting station. Closing of the switch 199 energizes the counting coil 197, whereupon the clutch 205 is momentarily engaged to advance the counter one position.

More particularly and by way of example, if 10 bag groups are required to form a bundle, as the 10 th group moves past the photosensitive device 184 the resultant energization of the coil 197 will cause the clutch 205 to be engaged and to rotate the counter shaft (not shown) through its final position at which it closes the switch 198. Closing of this switch completes the circuit to the control relay 200 and energization thereof closes the normally open switch contact 190 thereof to energize the solenoid-controlled valve 97s and thereby cause the clamping fingers 130 and 135 to be displaced upwardly into the extended positions thereof. At the same time, the switch contact 201 is opened by the control relay 200, but this has no effect upon the collator circuit because the switch 202 remains closed so long as the transfer section is in the lower position thereof shown in FIG. 15. Thus, the starting conditions initially assumed have been achieved and a complete cycle of operation of the apparatus has been completed.

The safety interlock switch 204 is torque controlled and opens automatically to interrupt the energizing circuit of the bundle-forming apparatus should the apparatus become jammed for any reason. The switch 191, which is also connected in the circuit of the clutch 205, constitutes in this respect an automatic reset switch to reestablish a starting condition for the counter 187 so as to provide a determinate starting condition at the initiation of each successive cycle of operation. The switch 206 is a manually operable reset switch enabling an operator to recondition the counter 187 to initiate a cycle of operation should this be required before a prior cycle has been completed. The manually operable switch 203 enables an operator to interrupt the energizing circuit of the control relay 200 even through the switch 198 is closed.

MODIFIED EMBODIMENT OF FIGURES 17 THROUGH 22

The modified embodiment of the apparatus illustrated in FIGS. 17 through 22 differs from the prior-described embodiment in several respects, and in many environments is considered superior and, therefore, preferred. As concerns structural differences, they constitute essentially replacement of the optical counter mechanism 27 (FIGS. 1, 7 and 8) with a limit switch counter; omission of any vibratory motion enforced upon the bags by the vibration-imparting side rails 67a and 67b and the vibration-imparting joggers 74a and 76b (FIGS. 2, 3 and 4), and use of a belt conveyor to aid in advancing the bags along the accumulator section; removal of the holder fingers 82 and constraining fingers 85a and 85b (FIGS. 2 and 3) and the stop 125 (FIG. 12), and use of a trolley mechanism in conjunction with movement of the bags through the compression section; and inclusion adjacent the infeed end portion of the accumulator section of a delay mechanism which momentarily increases the spacing between adjacent groups of bags being advanced thereinto.

It may be stated that in general the modified apparatus, except for the particular departures to be considered in detail, is substantially similar in structure and function to the embodiment of the apparatus illustrated in FIGS. 1 through 16 and described with particularity hereinbefore. Accordingly, only sufficient structural components will be again considered which are believed to be helpful in relating and referencing the modified embodiment of the apparatus to the prior-described embodiment thereof; and as an aid in this respect, the primed form of the same numerals are used to identify component parts in the modified apparatus as were used to identify the respectively corresponding parts in the embodiment of the apparatus shown in FIGS. 1 through 16.

Referring first to FIG. 17, the main shaft 45' is rotatably driven by an endless chain 47' from the associated collator apparatus. The chain 47' is entrained about a sprocket 46' carried by the shaft 45', and also mounted upon the shaft so as to be rotatably driven thereby is a gear 210 which meshes with and drives a spur gear 211 which is equipped with or otherwise drives a sprocket 212 about which is entrained an endless chain 213. The chain 213 is also entrained about and drives a sprocket 214 mounted upon a shaft 215 extending transversely of the accumulator section 23' and journaled for rotation adjacent its opposite ends, as shown in FIG. 18. The shaft 215 carries at transversely spaced locations a pair of rollers or drums 216a and 216b which respectively drive conveyor belts 217a and 217b. The conveyor belts extend generally along upwardly extending guide walls 218a and 218b which are spaced apart transversely and are adapted to pass therebetween successive bag groups 26. At their opposite ends the conveyor belts 217a and 217b are respectively entrained about idler drums or spools 219a and 219b, as shown in FIG. 19.

The successive bag groups 26 are adapted to be seated upon the conveyor belts 217 and are advanced from right to left, as viewed in FIG. 17, from the infeed end of the accumulator section to the discharge end thereof at which the bag groups are delivered to the compression section 24'. The conveyor belts 217 in conjunction with the pusher fingers 44a' and 44b' advance the bags smoothly along the accumulator section, and such pusher fingers are respectively interposed between successive bag groups and push the same along the accumulator section in the manner described hereinbefore with reference to the prior embodiment of the apparatus. It may be observed, especially in FIG. 18, that rails 33a' and 34a' and rail extensions 33'' and 34'' are interposed between the two conveyor belts 217 and serve therewith to support the bag groups 26 as they are advanced along the accumulator section by the conjoint action of the conveyor belts 217a and 217b and pusher fingers 44a' and 44b'.

The pusher fingers 44a' and 44b' are respectively carried at spaced-apart locations therealong by chains 35a' and 35b' which at one of their ends are entrained about sprockets driven from the main drive shaft 45' of the apparatus by means of a chain 49a' and drive sprocket 54a', all as described hereinbefore with reference to the preceding embodiment. The idler sprocket for the chains 35a' and 35b' are located adjacent the infeed end of the accumulator section 23', as shown most clearly in FIGS. 17 and 18, and such idler sprockets are respectively identified by the numerals 37a' and 37b'. As shown in FIG. 17, the sprocket 37b' is equipped with a hub 220b which rotates therewith, and the hub has a gear 221b affixed thereto which meshes with and drives a spur gear 222b. The gear 222b is constrained upon a shaft 233b so as to rotatably drive the same, and mounted upon such shaft so as to rotate therewith is a cam 224b. As shown in FIG. 18, a similar arrangement is provided in association with the chain 35a' and idler sprocket therefor so that the two cams 224a and 224b are rotatably driven in unison and in timed relation with the movement of the chains 35a' and 35b' which carry the pusher fingers 44a' and 44b'.

The cams 224 comprise a part of an interrupter or delay mechanism operative to increase the initial spacing between successive bag groups 26 advanced into the accumulator section 23' from the collator mechanism 20, and such spacing of the successive bag groups facilitates insertion of the pusher fingers 44 therebetween. In addition to the cams 224 and the gear trains 221 and 222 respectively associated therewith, such interrupter or delay mechanism (which is symmetrical and is formed in two sections respectively associated with the chains 35a' and 35b') includes, again considering the chain 35b', an arm b extending longitudinally along the chain 35b' and supported adjacent one end for angular displacements about an axis defined by a pivot post 226b. Intermediate its ends, the arm is equipped with a cam follower 227b that rides on the cam 224b and is moveable thereby between inner and outer positions, the outer position being shown in FIG. 18 in phantom. The arm 225a is biased by a helical spring 228b toward an inner position so as to maintain the cam follower 227b in engagement with the cam 224b.

As is evident in FIGS. 17 and 18, the plane of the arm 225b extends along the path of movement of the bag groups 26 through the accumulator section 23' and, therefore, is at an angular disposition relative to a horizontal plane. Adjustably secured to the arm 225b at a substantially horizontal orientation is a connector or arm extension 229b which is bifurcated at its outer extremity and is clamped thereby to a constraining finger 230b. By comparing FIGS. 17 and 18 it will be noted that the constraining finger 230b extends both inwardly and downwardly and is movable with the arm 225b between the inner and outer positions respectively shown in FIG. 18 by full and broken lines. In the innermost position thereof, the finger

230*b* extends into the path of travel of the bag groups **26** being advanced by the collator apparatus **20** into the compression section **23**.

More particularly in this respect, bags are advanced group by group from the collator between the guides **66***a*′ and **66***b*′ and onto the rail extensions **33**″ and **34**″ by action of the grouper fingers **64***a* and **64***b* of such collator **20** and which grouper fingers are cyclically reciprocable to displace each group of bags from right to left as the apparatus is viewed in FIGS. **17** and **18**. After each such advancement, the fingers **64***a* and **64***b* are retracted downwardly and are moved in the opposite direction beneath the next successive bag group **26** advancing between the guides **66***a*′ and **66***b*′. The fingers **64** are then extended upwardly behind such next successive bag group and are then displaced from right to left to advance the bag group onto the rails of the accumulator section. The details of such movement of the fingers **64** are explained in detail in the aforementioned Pat. application Ser. No. 494,742.

As each bag group **26** is advanced onto the rail extensions **33**″ and **34**″ at the infeed end of the accumulator section, the chains **35***a*′ and **35***b*′ advance a pair of pusher fingers **44***a*′ and **44***b*′ into engagement with the rearmost bag in such group and together with the conveyor belts **217** initiate continuous movement of the bag group toward the discharge end of the accumulator section. The delay mechanism is operative to increase momentarily the space between successive bag groups for the purpose of facilitating such insertion of the fingers **44**. In this respect and referring to FIG. **18**, it will be observed that any such increase in spacing is effected by delaying advancement of each bag group **26** positioned between the guides **66***a*′ and **66***b*′ while the pusher fingers **44** are inserted behind the rearmost bag of the preceding bag group **26**. More particularly, immediately after the grouper fingers **64** of the collator **20** have pushed a bag group **26** forwardly into a position at which the fingers **64** are adjacent the terminal edge portion of the guides **66***a*′ and **66***b*′, the cams **224** are approaching the angular dispositions thereof shown in FIG. **18** which enable the biasing springs **228** to pivot the arms **225** inwardly and thereby interpose the constraining fingers **230** within the path of movement of the bag group then located between the guides **66***a*′ and **66***b*′. Accordingly, as such next successive bag group **26** is being moved forwardly against the preceding, constrained bag groups by appropriate pusher structure **231** provided by the collator apparatus **20**, such constrained bag group is compressed somewhat against the constraining fingers **230** because they positively prevent movement of the bag group therepast.

While such inward movement of the constraining fingers **230** is effected under the influence of the springs **228**, the grouper fingers **64** continue to advance the preceding bag group forwardly along the rail extensions **33**′ and **34**′ thereby increasing the spacing between such preceding bag group and the next successive group which is then constrained against movement by the action of the fingers **230**. Following such enlargement of the space between successive bag groups, a pair of fingers **44***a* and **44***b* enter the space, engage the rearmost bag of the leading group, and commence to advance it along the accumulator section in conjunction with the conveyor belts **217**. Upon engagement of the pusher fingers **44** with the rearmost bag in a group thereof, the fingers **64** are retracted downwardly and the cams **224** have rotated into a position in which they begin to displace the arms **225** outwardly to retract the constraining fingers **230** from the path of movement of the next successive bag group previously constrained thereby. Such successive group then expands while it continues to be advanced by the pusher structure **231** of the collator **20** so that the leading bag in such successive group tends to engage the trailing edge of the preceding pusher fingers **44***a*′ and **44***b*′, as shown in FIG. **18**.

As each bag group **26** being advanced along the accumulator section **23**′ approaches the infeed end of the compression section **24**′, the pusher fingers **44***a*′ and **44***b*′ in engagement with any such bag group commence to move outwardly along the arcuate paths respectively traversed thereby about the associated drive sprockets **36***a*′ and **36***b*′, as indicated most clearly in FIG. **19**. At about the same time that the pusher fingers **44***a*′ and **44***b*′ release such group, additional pusher fingers located generally at the mergence of the accumulator and compression sections engage the group and displace it bodily into the compression section. In this respect, such additional pusher fingers perform essentially the same function as the fingers **87***a* and **87***b* heretofore described, and are substantially similar thereto in structural terms; wherefore, these pusher fingers are denoted with the numerals **87***a*′ and **87***b*′, and the structural assemblage embodying the same will be briefly described with particular reference to FIGS. **17, 20** and **21**.

The pusher fingers **87***a*′ and **87***b*′ are cyclically reciprocable between the forward and rearward positions respectively illustrated in FIGS. **17** and **20** by full and broken lines; and in order to effect such cyclic displacements, the fingers are supported for axial movement along a rod **93**′ fixedly secured at spaced locations to frame components of the apparatus by hangers **94**′ and **95**′. Slidable along the rod **93**′ intermediate such hangers is a drive block **99**′ pivotally connected to one end of a push rod **104**′ which at its opposite end is pivotally connected to an elongated link **105**′ supported for angular displacements in accordance with the configuration of a cam mounted upon the main drive shaft **45**′. In this reference, the link **105**′ bears the same structural and functional characteristics as the link **105** heretofore described in association with its cam follower **108** and cam **109**. Evidently, then, as the shaft **45**′ rotates, the link **105**′ is cyclically displaced by the cam associated therewith to reciprocate the block **99**′ axially along the rod **93**′ so as to shift the fingers **87***a* and **87***b* between the forward and rearward positions thereof.

Secured to the drive block **99**′ and extending downwardly therefrom is a carrier plate **91**′ rigidly attached adjacent the lower end portion thereof to the cylinder of a piston cylinder structure **97**′ equipped with a rod **98**′ extending upwardly therefrom. Connected with the rod **98**′ so as to reciprocate therewith in vertical directions is a transversely disposed support assembly **88**′ having the aforementioned fingers **87***a*′ and **87***b*′ secured thereto adjacent its opposite ends. Accordingly, the fingers **87***a*′ and **87***b*′ are spaced apart and engage each bag group **26** at transversely spaced locations therealong. The fingers **87***a*′ and **87***b*′ not only reciprocate longitudinally under the influence of the cam-actuated push rod **104**′, they also reciprocate vertically between an upper group-engaging and a lower retracted position in response to energization of the cylinder **97**′. Vertical movement of the fingers is stabilized by a guide rod **91***a*′ secured to the plate **91**′ at spaced locations by brackets **91***b*′ and **91***c*′ which are rigidified by a strap **91***d*′ extending therebetween. A collar **91***e*′ carried by the support assembly **88**′ slidably engages the rod **91***a*′.

Thus, as respects the pusher fingers **87***a*′ and **87***b*′ and components associated therewith, they are substantially the same as the pusher fingers **87***a* and **87***b* heretofore described with reference to the embodiment of the invention illustrated in FIGS. **1** through **16**, and no further description appears necessary except to recall that the fingers will be in their elevated position when displaced forwardly so as to engage and advance each bag group **26** from the accumulator section **23**′ into the compression section **24**′; and they will be retracted into a lower position below the bag group so as to permit the fingers to be displaced rearwardly beneath such bag group in being returned to their initial position. When in such initial position, they are again elevated into their upper position in preparation for another cycle of operation.

It will be appreciated that each bag group **26** so advanced into the compression section **24**′ by the pusher fingers **87***a*′ and **87***b*′ should be supported along the trailing edge thereof during the interval that the pusher fingers are returned to their starting position in preparation for advancing the next successive bag group because the apparatus is inclined, as shown best in FIG. **1**, and as a consequence thereof a rearwardlydirected gravitational force is imparted to each bag group tending to cause the bags thereof to topple as well as collapse rearwardly. In the modified apparatus being considered, such transient support is provided for each bag group by a pair of vertically reciprocable retainer fingers 232*a* and 232*b* which are spaced apart transversely and are located immediately inwardly of the pusher fingers 87*a*' and 87*b*', as shown most clearly in FIG. 21.

Such location of the retaining fingers 232 enables them to be displaced upwardly for engagement with the rearmost bag in a group 26 just advanced by the pusher fingers 87*a*' and 87*b*' prior to retraction of such fingers from contact with such rearmost bag in the group. As a result, there is substantially no interval during which the bags remain unsupported, and it may be observed in FIG. 20 that the retainer fingers 232 are located just rearwardly of the forwardmost position of the pusher fingers 87*a*' and 87*b*', thereby enabling the retainer fingers to be freely movable upwardly while the pusher fingers remain in engagement with the bag group advanced thereby.

The retainer fingers 232, as shown best in FIG. 21, are respectively secured by cap screws or other suitable means to a transversely disposed carrier plate 233 affixed to the upper end of a rod 234 connected with the piston of a piston-cylinder structure 235. The cylinder of the structure 235 is secured to a carrier plate 236 attached to stationary frame components of the apparatus and is thereby constrained against movement. Accordingly, the retainer fingers 232 are simply movable in generally vertical directions between an upper bag-retaining position and a retracted position in which a bag group can be advanced thereover by the pusher fingers 87*a*' and 87*b*'. Clearly, such reciprocable displacements of the retainer fingers 232 are effected in timed relation with the movement of the pusher fingers, as will be described in somewhat greater detail hereinafter. Such displacements of the fingers 232 are stabilized by a guide rod 236*a* secured to the plate 236 at spaced locations by brackets 236*b* and 236*c* which are rigidified by a strap 236 *d* extending therebetween. A collar 236*e* carried by the plate 233 slidably engages the rod 236*a*.

FIGS. 17, 20 and 21 make it evident that a third group of finger members are located adjacent the mergence of the accumulator and compression sections of the apparatus together with the pusher fingers 87*a*' and 87*b*' and retainer fingers 232*a* and 232*b*. Such third group of finger members comprises clamping fingers 130*a*' and 130*b*' which in terms of both structure and function are substantially the same as the clamping fingers 130*a* and 130*b* heretofore described. Therefore, further description of such clamping fingers would appear to be unnecessary, and for correspondence in a structural sense between the two embodiments, particular reference may be made to FIG. 12 for comparison with FIG. 21. It may be recalled at this time, however, that the clamping fingers are normally maintained in the retracted position thereof shown in FIGS. 20 and 21, and when a sufficient number (10 groups totaling 500 bags, in accordance with the previous example) of bag groups 26 have been compressed along the compression section 24' to form a bundle, the clamping fingers 130 are displaced upwardly and into engagement with the rearmost bag in such bundle and the transfer section is then actuated to displace the compressed bundle into position in the banding mechanism 21, as previously explained and as indicated in both FIGS. 1 and 15. During this transfer operation, the pusher fingers 87*a*' and 87*b*' and retainer fingers 232 are retracted from engagement with such bundle of bags.

As mentioned heretofore, the apparatus has an inclined disposition and angles forwardly and upwardly, as shown in FIG. 1, but as a matter of convenience in FIG. 20 the apparatus is depicted in a substantially horizontal position. However, the actual angular disposition is indicated in this FIG. by the axis line A. Such disposition of the apparatus has significance because the mechanism, now to be described, used to prevent the bag groups from collapsing in a forward direction is gravity biased and tends to move from left to right as viewed in FIG. 20. Such mechanism may be referred to as a trolley mechanism or trolley retainer and is generally denoted in FIGS. 20 and 22 with the numeral 237.

The bag groups 26 advanced into and compressed along the compression section 24' are supported on rails 111' and 112' which, therefore, extend longitudinally along the compression section. Respectively secured to such rails in spaced, underlying relation therewith are a pair of rail segments 238 and 239 oriented in substantial alignment with the associated rails and together therewith defining a track along which the trolley mechanism 237 rides. The rail sections 238 and 239 may be secured in their respective positions beneath the rails 111' and 112' by any suitable means as, for example, by means of a plurality of straps 240 and 241, as shown in FIGS. 20 and 21.

Respectively riding along the rail sections 238 and 239 and held in position thereon by the overlying associated rails 111' and 112' are two pairs of rollers 242*a* and 242*b* supported for rotation by a truck 243. Affixed to the truck 243 by capscrews, or other suitable means, and depending therefrom is support structure in the form of a plate 244 to which is rigidly secured adjacent the lower end thereof a motor means in the form of piston cylinder structure 245. Consequently, the cylinder of such structure 245 is rigidly related through the plate 244 with the truck 243 and necessarily travels therewith along the track defined by the rail sections 238 and 239.

The reciprocable piston of the structure 245 is equipped with a rod 246 extending upwardly therefrom which at its upper end is fastened through a transversely oriented plate 247 having bolted or otherwise secured thereto adjacent its opposite ends a pair of biasing or yieldable retaining fingers 248*a* and 248*b*. The plate 247 and fingers 248 carried thereby are evidently reciprocable in generally vertical directions upon energization of the piston-cylinder structure 245, and such reciprocable movements are stabilized by means of a collar 249 secured to the plate 247 and positioned slidably circumjacent a guide shaft 250 affixed adjacent its opposite ends to the plate 244 by brackets 251 and 252 which are rigidified by a connector strap 253.

The trolley mechanism 237 is reciprocable essentially along the entire length of the compression section 24' and is gravity biased toward the infeed end thereof because of the angular inclination of the apparatus. Considering the case in which the transfer section 25' has removed a bundle of bags from the compression section 24' which is, therefore, ready to receive a plurality of successive bag groups 26 so as to form another bundle therefrom, the trolley mechanism 237 will have returned to a position adjacent the infeed end of the compression section and the fingers 248 will be in their upper bag-engaging positions. As the first bag group 26 initiating the formation of the next bundle is advanced into the compression section 24' by the fingers 87*a*' and 87*b*', the leading bag in such first group will engage the fingers 248 and the trolley mechanism 237 will be bodily displaced from right to left, as viewed in FIG. 20, as such bag group is advanced into the compression section. As a result of the yieldable biasing force imparted to such bag group by the trolley mechanism 237, the bag group will be pressed tightly against the pusher fingers 87*a*' and 87*b*' (or against the retainer fingers 232 when the pusher fingers are retracted) and, therefore, the bags of such group cannot collapse either forwardly or rearwardly.

The biasing force developed by the trolley mechanism 237 is continuously applied to the bags being advanced along the compression section, and as each additional bag group is advanced thereinto, the trolley mechanism is pushed forwardly along the section 24'. As soon as a number of bag groups 26 sufficient to form a bundle therefrom have been advanced into the compression section 24', the clamping fingers 130*a*' and 130*b*' are displaced upwardly preparatory to transferring the compressed bundle to the banding mechanism 21, and the piston-cylinder structure 245 is energized to effect retraction of the fingers 248*a* and 248*b*, thereby enabling the compressed bundle of bags to traverse the arcuate path necessitated by movement thereof as the transfer section 25' pivots into the banding mechanism without interference from the fingers **248**. During such transfer of a bundle, it will be clamped adjacent the forward end thereof by the clamping fingers **135a'** and **135b'**, as heretofore explained in connection with the prior described embodiment.

Except for the movements cyclically enforced on the various components of the apparatus because of their mechanical connection with the main shaft **45'**, the operation of the apparatus is controlled by a counter mechanism; and, as heretofore stated, the optical counter **27** used in the embodiment of the apparatus shown in FIGS. **1** through **16** has been replaced by a limit switch counter shown in FIG. **17** and denoted with the numeral **254**. The counter **154** is placed so as to count each bag group **26** advanced from the accumulator section **23'** into the compression section **24'**, and in the case of each bag group comprising 50 bags and each bundle having a total of 500 bags, it will be evident that each operational cycle of the apparatus is initiated following displacement into the compression section of 10 bag groups. Thus, the counter **254** is located generally at the mergence of the accumulator and compression sections, and it may be noted that in the FIG. **17** illustration, the switch **254** is positioned generally at this location but has been shown somewhat rearwardly of its actual position in order that it may be more clearly depicted in this FIG.

The limit switch **254** may be essentially conventional and it is equipped with a depending feeler or actuator arm **255** disposed in the path of movement of the bag groups **26** so as to be engaged by each such group advanced into the compression section **24'**. As each such group engages the actuator arm **255**, it causes the switch to be shifted from open to closed position (or vice versa, in accordance with the particular control circuitry) thereby tabulating such movement of the bag group. A control circuit responsive to a predetermined number of counts or tabulations is operative to energize the various components of the apparatus necessary to shift the compressed bundle from the compression section **24'** into the banding mechanism **21**.

A limit switch **256** (FIG. **19**) is positioned along the rails **111'** and **112'** adjacent the terminal end of the compression section **24'**, and such switch is actuated by the trolley mechanism **237** as it approaches the end of the compression section. Actuation of the switch **256** causes the piston-cylinder structure **245** of the trolley mechanism **237** to retract the retaining fingers **248a** and **248b** thereof, thereby preparing the trolley mechanism for its return to the infeed end of the compression section **24'** preparatory to the start of the next bundle-forming cycle of operation. Typically, the switch **256** is located so that it will be actuated at about the time that the eighth or ninth bag group (assuming again the case in which the bundle being formed along the compression section will constitute 10 bag groups) is being advanced into the compression section. At this time, the clamping fingers **135a'** and **135b'** are in their extended positions and the forwardmost bag engaged by the trolley-retaining fingers **248** will be sufficiently close to the clamping fingers that it will come in contact therewith before the bags adjacent thereto can collapse or slide forwardly.

The cycle of operation of the modified apparatus illustrated in FIGS. **17** through **22** is essentially the same as the cycle of operation of the embodiment of the apparatus heretofore described in detail. However, minor changes in the control circuitry are necessarily included, and in some cases control switches have been located along the main shaft **45'** which has been provided with cams for actuating such switches in the sequence and at the times required to control and initiate the various functions constituting an operational cycle of the apparatus. However, all of these changes are of a conventional and readily apparent character, and for this reason a detailed illustration and description of such minor changes is quite unnecessary.

Reviewing the cyclic operation of the modified embodiment of the apparatus, each cycle is essentially controlled by the counting switch **254** which counts or tallies each bag group **26** being displaced into the compression section **24'** and, in the usual case, the switch is located and arranged so that it indicates or makes the count upon release of the actuator arm **255** thereof by a bag group **26** moving therepast which, at such time, will have been advanced almost completely into the compression section. It will be recalled that the pusher fingers **87a'** and **87b'** and mechanism associated therewith are cyclically displaced between forward and rearward positions because of the cam-controlled actuation of such mechanism imparted thereto via the push rod **104'** and link **105'**. Thus, such pusher fingers are continuously cycled between their forward and rearward positions irrespective of whether a bag group **26** is in position to be advanced thereby and irrespective of whether the counting switch **254** is actuated.

It may be noted that in one particular apparatus, the cam (not shown) for actuating the pusher finger mechanism is configurated so that the mechanism is displaced forwardly from its rearmost position through a predetermined distance (somewhat over 9 inches in such particular apparatus) and then dwells momentarily before being further advanced to its forwardmost location, shown in FIG. **17**, to displace any bag group in engagement with the fingers **87a'** and **87b'** into the compression section. In such particular apparatus, the additional distance through which the pusher fingers are advanced after such momentary dwell thereof is about 6 inches. In all cases after reaching its forwardmost position, the pusher finger mechanism is returned to its starting position by the cam that controls displacement therefor.

In further describing a cycle of operation of the apparatus, it will be assumed as a starting condition that the counter is in its zero or starting position; that the banding mechanism **21** is open and the transfer section **25'** is in its starting position; that the rear retainer fingers **232a** and **232b**, trolley fingers **248a** and **248b**, and clamping fingers **135a'** and **135b'** are all in their uppermost or elevated positions; and that the counting switch **254** and main switch controlling automatic operation of the apparatus are both in the run positions thereof. Then, as the main shaft **45'** rotates, a cam-controlled switch (not shown) associated with the shaft will be actuated to cause the piston-cylinder structure **97'** to displace the pusher fingers **87a'** and **87b'** upwardly into their elevated position. Thereafter, the pusher mechanism is displaced forwardly and if a bag group **26** is in a position to be advanced by the pusher mechanism, the actuator arm **255** of the counting switch **254** will be engaged by such bag group and the switch will be closed and held in closed position until the group has moved therepast, as previously explained. Closing of the counting switch **254** energizes a relay in circuit therewith which in turn actuates a switch-controlling energization of the piston-cylinder structure **235**, thereby causing such structure **235** to retract the rear retaining fingers **232a** and **232b** to clear the path of movement of obstruction so that the bag group is free to move into the compression section **24'**. The pusher mechanism continues to displace the bag group forwardly until it is completely within the compression section **24'**.

As the bag group **26** moves past and thereby releases the actuator arm **255** of the switch **254**, the count of such group is made and the aforementioned relay controlled by the counting switch **254** is deenergized by return of the switch to its open position. At about this time, another cam-controlled switch combination (not shown) arranged with the main shaft **45'** is actuated and effects energization of the piston-cylinder structure **235** in a direction causing the rear retainer fingers **232a** and **232b** to be displaced upwardly into their elevated positions. Since the switch controlling upward movement of the rear retaining fingers **232a** and **232b** is arranged with the shaft **45'**, the switch is closed during each cycle of the apparatus and, therefore, the motor structure **235** is energized and tends to displace the fingers **232** upwardly during each cycle. However, the fingers **232** are retracted downwardly only if a bag group **26** is being advanced into the compression section **24'** by the pusher fingers **87a'** and **87b'**. Thus, in the case that no such bag group is being advanced by the pusher fingers, the retaining fingers 232 will remain in their elevated position and no change in the condition of the apparatus will be affected by such closing of the switch and by the consequent effort of the piston-cylinder structure 235 to displace the retaining fingers 232 upwardly.

Still another cam-controlled switch assembly (not shown) arranged with the main shaft 45' is actuated upon complete displacement of a bag group into the compression section, and such switch causes the piston-cylinder structure 97' to retract the pusher fingers 87a' and 87b' just prior to pusher mechanism being returned to its starting position by the cam-determined action of the push rod 104' and link 105', as heretofore explained. Upon such return of the pusher mechanism, yet another cam-controlled switch combination (not shown) arranged with the main shaft 45' is actuated and causes the piston-cylinder structure 97' to be energized in a direction that elevates the pusher fingers 87a' and 87b', whereupon the pusher mechanism is conditioned for another cycle of operation. The described cycle of operation is then repeated, and each successive bag group 26 is advanced by the accumulator section 23' is advanced into the compression section 24'.

In the event that there is no bag group 26 in a position to be engaged by the pusher fingers 87a' and 87b' as they are displaced forwardly toward the compression section 24', the counting switch 254 is not actuated, no count is recorded, and the rear retaining fingers 232 are not retracted and they remain in their elevated positions to support any bags forwardly thereof along the compression section.

The bag groups advanced into the compression section 24' are confined between the trolley fingers 248 and the rear retaining fingers 232' until the trolley mechanism 237 has been displaced forwardly along the upwardly inclined compression section to a position adjacent the terminal end thereof, whereupon the trolley mechanism 237 actuates the switch 256 which causes the piston-cylinder structure 245 to retract the trolley fingers 248. As explained heretofore, such retraction of the trolley fingers 248 occurs before the final bag group forming a bundle thereof has been advanced into the compression section 24' and, therefore, the trolley mechanism will have been returned by the gravitational force acting thereon to a position adjacent the infeed end of the compression section to assume its being ready for the next cycle of operation.

As the 10th or final bag group is displaced into the compression section and the switch actuator 255 is released, the switch 254 makes its final count and in response thereto the counter mechanism associated with the switch energizes a relay which actuates a switch arranged with the rear clamping fingers 130a' and 130b' and operative to energize the motor means therefor to displace such clamping fingers upwardly for engagement with the final bag in the bundle thereof then positioned along the compression section. This same switch causes the transfer rails 155a' and 155b' to be swung upwardly so as to transfer the bundle of bags then confined between the rear clamping fingers 130a', 130b' and front clamping fingers 135a', 135b' into the banding mechanism 21, as described heretofore with respect to the prior-considered embodiment of the apparatus. Energization of such relay also effects resetting of the counter mechanism to condition it for a further cycle of operation.

As the transfer rails 155a' and 155b' begin to swing upwardly, they actuate a switch (corresponding to switch 202 shown in FIG. 15) which causes energization of the piston-cylinder structure 245 of the trolley mechanism 237 in a direction to displace the trolley fingers 248 upwardly. As a result, the next cycle of operation in which a subsequent bundle of bags is collected along the compression section 24' can start as a prior-formed bundle is transferred into the banding mechanism 21.

Entry of the transfer rails 155a' and 155b' into operative association with the banding mechanism 21 causes a switch (corresponding to switch 193 shown in FIG. 15) located at the banding mechanism to be actuated which results in the front and rear clamping fingers being retracted and operation of the banding mechanism being initiated. As the ram of the banding mechanism approaches the end of its stroke, a switch (corresponding to the switch 195 shown in FIG. 15) is actuated which causes the transfer rails 155a' and 155b' to be displaced outwardly and to swing downwardly into alignment with the compression section 24'; and such downward movement of the transfer rails actuates a switch (corresponding to switch 196 shown in FIG. 15) which effects displacement of the transfer rails inwardly to their initial position, shown in FIG. 21, and also effects displacement of the front clamping fingers 135a' and 135b' upwardly, all as previously described. Thus, an entire cycle of operation has been completed by the apparatus and the subsequent cycles are repetitively effected thereby in the same manner.

The apparatus is equipped with means for operating the compression and transfer sections by manual control to enable a partially formed bundle along the compression section to be completed and transferred into the banding mechanism 21 after operation of the accumulator section has been terminated. In the same sense, the counter mechanism can be reset manually to condition it for another automatic cycle of operation. Such means are not illustrated and they essentially include manual controls to enable appropriate energization of the pneumatic motor means controlling operation of the compression and transfer section.

While in the foregoing specification embodiments of the invention have been set forth in considerable detail for purposes of making a complete disclosure thereof, it will be apparent to those skilled in the art that numerous changes may be made in such details without departing from the spirit and principles of the invention.

We claim:

1. In bundle-forming apparatus, a compression section having an infeed end through which successive groups of collated bags or the like are transferred for collection and formation along said section into a compressed bundle, said compression section comprising longitudinally extending rail structure defining a track along which such successive groups are collected, a transfer device adjacent the infeed end of said compression section and being provided with pusher finger structure movable into engagement with each successive group arriving at such infeed end and being displaceable along said track for advancing each successive group therealong, and movement-limiting stop means provided adjacent the terminal end of said compression section forwardly of such infeed end thereof and defining a limiting position for the advancement of such groups along said track, whereby at cyclically repetitive times occurring whenever the aggregate number of groups being collected along said track is sufficient to define a bundle, the bundle-completing group then being advanced by said transfer device together with the groups forwardly thereof will be compressed between said stop means and pusher finger structure, drive mechanism for said transfer device to cyclically and repetitively displace the same along said track, and clamping means for maintaining such bundle in the compressed condition thereof following withdrawal therefrom of said pusher finger structure.

2. The bundle-forming apparatus of claim 1 and further comprising guide structure extending along said track for confining in transverse directions each such group being advanced along said track.

3. The bundle-forming apparatus of claim 1 in which the pusher finger structure of said transfer device is selectively movable between an extended group-engaging position and a retracted position remote from any such group, and further comprising motor means connected with said pusher finger structure and operable to enforce such movements of said pusher finger structure with respect thereto.

4. The bundle-forming apparatus of claim 3 in which said pusher finger structure comprises a pair of transversely spaced

pusher fingers each movable in enforced synchronism by said motor means between the aforesaid extended and retracted positions.

5. The bundle-forming apparatus of claim 1 in which said movement-limiting stop means includes a stop selectively movable between an extended position in which it projects above said track for engagement by such group and a retracted position below said track and further includes clamping fingers also selectively movable between a group-engaging extended position above said track and a retracted position therebelow, and in which said apparatus further comprises motor means for selectively displacing said stop and clamping fingers in timed relation between the extended and retracted positions thereof.

6. The bundle-forming apparatus of claim 1 in which said compression section further comprises a trolley mechanism movable along said track and having retaining finger structure selectively displaceable between an extended position in which it projects above said track for engagement by the leading bag in the forwardmost group and a retracted position below said track, and motor means for selectively displacing said retaining finger structure between the extended and retracted positions thereof.

7. The bundle-forming apparatus of claim 6 in which said track is inclined upwardly toward the terminal end thereof, and in which said trolley mechanism is freely movable along said track and is gravity biased toward the infeed end of said compression section.

8. The bundle-forming apparatus of claim 7 in which said movement-limiting stop means includes clamping fingers selectively movable between a group-engaging extended position above said track and a retracted position therebelow, and motor means for selectively displacing said clamping finger between such positions thereof.

9. In bundle-forming apparatus, a compression section having an infeed end through which successive groups of collated bags or the like are transferred for collection and formation into a compressed bundle and a transfer section operative to displace each such compressed bundle into a banding mechanism or the like, said sections comprising a longitudinally extending rail structure defining a track along which successive groups transferred through such infeed end are collected, a transfer device adjacent the infeed end of such compression section and being provided with pusher finger structure movable into engagement with each successive group arriving at such infeed end and being displaceable along said track for advancing each successive group therealong, drive mechanism for said transfer device to cyclically and repetitively displace the same along said track, longitudinally extending transfer rails extending generally along the aforesaid rail structure and being adapted to remove therefrom a bundle collected therealong and to transfer such removed bundle from the bundle-receiving position of said transfer rails to a bundle-discharge position adjacent such banding mechanism, motor means for selectively moving said transfer rails between such positions thereof, a pair of clamping structures for confining such a bundle therebetween and being respectively disposed adjacent opposite end portions of said transfer section and movable with said transfer rails thereof between such bundle-engaging and bundle-dishcarge positions, and motor means for selectively displacing said clamping structures between an extended bundle-engaging location above said rails and a retracted bundle-releasing location therebelow.

10. The bundle-forming apparatus of claim 9 in which said transfer rails are transversely displaceable relative to each other between an inner bundle-receiving position for engagement with such bundle supported upon said track to remove the bundle therefrom and an outer position free of any such bundle supported upon said track, and in which said apparatus further comprises motor means for selectively displacing said transfer rails between such inner and outer positions thereof.

11. The bundle-forming apparatus of claim 10 in which said transfer rails are pivotally supported adjacent an end portion thereof for angular displacements between such bundle-receiving and bundle-discharge positions thereof, and in which said apparatus further comprises support structure for such transfer rails including a pivotal support therefor defining an axis about which said transfer rails are angularly displaceable.

12. The bundle-forming apparatus of claim 11 in which said compression section further comprises a trolley mechanism movable along said track and having retaining finger structure selectively displaceable between an extended position in which it projects above said track for engagement by the leading bag in the forwardmost group and a retracted position below said track, and motor means for selectively displacing said retaining finger structure between the extended and retracted positions thereof.

13. The bundle-forming apparatus of claim 12 in which said track is inclined upwardly toward the terminal end thereof, and in which said trolley mechanism is freely movable along said track and is gravity biased toward the infeed end of said compression section.

14. The bundle-forming apparatus of claim 13 in which the pusher finger structure of said transfer device is selectively movable between an extended group-engaging position and a retracted position remote from any such group, and further comprising motor means connected with said pusher finger structure and operable in timed relation with the displacements of said transfer device to enforce movements of said pusher finger structure with respect thereto.

15. In bundle-forming apparatus, an accumulator section having an infeed end and a discharge end and being operative to advance therebetween successive groups of collated bags or the like delivered to such infeed end, a compression section having an infeed end adjacent the discharge end of said accumulator section and through which such successive groups are transferred for collection and formation into a compressed bundle, and a transfer section operative to displace each such compressed bundle into a banding mechanism or the like, said apparatus comprising bag-supporting means interposed between such infeed and discharge ends of said accumulator section and along which such successive bag groups are advanced, conveyor mechanism located along said supporting means for advancing each such group delivered to the infeed end of said accumulator section toward said discharge end thereof, drive means for said conveyor, longitudinally extending rail structure defining a track along which successive groups transferred through the infeed end of said compression section are collected, a transfer device adjacent the discharge end of said accumulator section and infeed end of such compression section and having pusher finger structure movable into engagement with each successive group arriving at said discharge end, said transfer device being displaceable between a group-engaging position adjacent the discharge end of said accumulator section and a group-releasing position adjacent the infeed end of said compression section for transferring each such engaged group therebetween, drive mechanism for said transfer device to cyclically and repetitively displace the same between such group-engaging and group-releasing positions, longitudinally extending transfer rails extending generally along and adjacent the rail structure of said compression section and being adapted to remove therefrom a bundle collected along said rail structure and to transfer such removed bundle from the the bundle-receiving position of said transfer rails to a bundle-discharge position thereof adjacent such banding mechanism, motor means for selectively moving said transfer rails between such positions thereof, a pair of clamping structures for confining such a bundle therebetween and being respectively disposed adjacent opposite end portions of said transfer section and movable with said transfer rails thereof between such bundle-engaging and bundle-discharge positions, and motor means for selectively displacing said clamping structures between an extended bundle-engaging location above said rails and a retracted bundle-releasing location therebelow.

16. The bundle-forming apparatus of claim 15 in which such successive bag groups are delivered to said accumulator section in spaced-apart relation, and in which said conveyor mechanism is equipped with a plurality of spaced-apart fingers carried thereby for movement into a space provided between successive groups and into engagement with the trailing bag of the group forwardly thereof so as to push the same toward such discharge end.

17. The bundle-forming apparatus of claim 16 and further comprising a delay mechanism located adjacent the infeed end of said accumulator section and being equipped with constraining finger structure cyclically displaceable into the path of movement of such successively delivered bag groups in timed relation with the delivery thereof to momentarily restrict movement of each such group and thereby provide a relatively large space between successive groups.

18. The bundle-forming apparatus of claim 17 in which the pusher finger structure of said transfer device is selectively movable between an extended group-engaging position and a retracted position remote from any such group, and said apparatus further comprising motor means connected with said pusher finger structure and operable to extend such pusher finger structure when said transfer device is in the group-engaging position thereof and to retract such pusher finger structure following transfer thereby of a bag group into said compression section.

19. The bundle-forming apparatus of claim 18 in which said transfer rails are transversely displaceable relative to each other between an inner bundle-receiving position for engagement with such bundle supported upon said rail structure to remove the bundle therefrom and an outer position free of any such bundle supported upon said rail structure, and in which said apparatus further comprises motor means for selectively displacing said transfer rails between such inner and outer positions thereof.

20. The bundle-forming apparatus of claim 19 in which said transfer rails are pivotally supported adjacent an end portion for angular displacements between such bundle-receiving and bundle-discharge positions thereof, and in which said apparatus further comprises support structure for such transfer rails including a pivotal support therefor defining an axis about which said transfer rails are angularly displaceable.

21. The bundle-forming apparatus of claim 20 and further comprising a trolley mechanism movable along said track and having retaining-finger structure selectively displaceable between an extended position in which it projects above said track for engagement by the leading bag in the forwardmost group and a retracted position below said track, and motor means for selectively displacing said retaining finger structure between the extended and retracted positions thereof.