United States Patent

Anastasio et al.

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[45] **Feb. 8, 1972**

[54] APPARATUS FOR HANDLING BOOKS

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[21] Appl. No.: **833,985**

[52] U.S. Cl. ..... **214/6 F**, 214/6 H, 214/6 N, 214/6 S, 214/6.5

[51] Int. Cl. **B65g 57/08**

[58] Field of Search ..... 214/6 F, 6 H, 6 N, 6 S, 6.5

[56] **References Cited**

UNITED STATES PATENTS

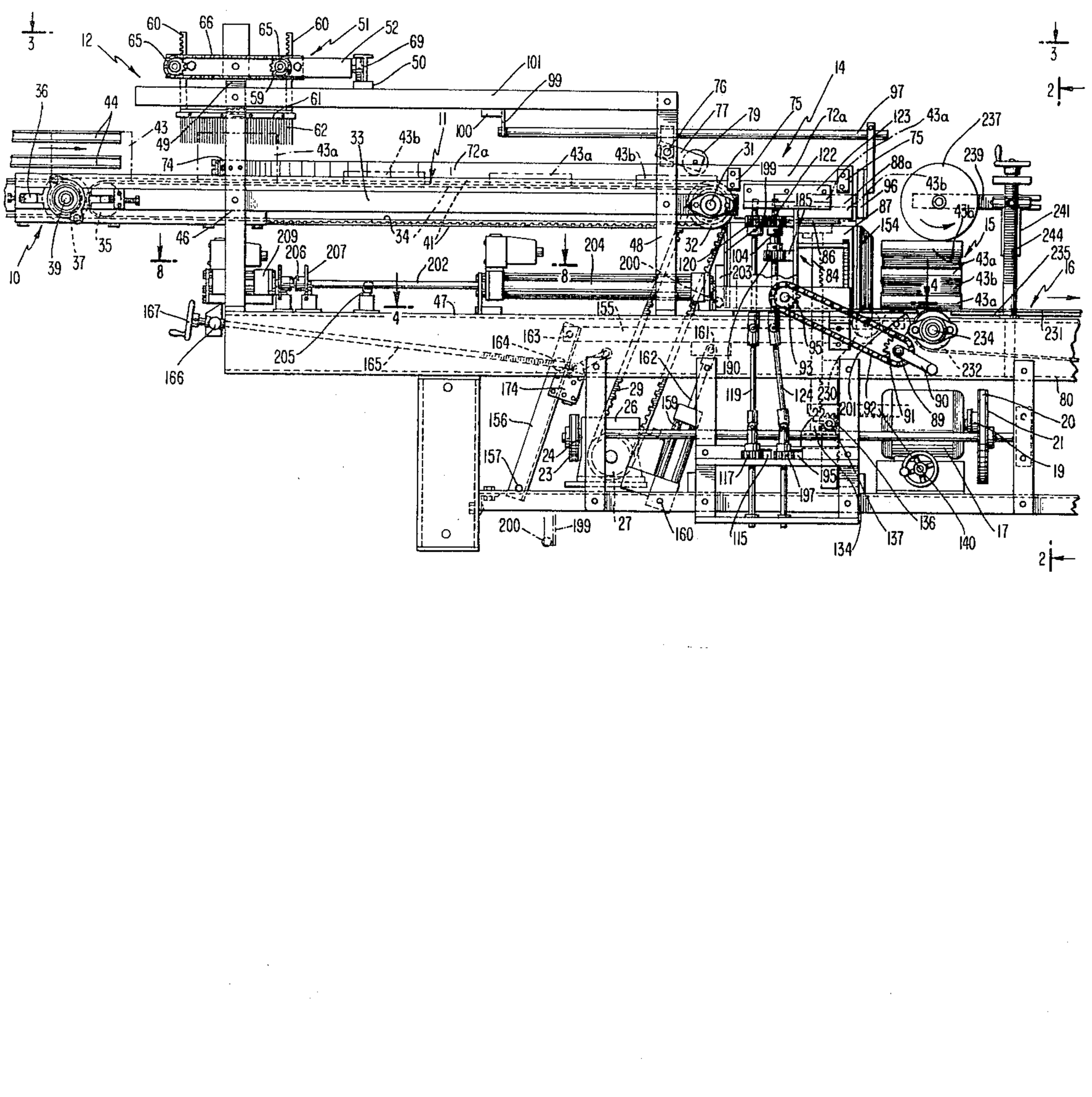
2,602,554	7/1952	Griffith	214/6 S
3,477,591	11/1969	Andersson	214/6.5

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[57] **ABSTRACT**

Method and apparatus whereby books delivered on-edge, spine-up, as by a building-in machine, are alternately tipped in opposite directions on a continuously operating belt conveyor, funneled into alignment and then stacked with the spine joints of adjacent books at opposite sides of the stack and offset to prevent crushing thereof. The progressively formed stacks are progressively lowered on a photocell-controlled elevator, jogged, and then removed to a delivery conveyor while the building of the succeeding stack is begun on an auxiliary retractable platform for subsequent transfer to the elevator.

20 Claims, 10 Drawing Figures



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SHEET 1 OF 6

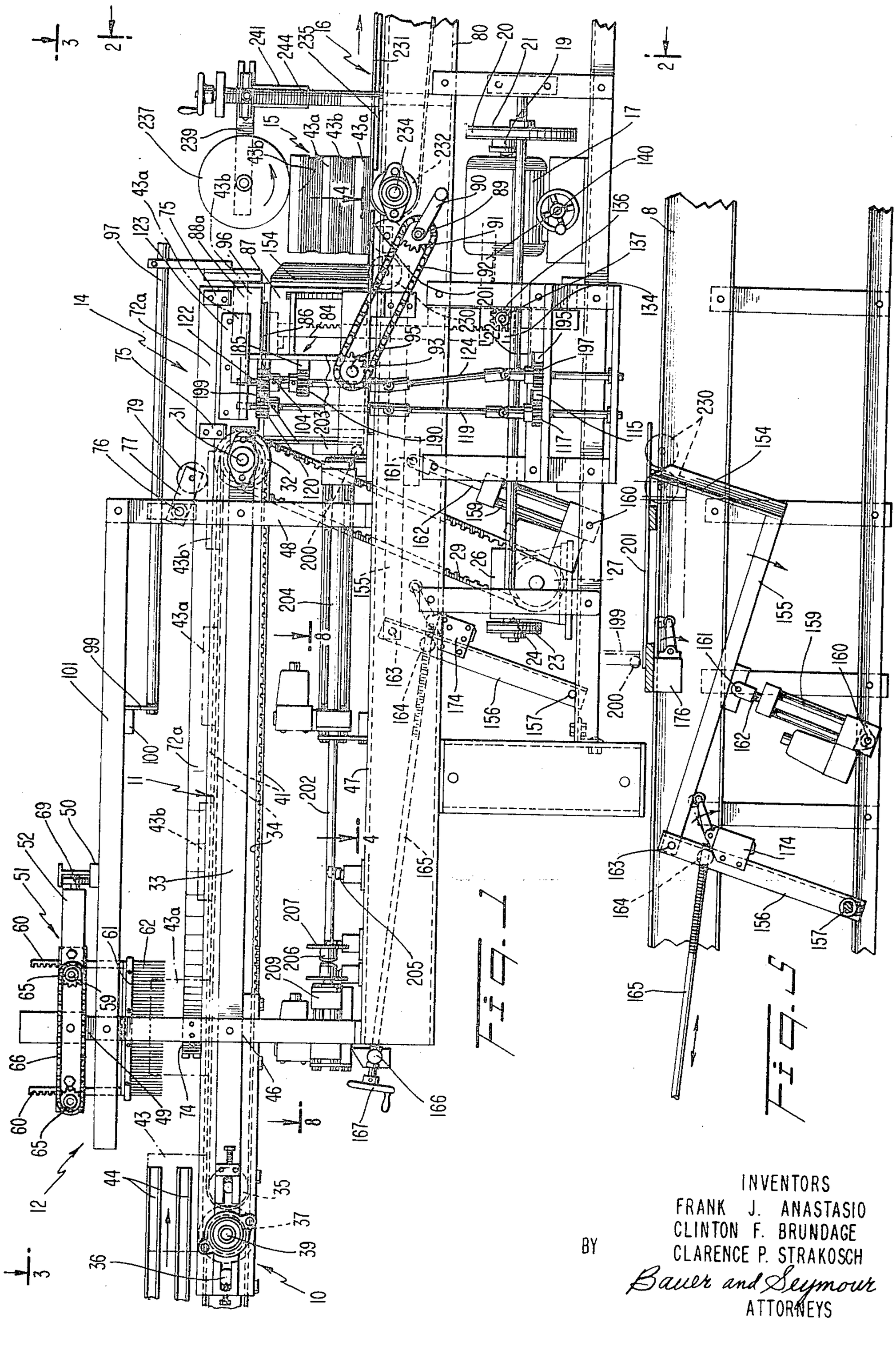


FIG. 1

FIG. 4

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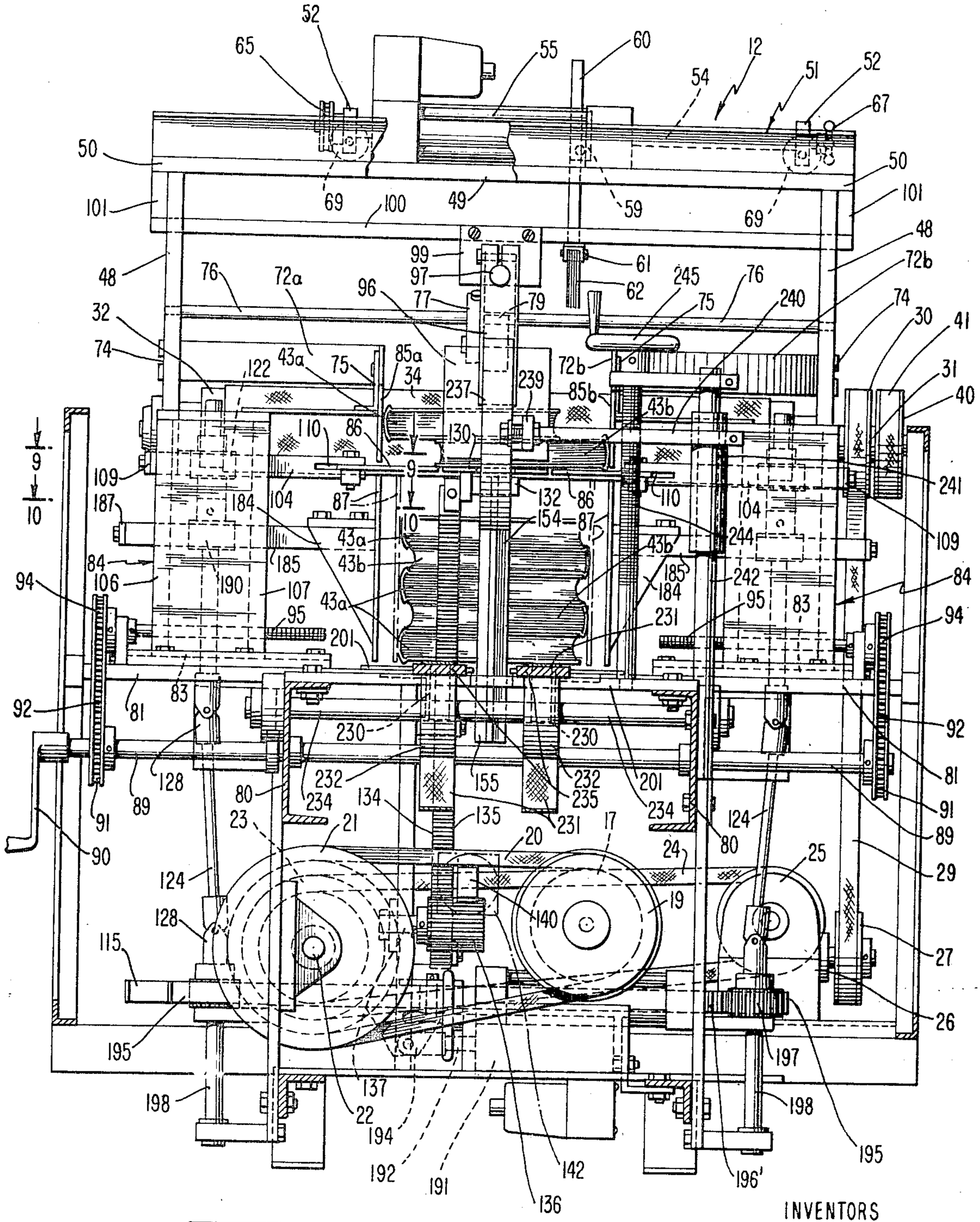


Fig. 2

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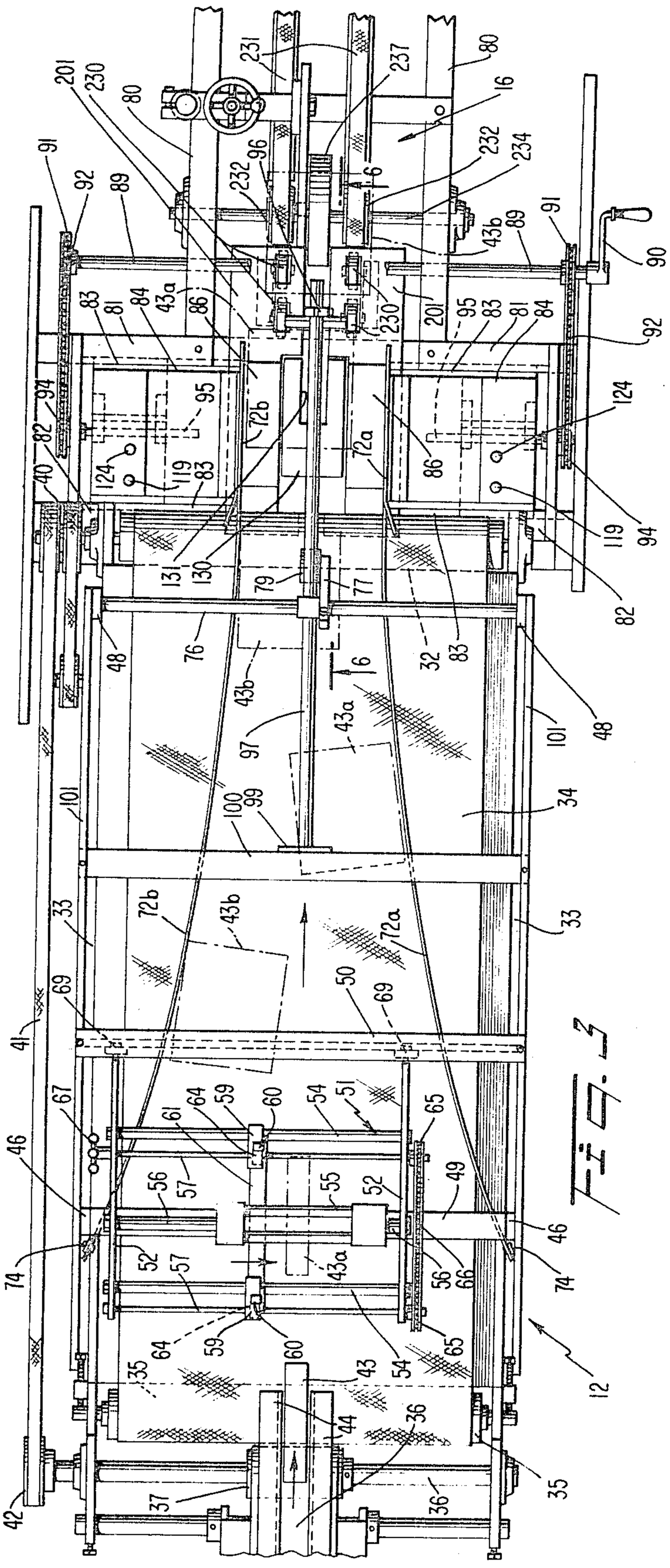


FIG. 2

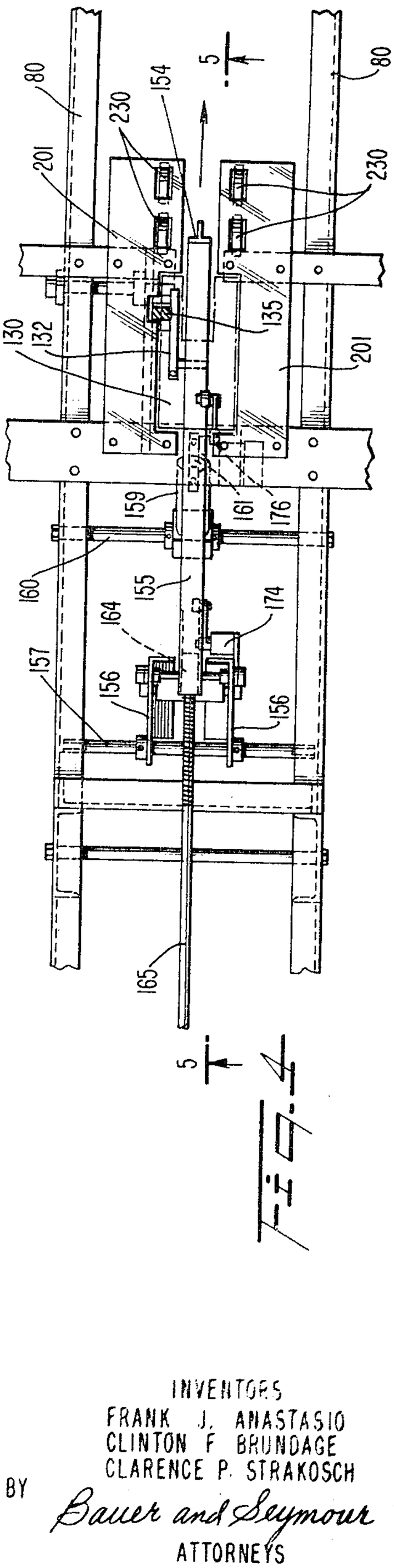


FIG. 4

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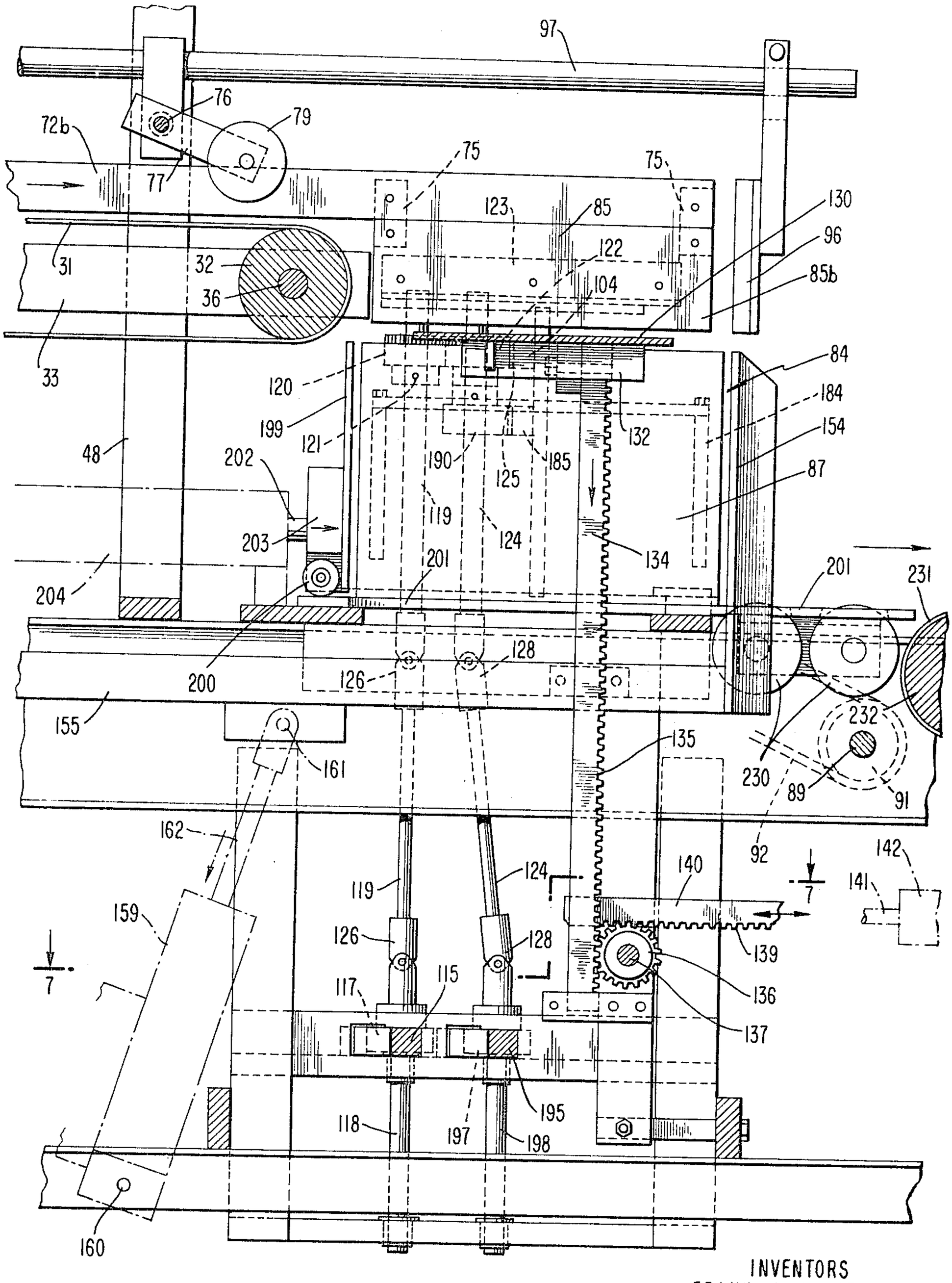


FIG. 6

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Fig. 7

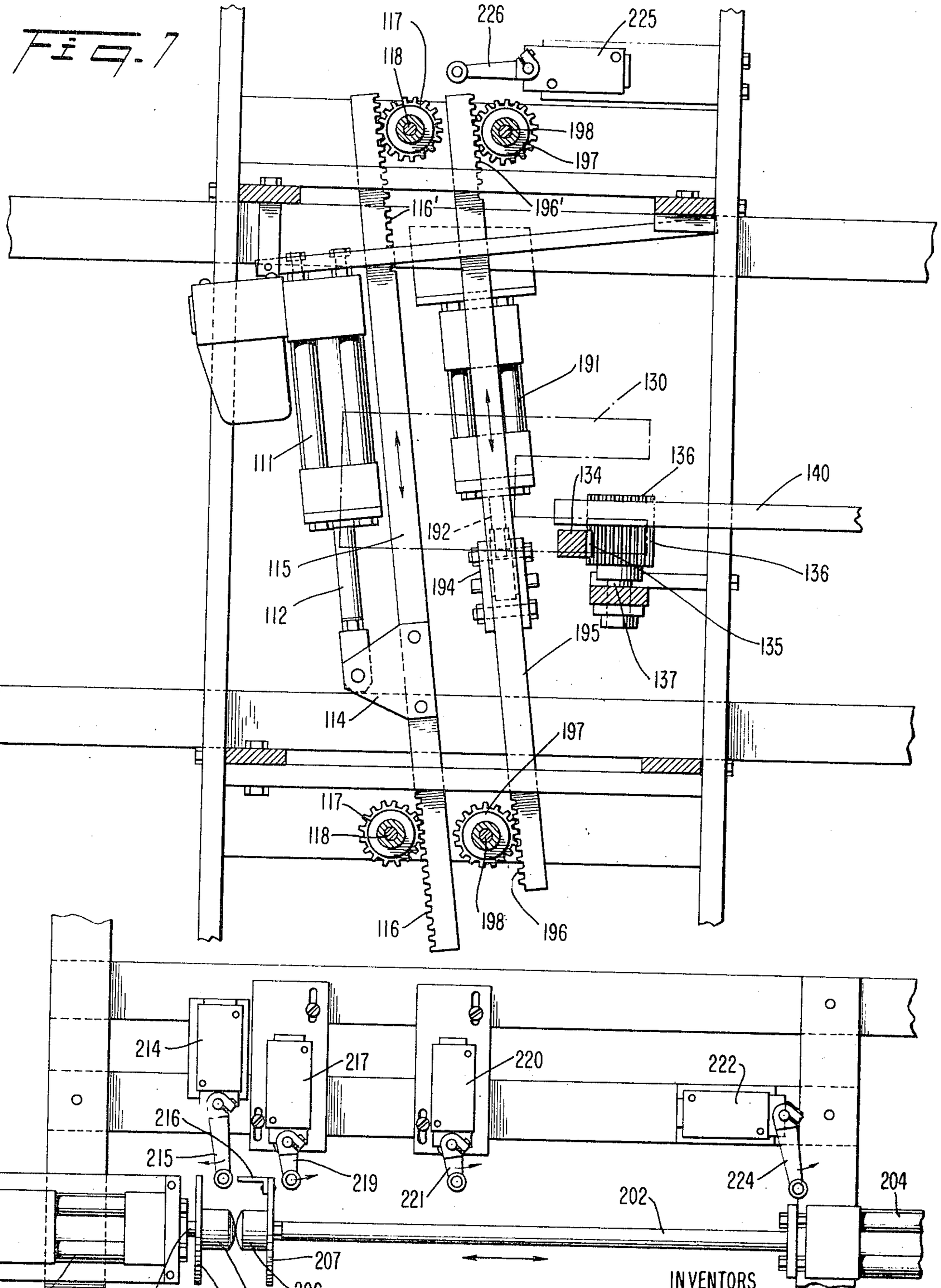


Fig. 8

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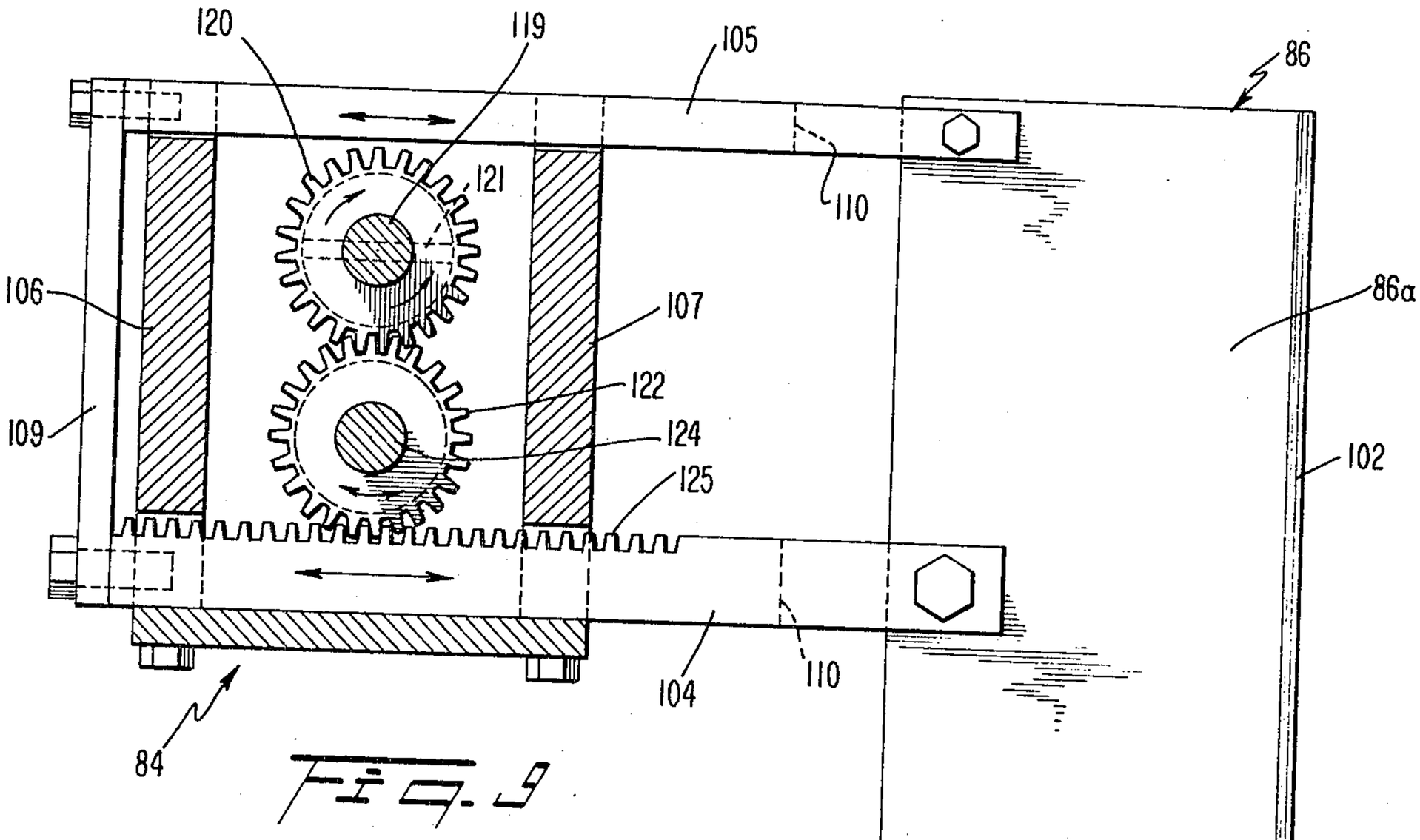


FIG. 9

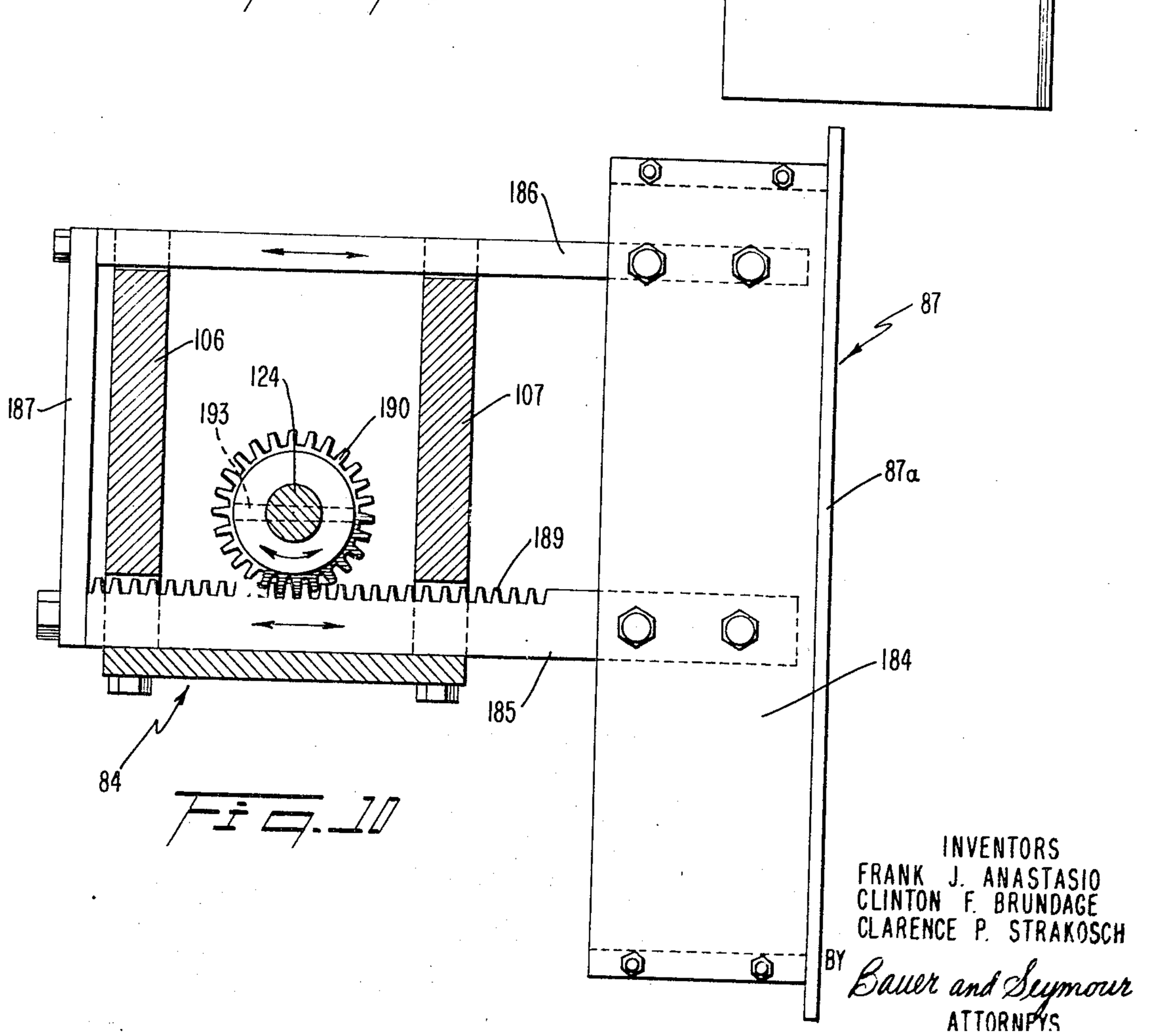


FIG. 10

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APPARATUS FOR HANDLING BOOKS

This invention related to an apparatus for stacking books.

The invention is particularly useful in the stacking of books which are thicker at their backbone or spine joints than throughout the remainder of the area of their covers or case boards. An example of books of this type is that wherein the spine of gathered signatures forming the body or filler of the book is rounded and backed, and the hinges or spine joints between the spine of the case or cover applied to such book body extend somewhat outwardly of the plane of the outer surfaces of the front and back case boards.

An object of the invention is to provide a novel apparatus for the stacking of books.

A further object is the provision of a method of and an apparatus for producing stacks of books wherein the spines of alternate books in the stack lie on opposite sides of the stack and offset slightly in the direction of the spines from the next adjacent book or books.

A still further object of the invention is the provision of a method of and an apparatus for rapidly and accurately producing stacks of books wherein the possibility of crushing the joints between the backbone and case boards is eliminated.

The above and further objects and novel features of the invention will more fully appear from the following description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only, and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

FIG. 1 is a view in side elevation of the book alternator and stacker of the invention, the conveyors for carrying single books in sequence to the alternator and stacker station and for carrying stacks of books away from such station being fragmentarily shown;

FIG. 2 is a view in end elevation of the apparatus shown in FIG. 1, the view being taken from the line 2—2 of FIG. 1, the parts of the stacker being shown in the positions which they occupy after a stack, shown in phantom, pushed from the stacker onto the delivery conveyor and the stack elevator and front stop have been returned to their upper positions, but before retraction of the auxiliary platform;

FIG. 3 is a view in plan of the apparatus shown in FIG. 1, the view being taken from the line 3—3 of FIG. 1;

FIG. 4 is a fragmentary view in horizontal section through the alternator and stacker, the section being taken along the line 4—4 of FIG. 1, the view particularly showing the retractable end stop for the book stacker in retracted position and the mechanism for operating such stop;

FIG. 5 is a fragmentary view in vertical longitudinal section through the alternator and stacker, the section being taken along the line 5—5 of FIG. 4;

FIG. 6 is a fragmentary view in vertical longitudinal section through the stack-forming portion of the apparatus, the section being taken generally along the line 6—6 of FIG. 3, certain of the parts being omitted and others being shown in phantom lines;

FIG. 7 is a view in horizontal section through the lower portion of the apparatus shown in FIG. 6, the section being taken along the line 7—7 of FIG. 6;

FIG. 8 is a fragmentary plan view taken along the line 8—8 of FIG. 1;

FIG. 9 is a fragmentary horizontal section through the stack-forming portion of the apparatus above a partial book-stack-supporting separator or platform blade, the section being taken along the line 9—9 of FIG. 2; and

FIG. 10 is a fragmentary horizontal section through the stack-forming portion of the apparatus above a side presser or jogger for a completed stack of books, the section being taken along the line 10—10 of FIG. 2.

The book alternator and stacker of the invention may be used, for example, at the delivery end of a book-forming or building-in machine from which books are delivered in upright

position with the spines uppermost. As delivered to the alternator and stacker, the books shown have had the backbones thereof rounded and backed and have been cased-in in a known manner. In such books the hinged joints between the spine and the case boards or covers thereof protrude outwardly somewhat beyond the outer surfaces of the front and back case boards. It is therefore desirable, in forming stacks of such books, that alternate books be so offset that the case boards of one book do not overlie the protruding spine joints of the next adjacent book or books. The apparatus of the invention forms stacks of books while offsetting adjacent books so that the spine joints of one are not contacted by the case boards of the other. As will become apparent hereinafter, the method and apparatus of the invention are useful also in stacking books of other types.

Turning now to the drawings, there is shown in FIGS. 1 and 3 a book alternator and stacker 12, 14 which receives spaced books (generally designated 43) in sequence from a first conveyor 10, forms stacks of such books in the manner above generally described, and delivers such stacks 15 to a further conveyor 16. The infeed conveyor 10 may be, for example, the delivery conveyor of a book building-in machine; the conveyor 16 may forward the book stacks 15 to suitable wrapping and strapping apparatus (not shown). The conveyor 10, which is relatively narrow, carries books 43 longitudinally in an upright, on-edge position in the direction of their general plane and deposits them in such position upon a second, wide conveyor 11 disposed in central alignment with conveyor 10. Disposed at the entering end of the continuously operating conveyor 11 there is a book alternator which tips or lays down successive books in opposite lateral directions. As shown in FIGS. 1 and 3, books which have been tipped toward the reader in FIG. 1 are designated 43*a* and those which have been tipped away from the reader in such figure are designated 43*b*. The thus tipped books, one-half of which now lie on their front covers and the other half of which lie on their back covers, are fed forwardly by conveyor 11 and are funnelled by fixed guides, to be described, toward the center line of the conveyor and a book stacking mechanism 14 disposed in central alignment with conveyor 11 and fed thereby. At the stacker 14 the books are formed into a pile or stack; the stack is progressively lowered as books are added thereto. After being lowered the books are jogged laterally inwardly in opposite directions to edge align the sets of alternate books in the stack while leaving one such set laterally offset somewhat from the other set, and all books in the stack are end aligned. The thus treated book stack 15 is then discharged from the stacker to the delivery conveyor 16.

The stacker 14 is so constructed and arranged as to provide normally vertically aligned upper and lower book receiving channels, the upper channel being periodically separated from the lower channel by laterally reciprocable, vertically fixed book supporting or separator blades 86. This permits the upper channel continuously to receive books delivered thereto from the book alternator conveyor 11 while a completed stack of books 15 in the lower channel is lowered by a vertically reciprocable book supporting elevator or platform 130 in such lower channel, is edge and end aligned while supported by the platform and is discharged from the stacker. Upon discharge of the stack, the platform 130 rises, the separator blades 86 are retracted, and the support of the partial book stack in the upper channel is thus transferred to the elevator platform 130. The cycle is then repeated.

THE MECHANICAL DRIVE

The conveyors 10 and 11 are driven by a motor 17 as shown in FIGS. 1 and 2. A motor drive pulley 19 is connected by a belt 20 to a large driven pulley 21 affixed to the forward end of a countershaft 22 which extends longitudinally of the stations 12, 14. A pulley 23 is affixed to the rear end of shaft 22, such pulley driving a speed reducer 26 (FIG. 2) through the medium of a Timing belt 24 which is entrained over the pulley 23

and a pulley 25 on the speed reducer. The speed reducer 26 in turn drives the conveyor 11 through the medium of a Timing belt sprocket 27 on the output shaft of the speed reducer, and a Timing belt 29 entrained over a sprocket 30 on the shaft 31 which carries the forward elongated drive pulley or roll 32 of the conveyor 11. Conveyor 11 has a wide belt 34 which runs over the roll 32 and a roll 35 at the rear end thereof as shown in FIGS. 1 and 3, the rolls 32 and 35 being journaled upon spaced parallel side frame members 33.

The infeed conveyor 10 has a narrow belt 36 (FIG. 3) which runs over a forward drive pulley 37 on a shaft 39 and over a similar pulley (not shown) at the rear of the belt. Belt 36 is driven in synchronism with and at the same speed as the belt 34 of conveyor 11 through the medium of a pulley 40, affixed to shaft 31 of conveyor 11, and a longitudinally extending Timing belt 41 which extends to a pulley 42 on the shaft 39 of conveyor 10. The books 43 are carried by conveyor 10 in upright, spine-up position between opposed side guides 44 which may be adjusted by means not shown to accommodate books of different thicknesses. Books 43, still in upright position, enter upon the conveyor 11 whereby they are carried to the alternator 12 free from lateral guidance. After the books have been tipped or laid down by the book alternator 12 in a manner to be next described, conveyor 11 carries them to the book stacker 14.

THE BOOK ALTERNATOR 12

The side frame members 33 of the conveyor 11 are carried by opposed rear and forward upright frame members 46 and 48, respectively, such uprights in turn being mounted upon a longitudinal frame 47. The upper ends of uprights 46 are connected by a horizontal cross frame member 49; member 49 and a similar forward cross member 50 connected to upper frame members 101 serve to support and guide a laterally reciprocable frame 51 of the alternator 12. Frame 51 has similar spaced parallel, longitudinally-extending side members 52 which are connected and spaced by tie rods 54. A double acting reciprocable fluid motor 55 having the cylinder thereof disposed above and connected to the cross member 49 has a piston rod 56 which extends through the opposite ends of the cylinder, the outer end of rod 56 being connected to members 52 as shown. The reciprocable frame 51 is partially supported by the double-ended piston rod 56 and is also partially supported by and guided by channel-shaped crossmember 50, there being rollers 69 journaled on the forward ends of the side frame members 52 which ride in the channel of member 50 as shown in FIGS. 1 to 3. It will be apparent that upon the alternate admission of fluid under pressure to the opposite ends of the motor 55 and the exhausting of fluid from the other, the piston rod 56 and the frame 51 reciprocate in a direction transverse to the lengths of the conveyors 10 and 11.

Mounted upon the frame 51 substantially midway between the side members 52 thereof, there is a horizontal longitudinally extending support member 61 from which brush 62 or comparable means depends. The brush holder 61 and brush 62 are so located that when the piston rod 56 of the motor 55 is at one end of its stroke the brush lies on one side of the path of books delivered to the alternator 12 on the conveyor 11 and that when the piston rod 56 is at the other end of its stroke the brush 62 lies on the other side of books delivered to the alternator 12. The brush holder 61 and brush 62 are vertically positioned as shown in FIG. 1 so that the brush, when reciprocated laterally, may engage the books below the spines thereof. It will be apparent that successive books pivot about the lower laterally outer edge of their respective opposite lower edges so as to fall in opposite directions depending upon the side thereof engaged by the moving brush.

The brush holder 61 and brush 62 are vertically adjustable to cooperate with books of different widths, that is, heights as the books 43 are presented thereto. Parallel longitudinally spaces shafts 57 span the opposite side members 52 of frame 51 and are journaled therein (FIG. 3). Mounted upon the respective tie rods 54 and shafts 57 are housings 59 within which similar vertical racks 60 are guided, there being a pinion 64 in each of the housings keyed to its shaft 57 and similarly meshing with the teeth on the respective racks 60. Shafts 57 are drivingly connected by a chain 66 which runs over similar sprockets 65 on corresponding ends of the shafts; the shafts 57 are turned in the same direction and in equal amounts simultaneously to adjust the racks 60 vertically in the same amount by means of a hand wheel 67 attached to one end of a shaft 57.

The motor 55 for reciprocating the frame 51 and brush 62 is under the control of a photocell (not shown) which may be disposed on one side of the path of travel of books as they emerge from the conveyor 10. When the photocell is darkened by a book travelling between it and its light source, the motor 55 is energized so as to travel into a terminal position opposite from that which it then occupies. In so doing, the brush 62 engages the book, designated 43*a* in FIG. 3, which is then passing so that such book is tipped toward the reader in FIG. 1. The next book 43*b* emerging from conveyor 10 again darkens the photocell and causes the motor 55 to operate in the reverse direction so that successive books 43*a* and 43*b* are alternately tipped or laid down in opposite directions by brush 62.

As the tipped books 43*a* and 43*b* are carried forwardly by belt 34 of conveyor 11, their backbones or spines engage the inner vertical surfaces of respective smoothly converging but oppositely disposed similar longitudinal guide members 72*a* and 72*b* which lie above the upper run of the belt 34. Guides 72*a* and 72*b* are made of somewhat flexible self-sustaining strip metal, the rear ends of the guides being connected at 74 to uprights 46 and the forward ends thereof being connected by straps 75 to side guide members 85 at the opposite sides of the stacker 14 shown in FIG. 2. Members 85, to be more specifically described hereinafter, define the sidewalls of an upper channel in stacker 14, and may be adjusted laterally toward and away from each other in order to accommodate books of different widths. Since the forward ends of the flexible guides 72*a* and 72*b* are connected to the respective members 85*a* and 85*b*, the forward ends of the guides are correspondingly laterally adjusted.

It will be apparent that as the conveyor belt 34 carries books 43*a* and 43*b* forwardly, the forward laterally outer corners of the books 43*a*, 43*b* engage the respective guides 72*a*, 72*b*; the books are progressively thrust sidewardly or funnelled by such guides toward the longitudinal center line of the belt 34 so that they enter the upper end of the stack defining means, made up in part of the forward ends of guides 72*a*, 72*b* and sidewall members 85*a*, 85*b*. Such members and the forward ends of said guides are disposed at equal distances on opposite sides of the longitudinal center line of conveyor 11 and are spaced apart a distance which appreciably exceeds the widths of the books being stacked; as a result, sets of alternate ones of the books in the upper channel portion of the stacker lie laterally offset in opposite directions an appreciable distance with respect to the longitudinal center line of the conveyor 11 and of said channel portion, as illustrated in FIG. 2.

THE STACKER 14

As the books 43*a*, 43*b* travel forwardly upon conveyor 11, their upper surfaces are engaged by a gravity actuated presser roll 79 which is journaled on the free end of a lever 77 pivotally mounted on a fitting secured to a cross bar 76 mounted on the upper ends of the uprights 48. Roll 79 holds the books down against the conveyor belt 34 and prevents premature tilting thereof over the end of belt 34 to insure their most desirable entry into the stacker channel onto the supporting platform, or the book stack. The stacker 14 is mounted upon fixed framework including members 47 disposed beneath the conveyor 11 and further less widely spaced frame members 80 forwardly of the stacker which underlie and support the conveyor 16. Frame members 47 and

80 are connected by cross frame members 81 which lie forwardly of the stacker and by similar transverse frame members 82 which are spaced rearwardly from members 81 at the rear of the stacker. Transversely extending guideways 83 are provided upon the upper surfaces of members 81 and 82 on both sides of the stacker. Similar but oppositely disposed carriages 84 are supported for lateral adjustment upon and guided by the guideways 83. Frames or carriages 84 support the above-mentioned upper sidewall members 85.

Beneath the lower edges of the sidewall plates 85 there are disposed horizontal separator blades 86 which are laterally reciprocable and extend into the book receiving channel when the parts are disposed as shown in FIGS. 2 and 3. When thus disposed, the blades 86 constitute an auxiliary or temporary support or platform for several books in the upper end of the stacker channel. The sides of the lower portion of the book-receiving channel of the stacker, below the level of the separator blades 86, are formed by spaced side guide or jogger plates 87, which are moved inwardly or jogged in order to dispose the books in the lower end of the stack with the desired degree of lateral offset from the longitudinal central vertical plane of the stack, before the discharge of the stack from the stacker.

As above explained, the carriages 84 are laterally adjustable in opposite but equal distances from the longitudinal central vertical plane of the conveyor 11 and the stacker so that the stacker may accommodate books of different widths. A cross shaft 89 (FIGS. 1 and 3) suitably journaled in the frame members 80, may be turned by a crank 90 affixed to one end thereof (FIGS. 1 and 3). The opposite ends of the shaft 89 have similar sprockets 91 affixed thereto, there being chains 92 connecting the respective sprockets 91 to sprockets 94 on the outer ends of oppositely disposed horizontal adjusting screws 95 of opposite hand. The outer ends of such screws are journaled in the fixed frame of the apparatus, whereas the laterally inner threaded portions thereof are threadedly received in nuts affixed to each of the respective carriages 84. It will be seen that the turning of the crank 90 in one direction adjusts the carriages 84 toward each other, whereas the turning of the shaft in the opposite direction further separates the carriages.

Centrally above the book receiving channel of the stacker 14 there is a horizontal longitudinally extending rod 97 which is suitably supported upon the fixed frame structure of the apparatus. One such support for the rod includes a bracket 99 affixed to the rear end thereof, the bracket being secured to a cross member 100 affixed to the longitudinal frame members 101. Another support for rod 97 is the bar 76. The forward end of rod 97 carries a transversely extending vertical plate 96, the lower edge of which lies substantially coplanar with the upper surface of blades 86. Member 96 forms an end stop for books fed into the upper portion of the book receiving channel of the stacker as shown in FIG. 2. When the separator blades 86 are in their inner position as shown in FIG. 2, books 43*a*, 43*b* are deposited into the upper end of the channel by the belt 34, the forward end of which lies slightly to the rear of the rear end of such channel. The thus deposited books fall into the channel, the lowermost one of such books lying upon the blades 86. The blades 86 lie a sufficient distance below the upper surface of the conveyor belt 34 so that the upper portion of the channel can accommodate a plurality of books. In the embodiment shown, the upper portion of the channel, above the blades 86, is capable of receiving at least three relatively thick books. As above indicated, during the time that such three books are being deposited upon the blades 86, a previously deposited stack of books in the lower portion of the channel of the stacker on elevator platform 130 are sidewardly aligned, end aligned, and discharged as a neat stack 15 from the stacker, and elevator 130 is returned to its elevated position (FIGS. 2 and 6).

THE SEPARATOR BLADES 86

The separator blades **86** are particularly shown in FIGS. **2**, **3**, and **9**. As shown in FIG. **9**, which is a section through the left-hand (FIG. **2**) carriage **84**, such blades have broad horizontal extents, the upper laterally inner edges of the blades being beveled at **102**. Secured to blade **86** are a horizontally reciprocable rack bar **104** and a parallel guide bar **105**, such bars having their outer ends extending through guiding slots and holes in vertical parallel frame members **106** and **107** of the carriage **84**. The outer ends of bars **104** and **105** are connected by a longitudinally extending strap member **109**. The blade **86** is secured to the inner ends of bars **104** and **105** by being received within slots **110** therein and bolted thereto as shown.

The separator blades **86** are moveable from their laterally inner position shown in FIGS. **2** and **3**, wherein they are shown supporting books in the upper portion of the stacker channel, to an outwardly retracted position in which their inner edges **102** lie at least slightly outwardly beyond the inner faces of the side guide members **85**. The separator blades are moved between such positions by a reciprocable fluid motor **111** (FIG. **7**) which is disposed horizontally beneath the stacker **14**. Motor **111** has a piston rod **112** which is connected to a horizontally reciprocable rack bar **115** by a bracket **114**. The rack bar **115** has a rearwardly facing rack gear **116** on one end thereof and a similar but oppositely facing rack gear **116'** on the other end. Rack gear **116** meshes with a pinion **117** which is connected to a vertical stub shaft **118** which is journaled in the fixed frame of the apparatus. A generally vertically extending shaft **119** which includes two universal joints **126** therein rises from the pinion **117** as shown in FIG. **6**. The upper end of shaft **119** is journaled in and supported by a bracket **123** which is secured to the upper portion of carriage **84**. Fixedly secured by a cross pin **121** to the upper end of shaft **119** beneath the bracket **123** is a pinion **120**. It will be seen that as the piston of motor **111** moved in opposite directions the pinion **120** is turned in opposite directions.

The pinion **120** meshes with a pinion **122** which is journaled upon and freely rotatable with respect to the upper end of a shaft **124** which is mounted parallel to the upper end of shaft **119**. The pinion **122** meshes with a rack gear **125** on the rack bar **104**. The driving connection between the rack gear **116'** and the separator blade **86** mounted on the right-hand (FIG. **2**) carriage **84** of the stacker is the same as that above described the exception of the reversal of positions of the rack gears **116**, **116'** with respect to pinions **117** to cause the opposed separator blades **86** to move simultaneously in opposite directions.

THE BOOK STACK ELEVATOR

Fitting between the inner edges **102** of the opposed separator blades **86** when such blades are in their laterally inner positions as shown in FIG. **3** is a horizontal elevator platform **130**. Such platform has a central forwardly open notch **131** therein which freely receives a retractible end stop **154** which may be swung downwardly from the position thereof shown in FIG. **1** to that shown in FIG. **5**. The platform **130** has a bracket fitting **132** secured to the bottom thereof, the fitting serving to connect the upper end of a vertically reciprocable elevator rack bar **134** to the platform, as shown more particularly in FIG. **6**. The bar **134** has a forwardly facing rack gear **135** thereon, such rack gear meshing with a rotatable pinion **136** which is mounted on a horizontal stub shaft **137**. Pinion **136** also meshes with a rack gear **139** on a horizontally reciprocable rack bar **140** which is connected to the piston rod **141** of a double acting reciprocable fluid motor **142** as indicated in FIGS. **2** and **6**. It will be apparent that upon the thrusting of the piston rod **141** and bar **140** to the left in FIG. **6** the elevator platform **130** is lowered and that upon the travel of such piston rod to the right the elevator platform is raised. The actuation of piston rod **141** is automatically controlled in a manner to be hereinafter described to insure proper timing

and sequencing with other parts of the apparatus. In general, after retraction of auxiliary platform **86**, **86** elevator **130** is moved down step-by-step as books are added to the stack until the desired number are present. The elevator is then moved down quickly to unloading position (FIG. 2), unloaded in a manner to be described, and returned quickly by motor **142** to its raised position (FIG. 6).

RETRACTIBLE BOOK STOP 154

As illustrated in FIG. 1, the end stop **154** is disposed with its rear face coplanar with and beneath the rear face of fixed end stop **96**. After the desired number of books have been formed into a stack on elevator **130**, as detected by suitable known counting means, such stack of books is thrust forwardly by a vertical plunger plate **199** through a small distance so that their forward ends engage the stop **154**, thereby vertically aligning the ends of the books. Immediately thereafter, the opposed side guide or jogger plates **87** which defines the sides of the lower portion of the channel of the stacker **14** are thrust laterally inwardly through a small distance to vertically align the spines of alternate books and bring the stack to the condition shown in FIG. 2. All of such functions are effected by suitable known types of detection means and sequencing controls.

The retractible end stop **154** is mounted upon the forward end of an elongated generally longitudinally extending lever arm **155** which lies substantially horizontal when the parts are in the position of FIG. 1. The rear end of the lever are **155** is secured to an upwardly and forwardly inclined lever composed of two similar parallel levers **156** (FIG. 4), the lower ends of which are pivotally mounted to the fixed frame of the apparatus at **157**. Adjustment of the angularity of the lever **156**, in a manner to be described, permits adjustment of the stop **154** in a direction longitudinally of the stacker for books of different lengths so that crushing of the books by plunger **199** will be avoided. The upper book stop **96** is releasably clamped on rod **97** for similar adjustment (FIG. 2). The lever arm **155** and the stop **154** are oscillated from their elevated position of FIG. 1 to their retracted or lowered position of FIG. 5 by a double acting reciprocating fluid motor **159**. The lower end of such motor is pivotally mounted to the frame at **160**, the piston rod **162** of the motor being pivotally connected at **161** to an intermediate portion of the lever **155**.

As shown in FIG. 4, the lever arms **156** are connected at their upper ends by a cross bar **164**. A longitudinally extending threaded adjusting rod **165** has its forward end threadedly received in a fitting mounted on bar **164**. The rear end of rod **165** is journaled in the frame of the apparatus at **166**. A hand wheel **167** on the rod rearwardly of the bearing **166** permits the rod to be turned in the desired direction relative to said fitting so as to change the angularity of the lever arm **156**. As arm **156** is inclined further away from the vertical in FIG. 1, the connection **163** and hence the end stop **154** are moved forwardly; conversely, adjustment of the arm **156** closer to the vertical moves the stop **154** rearwardly. For purposes to appear hereinafter, the movements of the retractible stop **154** into its elevated and retracted positions are relied upon to operate a switch **174** having an operating arm **175** mounted on lever arm **156** and a switch **176** having an operating arm **177** is actuated by the lever **155**.

THE SIDE JOGGERS

Since the side jogging plates **87**, which are disposed on opposite sides of the lower portion of the book receiving channel of the stacker **14**, are similar to each other and are operated by identical mechanism, a specific description of the joggers carried by the left-hand (FIG. 2) carriage **84** will suffice. The side guide plate **87** is mounted in vertical position on a bracket **184** which in turn is secured to the end of a horizontally reciprocable rack bar **185**. As shown in FIG. **10** the outer end of the rack bar **185** is guidingly received in passages through the vertical parallel plate members **106**, **107** of the carriage **84** (FIG. **10**). A guide bar **186** disposed parallel to bar **185** is also secured to the bracket **184** and is guided by the members **106**, **107**. The outer ends of bars **185**, **186** are connected by a strap **187**. The plate **87**, the bracket **184**, and the bars **185**, **186** of the opposite carriages **84** are moved laterally inwardly in opposite directions through equal distances at substantially the same time that the book stack **15** is being thrust forward against the stop **154**. Immediately thereafter front stop **154** and the plates **87** are retracted and the side aligned books forming the stack **15** are thrust forwardly onto the conveyor **16** by pusher **199**.

Each plate **87** of the side jogger means is moved inwardly and outwardly between the full and dotted line positions in FIG. 2 by the following mechanism. A rack gear **189** on bar **185** meshes with a pinion **19o** which is affixed to the shaft **124** by a pin **193**. The shaft **124** is turned in opposite directions by a double acting fluid operated reciprocable motor **191** (FIG. 7) which is disposed beneath the stacker and close and parallel to the above described motor **111**. The piston rod **192** of motor **191** is connected through a fitting **194** to a horizontally reciprocable rack bar **195**. The left-hand end of bar **195** as it is shown in FIG. 2 carries a rearwardly facing rack gear **196** whereas the right-hand end of such bar carries a forwardly facing rack gear **196'**. Rack gear **196** meshes with a pinion **197** which is journaled on the upper end of a vertical stub shaft **198** (FIG. 6) affixed to the frame parallel to the shaft **118**. The lower end of the shaft **124** is connected to the pinion **197**. As shown, shaft **124** includes serially disposed universal joints **128** which permit the drive between the pinion **197** and the pinion **190** to be preserved despite laterally adjustment of the carriage **84**. The disposition of the rack gears **196**, **196'** on opposite sides of bar **195** permits the opposite jogger plates **87** to be moved laterally inwardly toward each other upon movement of the piston rod **192** of motor **191** in one direction and to be retracted outwardly upon movement of such piston rod in the opposite direction.

THE BOOK STACK PUSHER

The vertically disposed pusher platen **199** forms the rear wall of the lower portion of the book receiving stacker channel when the parts of the apparatus are disposed as in FIGS. **1** and **6**. Such platen is secured to a carriage **203** which is supported for longitudinal reciprocation by guide wheels **200** which travel along a horizontal supporting plate **201**. The carriage **203** is secured to the forward end of the piston rod **202** of a double acting reciprocable fluid motor **204** (FIGS. **1** and **8**) which is disposed longitudinally of the apparatus beneath the conveyor **11**. Piston rod **202** extends in both directions from the cylinder of the motor **204**, the rearwardly extending portion of said piston rod being supported upon a roller guide **205** as shown in FIG. **1**. The rear end of piston rod **202** is provided with an abutment cap **206** (FIG. **8**), such cap being provided with a flange **207** on its forward end. A further, relatively short, fixed stroke double acting reciprocable fluid motor **209** is disposed rearwardly of and in alignment with the motor **204**. The piston rod **211** of motor **209** has an abutment cap **210** thereon, such cap having a flange **212** on its rear end. When elevator **130** is lowering a completed stack **15** to unloading position ready for vertical alignment as described above, motor **209** is first actuated so as to thrust its piston rod **211** against the abutment cap **206** and thereby to thrust the piston rod **202** of the motor **204** with platen **199** forwardly with sufficient force to override the then opposing fluid pressure in motor **204** to move the stacked books gently against the stop **154** to effect substantial end alignment. Following this and after the stop **154** has been retracted by motor **159** and the side jogger plates **87** have been moved laterally inwardly to side align alternate books, the motor **204** moves the pusher platen **199** further to the right as viewed in FIG. **1** and between jogger plates **87** so that the book stack **15** is fully discharged from the stacker and supported upon the conveyor **16** (FIG. **1**). It will be understood that as soon as a completed

stack 15 is lowered for jogging and discharge, the auxiliary platform plates 86 are temporarily moved in to catch the next few incoming books from conveyor 11.

The platen 199 pushes the stack of books 15 to the right across the plate 201 and onto rollers 230 which protrude upwardly through slots in said plate to facilitate such travel of the stack. The stack then enters upon laterally spaced similar belts 231 of the conveyor 16, such belts being driven by means not shown. Idle pulleys 232 affixed to a rear shaft 234 of conveyor 16 support the rear ends of the belts 231; similar driven pulleys (not shown) engage and drive the belts 231. Such belts travel across and are supported by longitudinally extending plates 235 which underlie them.

In the initial portion of its travel on the conveyor 16 the stack is engaged at its upper end by a presser roll 237 which is preferably of soft resilient character, being made, for example, of soft sponge rubber. The roll 237 is mounted upon a longitudinally extending arm 239 (FIG. 1) which is affixed to a lateral arm 240 to which a vertical sleeve 241 is secured. Sleeve 241 slides upon a fixed vertical post 242. The arm 240 intermediate the sleeve 241 and the arm 239 has a vertical threaded passage therethrough, such passage threadedly receiving a vertical screw 244 which is journaled at its upper end against vertical motion. A hand wheel 235 on the upper end of screw 244 permits the arms 239, 240 and the sleeve 241 to be adjusted vertically in response to rotation of the screw, thereby permitting the roll 237 to engage the upper end of the stack 15 with the desired amount of pressure so as to press the stack securely against the infeed ends of belts 231 of conveyor 16.

SEQUENCING CONTROLS

The operating sequence of the various elements of the stacking means of the apparatus is preferably effected by electrical and pneumatic means, the latter being in the form of fluid motors described above. The electrical controls include switches 174 and 176 operable by bar 155 when front stop 154 is in its terminal down and up positions, respectively (FIG. 5). A switch 214 having an arm 216 is actuated by a bar 212 on the forward stroke of piston rod 211 (FIG. 8). Switches 217, 220 and 224 are operable, for purposes to hereinafter appear, by a bar 207 on piston rod 202, the flange being adapted to engage the roller equipped arms 219, 221 and 224, respectively, on said switches. A switch 225 shown in FIG. 7 is operable by bar 195. Other switches and photocell detection devices of known construction are referred to in the following description of the operation but are not shown in order to avoid unnecessary complication of the drawing.

MODE OF OPERATION

From the foregoing it will be seen that conveyor belts 34, 43 and 231 are the only parts of the apparatus which are continuously driven by motor 17. The other operating elements are operated by cylinder and piston fluid motors, such as double acting compressed air motors. The application of pressure in opposite ends of each cylinder may be controlled in a known manner by solenoid actuated valves which may in turn be controlled by suitable relays, switches, photocells and the like which are responsive to the passage of books or movements of the operating elements of the apparatus.

By way of example, book detection means of known type, such as a photocell, may be provided to detect books approaching brush 62 and to control the reciprocation of motor 55 to actuate the brush and tip successive books in opposite directions on conveyor 11. Means well known in the art, such as a photocell counter, are also provided for electrically counting the books as the same drop off the end of conveyor 11, said means being employed to control the operation of auxiliary platform 86, elevator 130 and end jogging motor 209. When the first of a series of a selected number of books for a stack passes the counter detector, the motor 111 is energized to move plates 86 into operative position to catch and support a few books, usually about one-third of a full stack. This number may depend on several factors such as the rate of travel and spacing of the books, the thickness of the books, the vertical height of the stacker channel, the time required for the elevator 130 to complete a down-up cycle and others. When the selected number of books have been stacked on plates 86, as determined by the counter, said plates are retracted by motor 111. This preliminary number of books now rest on elevator 130 in its up position where they are detected by suitable control means, such as a photocell and light beam, to control the descent of the elevator. Thus, when the photocell, for example, is darkened by the uppermost book on the stack being in the beam, motor 42 is operable to slowly lower the elevator until the photocell is again lighted across the top of the stack. As each book is added, the elevator is progressively lowered. This may be effected by causing motor 42 to operate against a hydraulic dash pot with an escape valve controlled by the photocell and a solenoid. When the counter signals the entry of the final book of a stack the dash pot is rendered ineffective so as to permit the elevator to be moved promptly to fully lowered position. The next book entering the stacker, i.e., the first book of the next stack, is detected by the counter and motor 111 is thereby caused to be energized to again move auxiliary platform plates 86 into operative position as explained above.

When the last book of a stack arrives, the counter also disables the dash pot control of motor 142 to permit rapid, continuous descent of the elevator and effects energization of end jogger motor 209 to move pusher 199 to the right (FIG. 1) to end align the stack against front stop 154 as explained above. In response to actuation of switch 214 by flange 212, motor 191 is energized to move side jogger plates 87 inwardly against the stack by actuation of bar 195. The latter, near the end of its stroke, actuates switch 225 to thereby effect proper energization of motor 159 to lower front stop 154. As elevator 130 reaches its lowermost position, it actuates a switch (not shown) which, conditioned on the completion of the end jogging signalled by actuation of switch 214 and on the lowering of front stop 154 signalled by actuation of switch 174, signals the proper energization of motor 204 for actuating pusher 199 to move the jogged book stack from between plates 87 onto conveyor 16.

The energization of pusher motor 204 for returning pusher 199 is effected when flange 207 actuates switch 222 at the end of the forward stroke of piston rod 202. On the pusher retraction stroke of piston rod 202, the switch 221 is actuated by flange 207 to signal the return of front stop 154 to raised position by motor 159 and consequent actuation of switch 176. Near the end of its return stroke, flange 207 momentarily actuates the one-way switch 217 to initiate the raising of elevator 230 which is effected with continuous rapid movement by motor 142. When the elevator reaches its upper position it actuates a switch, not shown, which reverse energizes motor 142 to apply a lowering force to the elevator under control of the dashpot and stack level detecting means as above described. In the interval thus required for lowering, unloading and returning the elevator several books will have been deposited on platform 86. When the preselected number of books have been deposited onto plates 86, as determined by the counter, said plates are retracted and the complete cycle is repeated.

Although only one embodiment of the invention has been illustrated in the accompanying drawings and described in the foregoing specification, it is to be expressly understood that various changes may be made therein without departing from the spirit and scope of the invention, as will now be apparent to those skilled in the art. Thus, alternate books 43 which have been tipped or laid down in opposite directions upon the belt 34 of the conveyor 11 may be moved laterally so as to enter the stacker 14 in offset position by means other than the opposed curved guides 72*a*, 72*b*. One such alternative means for so doing is in the form of a transversely reciprocable carriage similar to carriage 51 and suspended in a similar manner above the belt 34 downstream of the carriage 51. Such unillus-

trated carriage may have horizontal, longitudinal bars rigidly suspended therefrom and positioned above the upper surface of belt 34 but close enough thereto to engage the spines of the books which have been laid down upon the belt. Suitable means such as a photocell and light source are disposed to detect the passage of the laid-down books on the conveyor and to effect proper energization of the carriage motor. In one terminal position of the carriage, the bar on one side thereof is disposed laterally outwardly of the spines of the books which have been laid over in the respective direction; the bar on the other side of the carriage is similarly disposed with respect to the books laid over in the other direction when the carriage is in its other lateral terminal position. As the carriage moves from one terminal position toward the other, one of the bars engages the book which it confronts and carries it laterally inwardly; in the reverse travel of the carriage the other bar carried the book on the other side of the belt 34 laterally inwardly. The books thus carried inwardly are released in such lateral position on the belt that they can enter the upper portion of the channel in the stacker 14 but are laterally offset in the same manner as in the illustrated apparatus.

Although the apparatus of the invention has been illustrated in connection with books which have been rounded and backed, and encased, it is to be understood that the invention may be employed to advantage in the stacking of books of other types. Among such other types of books are those in which the front and rear surfaces of the books, including the spine joints, throughout their extent lie substantially in parallel planes, making the offsetting of adjacent books unnecessary. The apparatus is also useful for stacking books without alternating the position of the spines thereof.

What is claimed is:

1. Apparatus for stacking books which comprises means for feeding longitudinally a plurality of similar books in succession generally along a path and for disposing the books flat in first lateral positions with successive books substantially offset laterally in opposite directions from the longitudinal center line of such path, means for moving one set of alternate books, as the books travel longitudinally, laterally toward the other set of alternate books so that the books lie in second lateral positions wherein there is decreased lateral offset between successive books, and means for discharging the books in such second lateral positions into an at least generally vertical stack.

2. Apparatus for stacking books as defined in claim 1 wherein said means for moving said one set of alternate books laterally toward the other set of books comprises guide means engaged by said one set of books and moving them progressively laterally inwardly toward the other set of books as the books travel longitudinally.

3. Apparatus for stacking books as defined in claim 1, wherein said means for moving said one set of alternate books laterally toward the other set of books comprises means for moving alternate books as they travel longitudinally laterally inwardly in opposite directions toward the longitudinal center line of said path.

4. Apparatus for stacking books as defined in claim 1, comprising means for initially disposing the books on edge in end-to-end alignment along said path of travel, and wherein the means for disposing the books in said first lateral positions comprises means for tipping successive books in opposite directions about their lower edges as they travel longitudinally along said path.

5. Apparatus for stacking books as defined in claim 4, comprising means for detecting the approach of each book toward the tipping means, and means actuated by the detecting means controlling the tipping means.

6. Apparatus for stacking books as defined in claim 4 wherein the means for moving said one set of alternate books laterally toward the other set of books comprises guide means on each side of said path, each guide means being engaged by the respective set of books and progressively moving them laterally inwardly toward the center line of said path as the books travel longitudinally.

7. Apparatus for stacking books as defined in claim 4 wherein the means for tipping successive books in opposite directions from their initial on-edge positions comprises a member movable laterally of said path, and means for reciprocating said member so that it engages opposite sides of the upper portion of successive books as the books travel therepast.

8. Apparatus for stacking books as defined in claim 1 wherein the books have back covers and caseboards connected by spine joints to the back covers, the books in their initial on-edge position have their back covers disposed uppermost, the books in said first lateral positions thereof have the spine joints of the sets of alternate books disposed laterally outwardly, and wherein the means for moving one set of alternate books laterally toward the other set of alternate books is so constructed and arranged that the outer free edges of the caseboards of each book in said second lateral position thereof falls somewhat short of overlying the spine joints of each adjacent book in the stack.

9. Apparatus for stacking books as defined in claim 1 comprising means for stopping the longitudinal forward travel of books in their second lateral position and sequentially adding them to the top of said stack by dropping them onto the stack after their forward travel has been stopped.

10. Apparatus for stacking books as defined in claim 9, comprising means for retaining the bottom book of the stack at a first, upper fixed level while continuing to pile books on the top of such stack, and means for subsequently progressively lowering the bottom of the stack while piling additional books on the top of the stack.

11. Apparatus for stacking books as defined in claim 10 comprising means for terminating the lowering of the bottom book in the stack at a second, lower fixed level, means for pressing the opposite sides of the thus lowered stack laterally inwardly toward each other to a point at which the alternate books lie in third lateral positions in which the alternate books in one set thereof are slightly offset laterally from the books in the other set thereof.

12. Apparatus for stacking books as defined in claim 10 wherein the books have back covers and caseboards connected by spine joints to the back covers, the back covers of the books in both sets of alternate books lie laterally outwardly of the free edges of the caseboards of the contiguous books in the stack, and comprising means for terminating the lowering of the bottom book in the stack at a second, lower fixed level, and means for thereafter pressing the backs of the books on opposite sides of the thus lowered stack laterally inwardly toward each other to a point at which the outer free edges of the caseboards of each book fall slightly short of overlying the spine joints of each contiguous book in the stack.

13. Apparatus for stacking books as defined in claim 9 wherein the book feeding means feeds them continuously forwardly until they are stopped to be dropped onto the top of the first recited stack, including means for retaining the bottom book of the first stack at a first, upper fixed level that comprises at least one separator blade which supports the first stack while books are continually piled on the top of the first stack, means comprising an elevator located below the separator blade for lowering a previously formed second stack of books disposed below the first stack to a lowered position wherein the lowest book of the second stack lies at a second, lower fixed level, and means for discharging the thus lowered second stack of books from beneath the first stack, thereafter raising the elevator to a position close to and below the separator blade, and retracting the separator blade to transfer the first stack of books to the elevator where they form the lower portion of a subsequent second stack.

14. Apparatus for stacking books as defined in claim 13, comprising means for moving the books in the second stack endwise against stop means so as to end align the books in the second stack in a longitudinal direction.

15. Apparatus for stacking books as defined in claim 14 wherein the means for end aligning the books in the second

stack is so constructed and arranged that such end alignment takes place while the second stack is moving to its lowered position.

16. Apparatus for stacking books as defined in claim 13, comprising means for pressing the opposed side edges of the books in the second stack laterally inwardly toward each other to a point at which the alternate books lie in third lateral positions in which the alternate books in one set thereof are slightly offset laterally outwardly from the books in the other set thereof, so as to align the laterally outer edges of the books in the respective sets thereof.

17. Apparatus for stacking books as defined in claim 16, wherein the means for edge aligning the sets of books in the second stack is so constructed and arranged that such edge alignment takes place as the second stack is moving to its lowered position.

18. Apparatus for stacking books as defined in claim 17 comprising means for end aligning the books in said second stack while such second stack is moving to its lowered position including means for pressing the forward ends of the books against retractable stop means.

19. Apparatus for stacking books as defined in claim 18 wherein the means for end aligning the books in the second stack and the means for edge aligning the sets of books are so constructed and arranged that such two aligning operations take place in quick succession.

20. Book stacking apparatus comprising laterally retractible platform means, an elevator below said platform means, means for feeding books to form a preliminary stack on said platform means and thereafter to form a complete stack on said elevator, means for counting the books so fed, means responsive to said counting means for retracting said platform means to transfer the preliminary stack to the elevator, means successively responsive to the stack level and to said counting means for moving the elevator to its lowermost position, means responsive to the counting means for end jogging the book stack on the elevator, means responsive to the end jogging means for side jogging the book stack, and means responsive to said side jogging means for removing said stack from the elevator.

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