Feb. 20, 1973 J. LOPEZ 3,717,075

STACKER APPARATUS FOR MULTIPLE CORRUGATED SHEETS

Filed Oct. 4, 1971 6 Sheets-Sheet 1

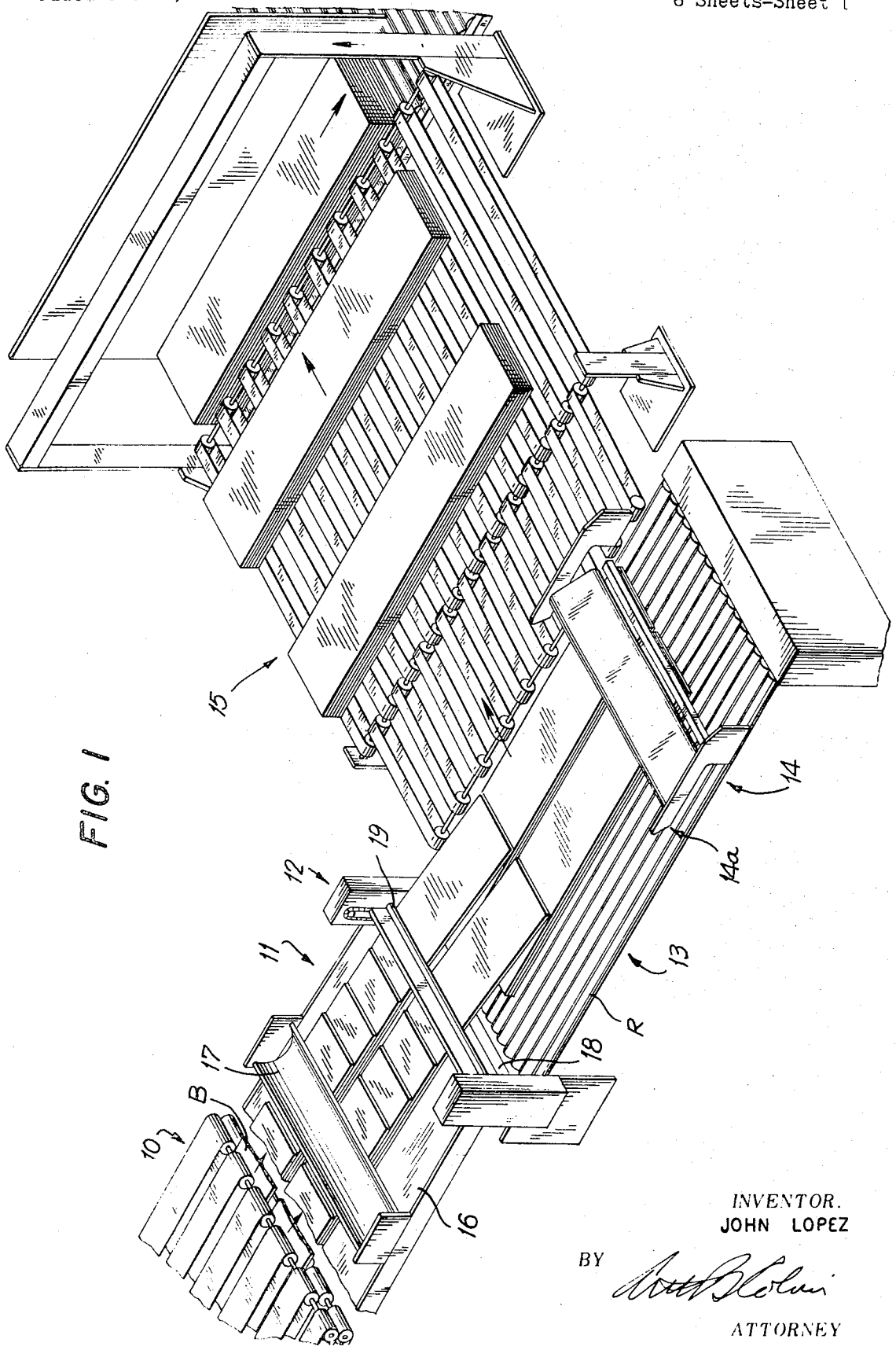


FIG. 1

INVENTOR.
JOHN LOPEZ

BY

ATTORNEY

Feb. 20, 1973 J. LOPEZ 3,717,075

STACKER APPARATUS FOR MULTIPLE CORRUGATED SHEETS

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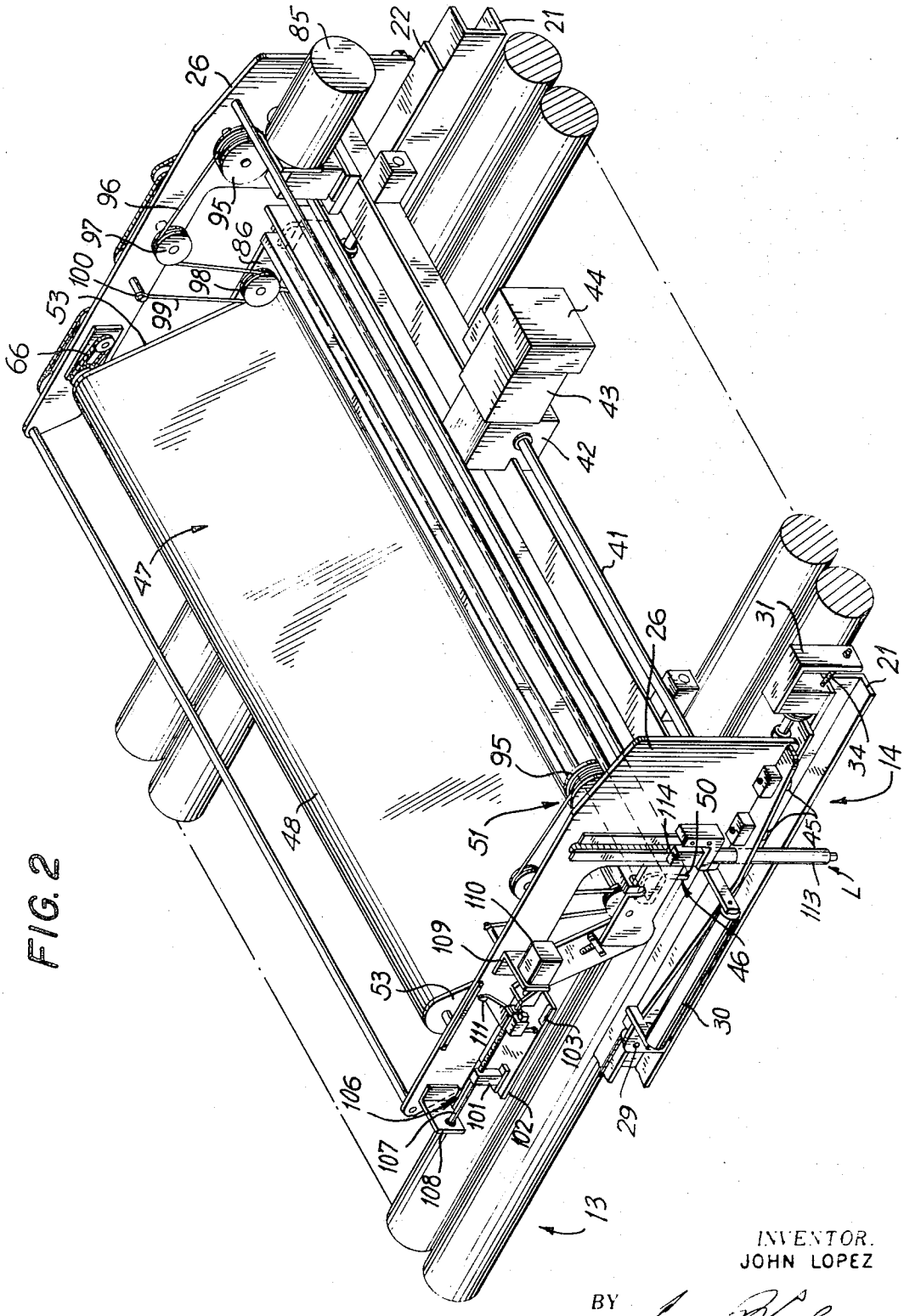


FIG. 2

INVENTOR.
JOHN LOPEZ
BY
ATTORNEY

Feb. 20, 1973 J. LOPEZ 3,717,075

STACKER APPARATUS FOR MULTIPLE CORRUGATED SHEETS

Filed Oct. 4, 1971 6 Sheets-Sheet 3

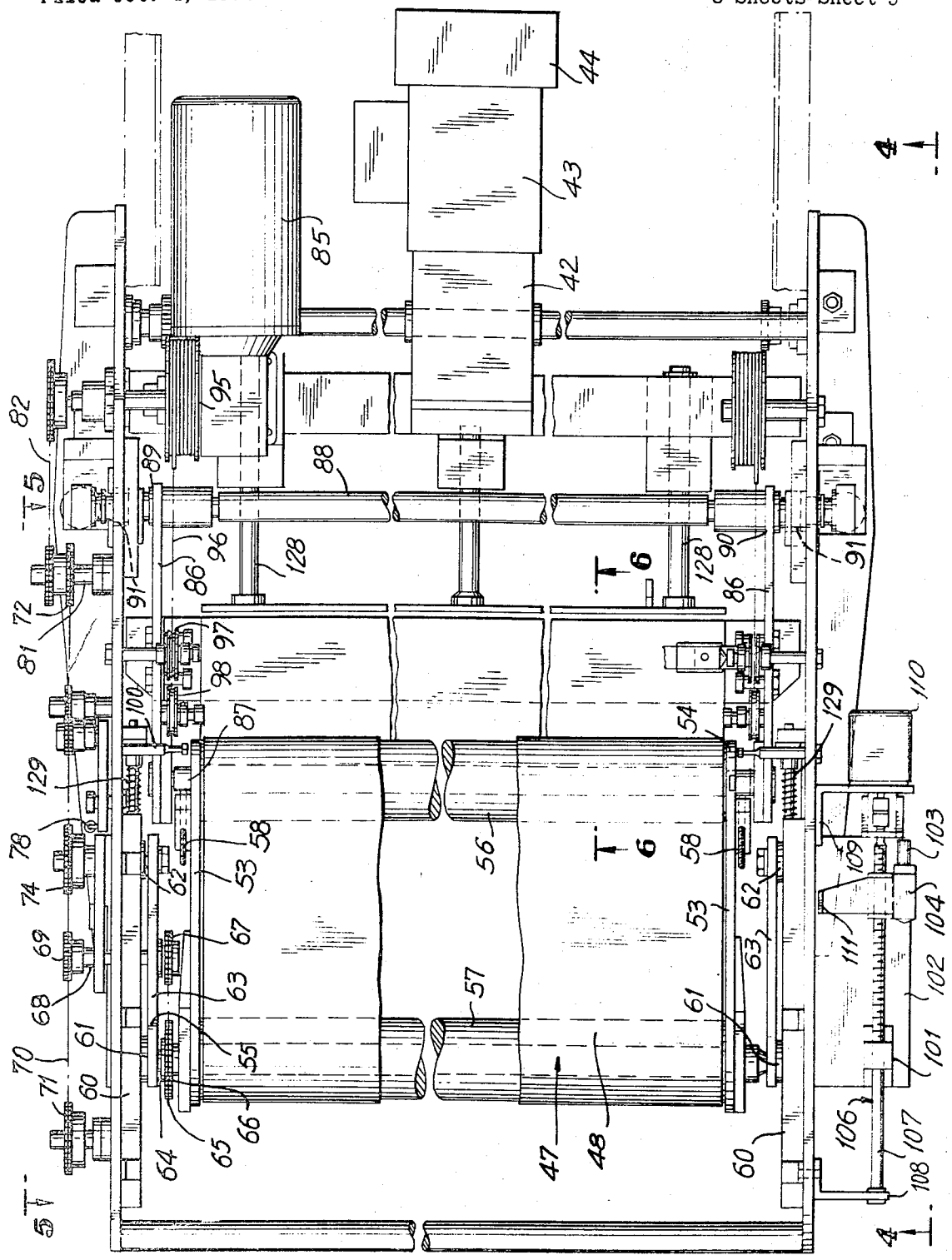


FIG. 3

JOHN LOPEZ

Scott D. Cohen
ATTORNEY

Feb. 20, 1973 J. LOPEZ 3,717,075

STACKER APPARATUS FOR MULTIPLE CORRUGATED SHEETS

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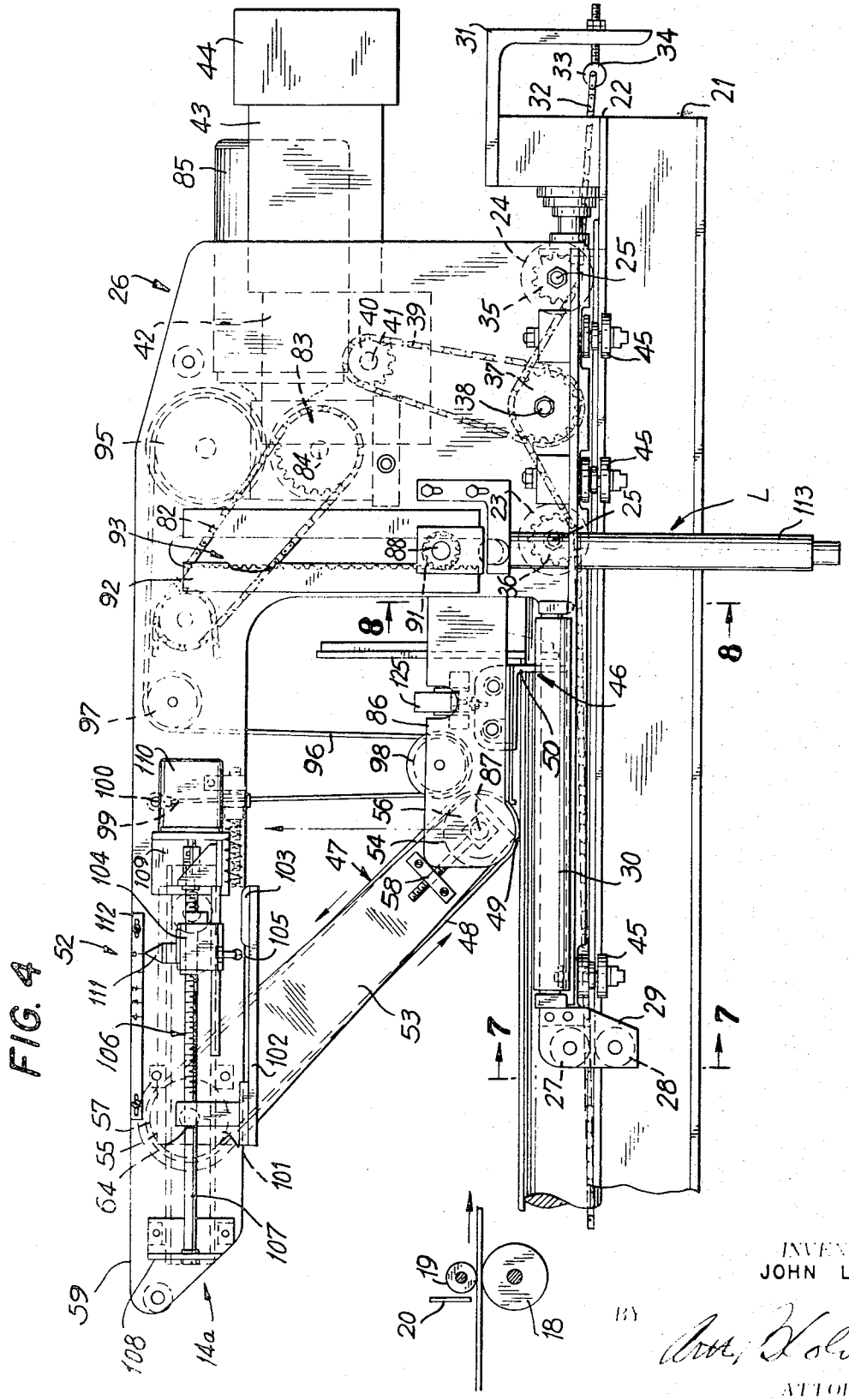


FIG. 4

INVENTOR
JOHN LOPEZ

BY

ATTORNEY

Feb. 20, 1973 J. LOPEZ 3,717,075

STACKER APPARATUS FOR MULTIPLE CORRUGATED SHEETS

Filed Oct. 4, 1971 6 Sheets-Sheet 5

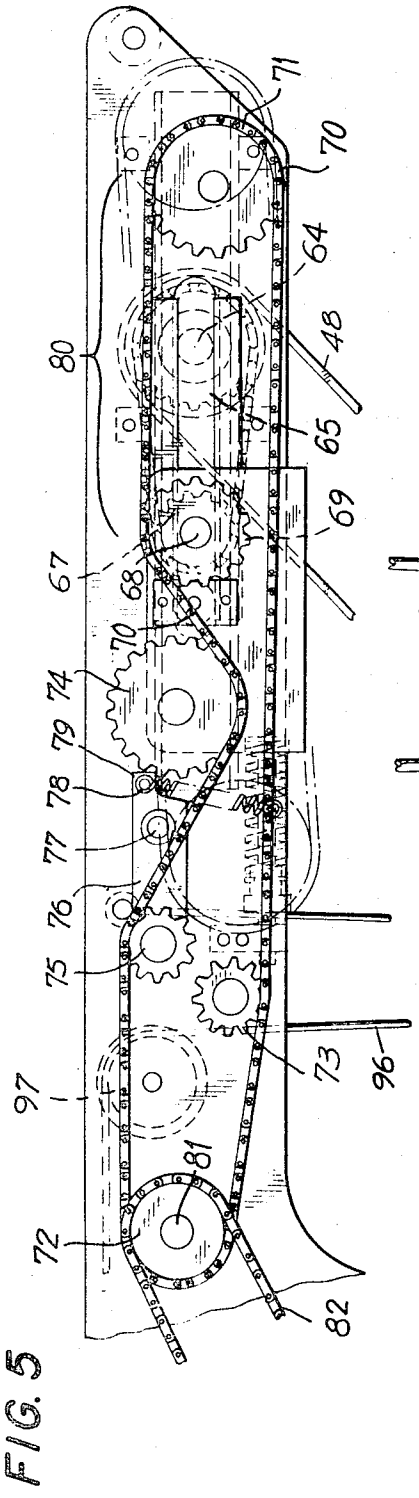


FIG. 5

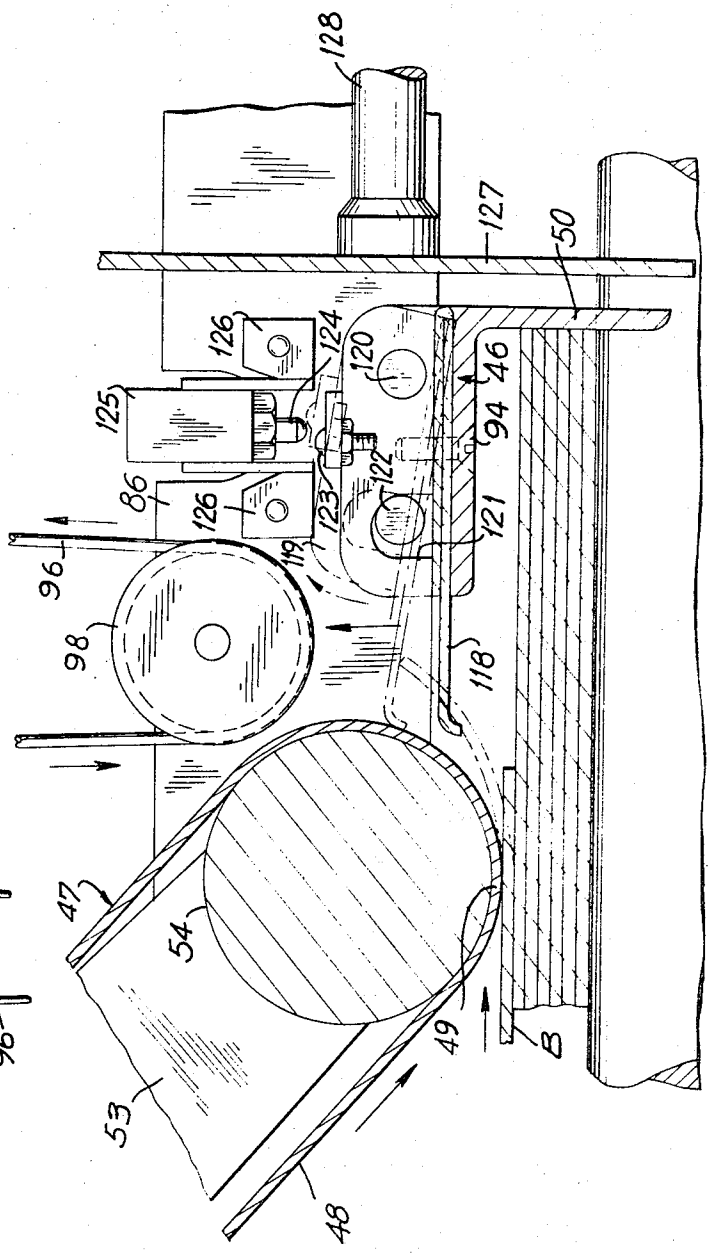


FIG. 6

INVENTOR
JOHN LOPEZ

ATTORNEY

Feb. 20, 1973 J. LOPEZ 3,717,075

STACKER APPARATUS FOR MULTIPLE CORRUGATED SHEETS

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FIG. 7

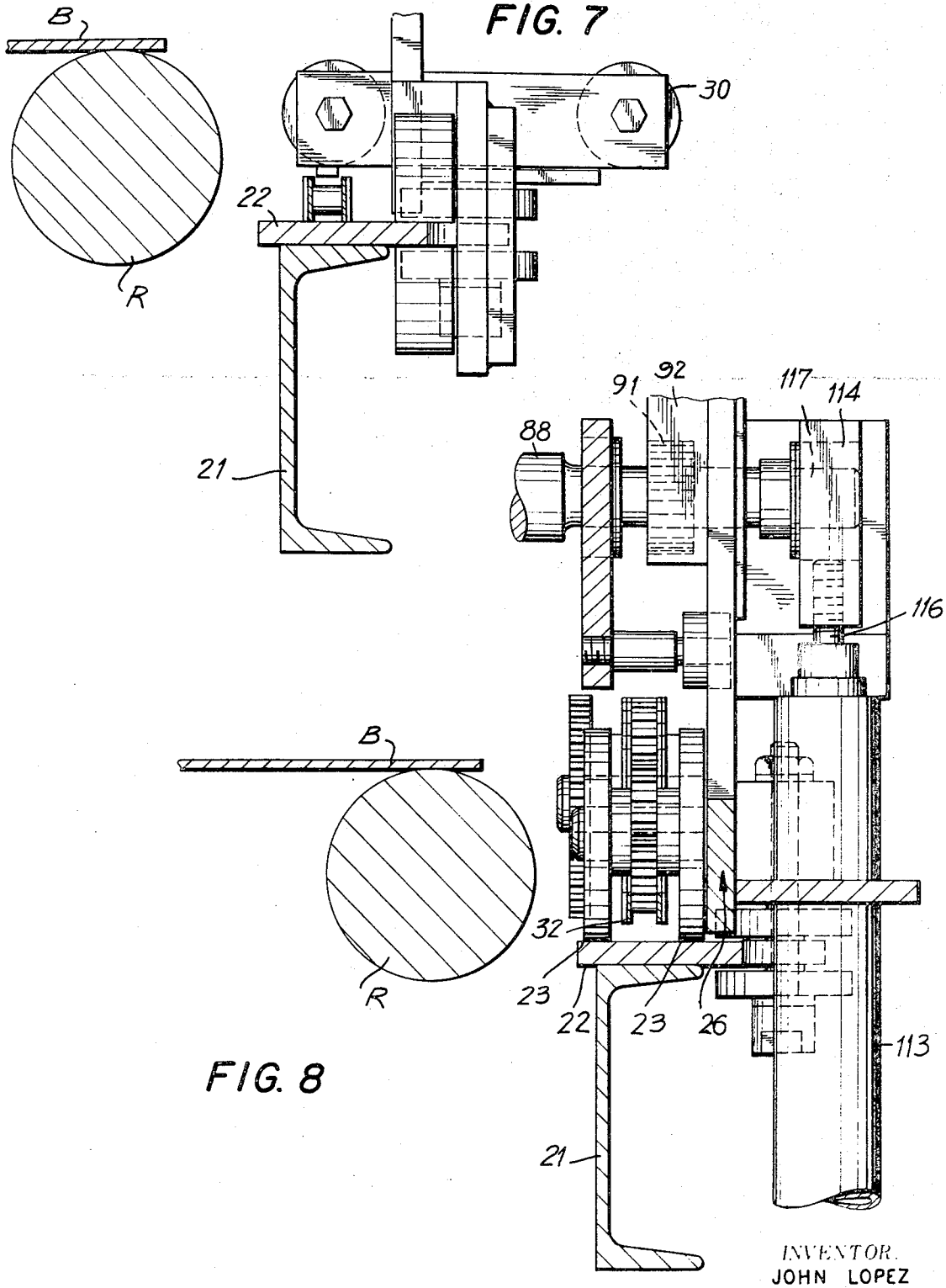


FIG. 8

INVENTOR.
JOHN LOPEZ

BY

ATTORNEY

United States Patent Office 3,717,075
Patented Feb. 20, 1973

3,717,075

STACKER APPARATUS FOR MULTIPLE CORRUGATED SHEETS

John Lopez, Westfield, N.J., assignor to Koppers Company, Inc., Pittsburgh, Pa.

Filed Oct. 4, 1971, Ser. No. 186,310
Int. Cl. B65h 31/34, 33/00
U.S. Cl. 93—93 M 17 Claims

ABSTRACT OF THE DISCLOSURE

A stacker apparatus for forming at an unloading zone a plurality of stacks of corrugated sheets, said stacks having their lead edges aligned, the stacks being free of interleaving. The stacker incorporates a takeoff table and a transversely directed alignment bar, the sheets to be stacked being serially fed beneath a squaring belt assembly including a transverse belt overlying and driven to feed a plurality of side by side sheets at one time against the bar. The lower peripheral portion of the belt engages the upper surfaces of the sheets under controlled downward pressure and urges the sheets continuously against the bar, the sheet engaging portion of the belt being guided against tilting movement and being constrained to be shifted in a vertical plane only by the progressive accumulation of sheets against the alignment bar.

Means are provided for clearing the alignment bar and belt assembly at the completion of the formation of a series of stacks of desired height.

The progressive urging forces of the squaring belt assembly, coupled with the vertical movement and non-tiltability of the feed portion of the squaring belt assembly eliminate any interleaving of the stacks stored against the alignment bar.

This invention is in the field of apparatus for the processing of sheets, and especially corrugated cardboard sheets of the type commonly used in the formation of boxes.

As conducive to an understanding of the present invention, it should be appreciated that corrugated cardboard material is typically produced in wide bands or sheets, which bands or sheets are subsequently slit lengthwisely, and cut transversely, to the size required for the fabrication of individual box blanks. Thereupon, the parallel box blanks are advanced past a vertically movable gate for sequential discharge onto a takeoff table, the blanks as they are discharged abutting against the squaring bar, the purpose of which is to square the parallel stacks of box blanks as they are built up on the squaring table.

After a desired number of blanks have been built up to form stacks of desired height, the gate is then closed to stop further discharge of the blanks and thereupon the parallel stacks are moved transversely for discharge from the takeoff table.

Specifically, the end result of severing individual box blanks from a continuously advanced bulk supply of wide cardboard should ideally be a multiplicity of side by side stacks of box blanks, each of which stacks may be readily separated from the adjacent stack. The stacks should be neatly arrayed so that they may be removed from the stacking area and subjected to subsequent processing steps, e.g., bending, folding, gluing, printing, etc. or stored for subsequent processing. Obviously, if the sheets of one stack are interleaved with the sheets of adjacent stack, it will be impossible to separate the stacks without substantial manual labor, resulting in a great deal of down time since, clearly, operation in the preceding box blank forming stages of the apparatus must be interrupted in order to clear prior imperfectly formed stacks.

Due to the fact that when the gate is closed, as the box blanks abut thereagainst they may tend to skew slighty, causing interleaving of adjacent blanks, so that when the blanks are then subsequently discharged onto the squaring table to form parallel stacks, some of the blanks of adjacent stacks may be interleaved. In addition, when the blanks abut against the squaring bar of the takeoff table, the force of such abutment may also cause interleaving of adjacent blanks.

Numerous attempts have been made to provide an apparatus which will sever discrete sheets or box blanks from a continuously advanced length of corrugated board, and form the sheets into neat, non-interleaved adjacent stacks. Heretofore, however, such apparatuses and methods have met with only limited success. Precise stacking has proven a bottleneck which materially reduces the efficiency of the entire box blank production line.

The present invention may be summarized as comprising an apparatus and method for causing a multiplicity of simultaneously advancing, side-by-side sheets of stiff material, such as corrugated cardboard, to become stacked or arrayed into neat and non-interleaved side-by-side disposed stacks of box blanks.

The apparatus which normally forms a terminal station in the fabrication of the blanks is positioned to receive the blanks in side-by-side array after they have been discharged past the gate. The side-by-side columns of blanks are fed onto a flat surface or table, which surface is optionally but preferably defined by a series of elongated rollers mounted for rotation about an axis parallel with the path of movement of the blanks to provide a right angle takeoff.

A squaring belt assembly, which forms a principal advance of the present invention, is disposed above the takeoff table. The squaring assembly preferably comprises an inclined frame including side arms, the arms having at their upper and lower ends a pair of transversely extending rollers, about which rollers is disposed a continuous belt. The width of the belt preferably substantially equals the width of the takeoff table.

A transversely extending alignment bar, which may preferably be adjustable toward and away from the gate for purposes of being adaptable to the processing of blanks of various lengths, is disposed above the takeoff table in blocking relation to blanks advanced along the table. The bar forms or defines a lead edge alignment fixture.

The lower roller of the squaring assembly is so positioned that the lowermost edge of the belt arrayed beneath the roller is precisely parallel to the alignment bar. The lowermost peripheral portion of the belt thus engages the upper surfaces of sheets passing over the takeoff table and, by reason of the fact that said lowermost portion is continuously advancing in the direction of the bar, urges the blanks so that the lead edges thereof engage against the bar and hence are squared.

The lower edge of the squaring belt assembly is counterbalanced so as precisely to control the downward pressure which may be exerted by the lowermost peripheral portion of the belt against the upper surfaces of the sheets.

The squaring assembly is guided in such manner that the lower peripheral portion of the belt which engages the sheets is raised in a vertical plane perpendicular to the surface of the table. Apparatus is provided for preventing the lowermost peripheral portion of the belt from tilting within the vertical plane.

The upper edge of the squaring assembly is guided for horizontal movement, it being appreciated that the accumulation of sheets beneath the lower end of the squaring assembly will induce a progressive upward movement of the lower end and a concomitant progressive horizontal movement of the upper end. The horizontal movement

optionally but preferably may be used as an index of the number of sheets which have been accumulated so that, when a desired number of sheets is present against the alignment bar, the squaring assembly may be cleared from the accumulated and aligned sheets, permitting the lateral removal of discrete, edge-aligned stacks of sheets of a desired height.

Clearing of the squaring assembly from the sheets is preferably effected by powerized actuating apparatus, the operation of which is instituted automatically as a result of the sensing of a sufficient heightwise accumulation of sheets against the alignment bar.

The application of substantially continuous and progressive forces frictionally urging successive sheets against the alignment bar, which forces, by reason of the counterbalancing effect, may be maintained within a controlled range, have been found to be highly effective in preventing interleaving in the plural, side-by-side stacks of sheets formed adjacent the alignment bar.

In addition to preventing interleaving from occurring adjacent the alignment bar, the squaring assembly has been found effective to separate or laterally spread sheets which may have been interleaved or overlapped in an earlier stage of production.

Optionally, but preferably, there is provided immediately adjacent the alignment bar, a sensor mechanism for sensing severely warped or distorted sheets, and interrupting operation of the apparatus until the offending sheet or sheets are automatically or manually removed.

In the light of the foregoing, it is an object of the invention to provide a stacker apparatus for forming a plurality of non-interleaved, side-by-side, lead edge aligned stacks of corrugated blanks formed from a plurality of continuously advancing side-by-side columns of sheets or blanks.

A further object of the invention is to provide a device of the type described wherein the height of the various columns is automatically sensed and the operation of the apparatus automatically interrupted when the desired height is reached.

A further object of the invention is the provision of a device of the type described and including apparatus for detecting severely warped or distorted blanks, or blanks which have been misfed, so as to prevent formation of a jam and permit the defective sheet to be cleared without the formation of interleaved stacks.

Still a further object of the invention is the provision of a device for forming side-by-side non-interleaved stacks by progressively engaging the upper surfaces of serially advanced sheets against a transversely directed stop surface, the frictional forces being exerted through a belt or roller apparatus which is constrained to be disposed at all times in a horizontal position parallel to the alignment bar or stop assembly, and which is likewise constrained to rise in a precisely vertical direction. The frictional forces which may be exerted by the roller are controlled to provide a constant pressure of the lead edges of the sheets against the alignment bar, whereby the lateral edges of adjacent sheets are maintained clear of an overlapping relation.

To attain these objects and such further objects as may appear herein or be hereinafter pointed out, reference is made to the accompanying drawings, forming a part hereof, in which:

FIG. 1 is a perspective view of an apparatus for feeding, stacking and removing the stacks of corrugated sheets;

FIG. 2 is a perspective view of the takeoff table and stacker components of the assembly of FIG. 1;

FIG. 3 is a top plan view of the portion of the apparatus illustrated in FIG. 2;

FIG. 4 is a vertical section taken on the line 4—4 of FIG. 3;

FIG. 5 is a magnified vertical section taken on the line 5—5 of FIG. 3;

FIG. 6 is a magnified vertical section taken on the line 6—6 of FIG. 3;

FIG. 7 is a magnified section taken on the line 7—7 of FIG. 4; and

FIG. 8 is a magnified vertical section taken on the line 8—8 of FIG. 4.

Referring now to the drawings, there is shown in FIG. 1 an overall perspective view of an assembly for completing the final stages of stacking corrugated cardboard sheets or box blanks for subsequent processing. It will be understood that the sheets or blanks, after they are formed in stacks, will be transported to remote zones for subsequent processing steps, such as punching, printing, folding, gluing, etc.

As best seen in FIG. 1, the apparatus of the present invention includes separate zones or processing stations including a sandwich or infeed conveyer zone **10**, a slow down conveyer zone **11**, stop gate and roller feed mechanism **12**, right angle roller takeoff table **13**, having a backstop conveyer **14** and right angle takeoff mechanism **15**.

The principal advance of the present invention is centered in the table **13** and backstop conveyer **14**, the functions of the associated mechanisms being generally discussed to permit an appreciation of the interaction of the various components.

The sandwich conveyer **10** will be understood to function to feed side-by-side box blanks or corrugated sheets B which have been severed from a large web or corrugated sheet source (not shown). While for the sake of simplicity, the present apparatus has been illustrated as feeding two lengthwisely extending columns of blanks B, it will be understood that a multiplicity of such columns, within the size range subject to processing, may be simultaneously fed.

The slowdown conveyer **11** is operating at a reduced speed as compared with the speed of advance of the blanks B from the sandwich conveyer **10**, such that the blanks assume a "shingled" configuration on the conveyer **11**, with the lead edges of trailing blanks overlapping the trailing edges of preceding blanks.

The slowdown conveyer includes a belt portion **16** onto which the blanks from the sandwich conveyer are deposited, the belt **16** and hence the blanks B advancing at a slower speed than the speed of the conveyer **10**. It is this reduction in speed which effects the desired shingling.

17 is a transversely extending holddown guide member which includes an arcuate undersurface yieldingly pressing against the upper surfaces of blanks on the conveyer **11**, to assure contact with the belt and consequent continuous advance of the sheets.

The blanks on the conveyer **11** advance between the nip of a driven lower discharge roller **18** and an idler roller **19**. It will be understood that the idler roller **19** functions to maintain a sufficient pressure against the sheets to induce their lengthwise advance to the table **13**. The idler roller **19** is mounted to move conjointly with the gate **20** during the normal operation of the apparatus, it being understood that in order to interrupt the flow of sheets to the table **13**, the gate is connected to lowering apparatus (not shown) which will shift the gate to a depending position as contrasted to the position shown in FIG. 4. In this position it will be appreciated that multiple sheets will accumulate against the downstream or trailing face of the gate **20**.

As the gate mechanism is known in the art, it will only be described sufficiently for a clear understanding of the invention herein.

The sheets fed from the discharge roller **18** to the table **13** are stacked by a stacker assembly forming the principal subject of the present invention.

It will be understood that the primary function of the stacker assembly is to form multiple lead edge aligned,

discrete stacks of corrugated sheets, which stacks are free from interleaving, i.e., from a situation in which marginal edges of sheets of one stack are sandwiched between sheets of an adjacent stack and which may be caused by the abutment of the leading edges of the side-by-side blanks against the closed gates which may cause skewing of such box blanks with consequent interleaving thereof.

The operative components of the stacker assembly are best shown in FIGS. 2, 3 and 4. It will be appreciated that the apparatus may be adjusted to feed and align box blanks or sheets of a variety of different sizes. In view of the massive nature of the apparatus, a powerized adjustment assembly is provided.

For purposes of adjustably supporting the mechanism, the stacker assembly **14** is lengthwisely shiftable along a pair of side rails **21, 21**, including horizontally directed parallel top flange portions **22, 22**. The stacker assembly **14** includes paired depending support rollers **23, 24**, which ride on the flanges **22** and are mounted on stub shafts **25, 25**, affixed to the side frame portions **26, 26** of the stacker mechanism.

The forwardmost end **14***a* of the stacker mechanism is supported against tilting by upper and lower tilt resisting rollers **27, 28** fixed to bracket **29**, it being appreciated that the rollers **27, 28** engage the upper and lower surfaces of the flanges **22**. An extensible connection mechanism **30** is interposed between the bracket **29** and the side plates **26**, so as to permit a variation in the spacing of the noted parts.

An angle bar **31** extending transversely between the side rails **21** is secured to the rearwardmost terminal end of the rails as by welding.

A spaced parallel pair of lengthwise adjustment chains **32** are distended between the bracket **31** and a comparable bracket (not shown) disposed in a downstream position along the length of the table **13**. As best shown in FIG. 4, the rearward end **33** of the chain **32** is fixed, as by stretcher bolt **34**, to the bracket **31**. As shown in FIG. 4, sufficient slack is provided in the chain to permit the same to be reeved under idler sprockets **35, 36** mounted on stub shafts **25, 25**, and over the upper surface of drive sprocket **37** mounted on drive shaft **38**.

It will be appreciated that the various drive sprockets, idler sprockets and chains forming the adjustment mechanism are duplicated at both sides of the apparatus.

Drive shaft **38** is actuated for rotation in either direction by an adjustment drive chain **39** connected between a sprocket fixed to the shaft **38** and a takeoff sprocket **40** fixed to an output shaft **41** extending from reduction gear assembly **42**. The shaft **41** is rotated by energizing the adjustment motor **43** which is of the reversible type, the motor **43** preferably including a stop brake **44** so as to enable the chassis to come to a stop promptly following interruption of the circuit to the motor.

From the foregoing it will be evident that the position of the stacker assembly **14** along the table **13** may be readily adjusted by energizing the circuit to the motor **43** in either desired sense, depending upon the change of position which is sought. To accommodate shorter boards or sheets, the motor is energized so as to drive the gear **37** in a clockwise direction, in the embodiment shown, whereupon the rotation of the gear will cause the chassis bodily to move to the left, as shown in FIG. 4, along the chain member **32**.

A series of centering rollers **45** are provided at both sides of the frame, the rollers encompassing the flange **22** of the channel to assure against skewing of the chassis relative to the supporting frame.

The stacker assembly may be generally described as including an alignment bar member **46** in the form of an angle bar having a depending leg defining a squaring plate **50**, a squaring belt assembly **47**, and a lift assembly L. As will be more clearly apparent from the ensuing description, the squaring assembly **47** includes a continuously driven belt **48**, the lowermost peripheral portion **49** of which extends transversely across the entire width of the table **13**, such peripheral portion being yieldingly pressed into engagement in a linear locus against sheets pinched between the peripheral portion and the table **13**. The sheets are advanced by the driving force applied by the belt into a squared position against the vertical surface or squaring plate portion **50** of the alignment bar **46** thereby eliminating any skewing of the blanks caused by their abutment against the closed gate as previously set forth and hence eliminating any interleaving. It will be understood that when the lead edges of the advancing blanks or sheets are engaged against the alignment bar, the belt **48** will still be continuously advancing, the downward pressure exerted by the peripheral portion **49** of the belt being yieldingly adjustable under the influence of a counterbalance mechanism illustrated generally at **51** (FIG. 2). It is the continuous frictional pressure exerted against the sheets even after the same are disposed against the alignment bar which is considered to be an important factor in eliminating the interleaving tendency experienced with apparatuses heretofore known.

There is shown at **52** a stack height sensing mechanism which functions to determine the height or number of sheets accumulated adjacent the squaring plate **50**. When a sufficiency of such sheets are sensed, a lift mechanism L is activated and the gate **20** lowered to interrupt continued feed, whereupon the alignment bar and associated assembly are lifted to relieve the pressure against the accumulated stacked sheets on table **13**, permitting the stacks to be discharged onto the right angle takeoff **15**.

The squaring belt assembly includes a spaced pair of inclined arms **53**, maintained in spaced parallel relation by appropriate braces (not shown). At the distal ends **54, 55** of the arms **53**, there are mounted, respectively idler and drive rollers **56, 57**, about which the belt **48** is arrayed. Preferably the arms **53** include stretcher assemblies **58, 58** which may be employed to maintain the belt **48** under appropriate tension.

The upper end of the arms **53** are mounted to the extension portions **59** of the side plates **26** for horizontal sliding movement as well as pivotal movement within horizontally extending guide channels **60, 60** (FIG. 3). It will be understood that the channels include horizontally directed, inwardly opening slots or guideways, and that roller members **61, 62** are mounted within the guideways. The rollers **61, 62** are rotatably disposed at the opposite ends of side guide bars **63, 63** (FIG. 3), the guide bars being constrained to move in a horizontal plane only.

The roller mounting shaft **64** is pivotally mounted at its opposite ends in spaced bearing blocks supported adjacent the roller assemblies **61**, thus permitting the entirety of the arm assembly to pivot about a horizontal pivot axis, as well as enabling the blocks supporting the upper end of the same to move in a purely horizontal plane within the tracks or guideways **60, 60**.

The upper or driving roller **57** is mounted on shaft **64** which also carries a drive sprocket **65** (FIGS. 3 and 5). As is apparent, particularly from a consideration of FIG. 5, the drive sprocket **65** must be continuously engaged in driving connection with a belt drive assembly regardless of the horizontal position occupied by the upper ends of the inclined arms as the stack of sheets accumulates adjacent the alignment bar **46**. Driving movement is imparted to the sprocket by drive chain **66** which, in turn, is linked to power takeoff sprocket **67** fixed to shaft **68**.

The shaft **68** carries a dancer sprocket **69** at its distal end, which dancer sprocket **69** effects a driving connection to the power chain **70**, notwithstanding the horizontally adjusted position of the squaring belt assembly.

The power chain **70** is stretched around idler sprocket

71 and synchronized drive sprocket 72, the lower chain flight being arrayed across a further idler sprocket 73.

A presser sprocket 74 presses the upper flight downwardly, tension being maintained in the chain flight by a tensioning sprocket 75. The tensioning sprocket 75 is rotatably mounted on a pivotal lever arm 76, fulcrumed at 77 to the side walls of the frame. A tension spring 78 urges the end 79 of the lever downwardly, forcing the sprocket 75 upwardly against an undersurface portion of the upper flight of the chain, to maintain the chain under the desired degree of tension.

It will be appreciated that the section 80 of the chain is maintained taut by the above described chain distending assembly whereby the sprocket 69 (FIG. 3) is maintained in driving engagement with the substantially straight section 80 of the chain at any point along such section occupied by the upper end of the inclined arm assembly. Thus, as the rollers 61, 62 are shifted horizontally within the channels 60, 60, a driving connection with chain 70 is at all times maintained, and the squaring belt 48 is continuously driven.

As shown in FIG. 5, the synchronized drive sprocket 72 is mounted on shaft 81, which shaft is rotated by power takeoff chain 82 connected to a sprocket 83 affixed to the output shaft 84 of a gear reducer unit powered by squaring belt drive motor 85. The lower ends 54 of the arms 53 are pivotally fixed to a pair of vertically arrayed alignment bar support plates 86 by the opposed ends of the shaft 87 of the lower squaring belt roller 56, being pivotally mounted within appropriate bearing blocks secured to said plates. The plates 86 are mounted in spaced parallel relation by cross struts (not shown). Additionally, a horizontally disposed counter shaft 88 is rotatably secured at 89 and 90 to the plates 86.

The shaft 88 carries a pair of pinion gears 91, 91 adjacent its ends. The pinion gears 91, 91 mesh with vertical racks 92, forming one limiting side portion of vertical guide assemblies 93. Preferably, the shaft may include an additional roller at each end, recessed within the two side vertical guide assemblies 93, so as to prevent any lateral movement of the shaft.

The pinion gears 91, 91 are keyed to the shaft 88, the pinions as noted, being meshed with the rack portions 92 of the vertical guides 93. In this manner, i.e. by reason of the meshed relation of the gears at the ends of the shaft 88, it will be appreciated that when the shaft is shifted upwardly or downwardly within the confines of the guides 93, there is no possibility of any tilting of the shaft within the vertical plane in which the shaft is permitted to move. This tilt prevention results from the arrangement of the gears and rack, which will prohibit one end of the shaft rising above the other end, due to the fact that any lifting of the shaft is accompanied by a rotation, and a rotation of one end of the shaft induces a concomitant rotation and, hence, an equal lifting of the other end.

As best seen in FIG. 6, the alignment bar 46 is secured, as by machine screws 94, to the plates 86.

The force with which the peripheral portion 49 of the belt 48 is permitted to press against the advanced sheets is regulated by counterbalance assembly 51. The counterbalancing force, which may be supplied by conventional means, is, in the illustrated embodiment, developed by a pair of negator spring assemblies 95, 95, mounted to the side plates 26, 26. The negator spring assemblies exert a selected pull on lift cables 96 reeved over idler pulleys 97 and under lift pulleys 98 fixed to the side plates 86, the terminal ends 99 of the cables 96 being fixed to support pins 100 mounted on the side frames 26.

It will be thus understood that by adjusting the tension exerted by the negators 95, which tension is essentially constant throughout the entire stroke of the carriage, the pressure exerted by the peripheral portion 49 against the sheets may be closely controlled. The pressure should be such as to induce a substantial feeding force on sheets against the squaring plate 50 of the alignment bar 46, but not so great that after a sheet is pressed against the squaring plate, continued rotation and concomitant relative movement between the belt and sheet will cause abrasion or other damage to the sheet.

From the foregoing description, it will be evident that with each sheet that advances to a position against the squaring plate, the squaring belt and, accordingly, the side plates 86, together with all apparatus thereto connected, will be shifted upwardly an increment equivalent to the thickness of the sheet. As noted above, the upward shifting movement is constrained to be in a strictly vertical direction by reason of the pinions, racks and guides heretofore described.

There will next be described the assembly which selects the height of the stacks of sheets which are to be accumulated against the alignment bar during any given cycle.

The height of the stacks is determined by the degree of horizontal movement of the upper end of the squaring belt assembly.

Referring now to FIGS. 2, 3 and 4, a bracket member 101 is secured to a platform 102, the platform being fixed to the block within which shaft 64 is mounted or to a component connected thereto. Thus, the platform 102 will move in a horizontal plane in accordance with the movement of the upper end of the squaring belt assembly.

The platform carries a cam 103 including vertical slope components. The cam 103 is positioned to trip an adjustably located microswitch 104, having a depending finger 105 disposed in the path of the cam 103.

Depending upon the adjusted position of the microswitch assembly 104, the cam 103 will engage the finger 105 at a point which is a function of the number and thickness of sheets disposed beneath the peripheral point 49. In this connection it will be understood that the peripheral portion 49 must rise in a precisely vertical plane by reason of the mounting of the side plates 86 and, accordingly, a right to left purely horizontal movement of the platform 102, as viewed in FIG. 4, is the result of the accumulation of sheets beneath the peripheral portion.

In order to regulate the number of sheets which must be accumulated before the microswitch 104 will be tripped, there is provided a microswitch adjustment control. This control comprises a longitudinally extending screw 106, one end 107 of which is rotatably mounted in a bracket 108 fixed to side plate 26. A similar bracket 109 mounts an adjustment motor 110. The motor is of the reversible type and is connected to drive the screw in any selected direction of rotation.

The microswitch 104 includes a threaded coupling mounted on the screw, with the adjusted position of the microswitch being effected in response to a rotation of the screw by the motor 110. Preferably an index finger 111 is fixed to the switch, the finger being disposed adjacent a scale member 112 secured to the side plate 26. The scale may be lined in any convenient measuring unit, such as number of box blanks or the height in inches of a stack of sheets.

When the switch 104 is tripped by the cam member 103 the lift mechanism L next to be described is activated, the function of the lift mechanism being to clear the belt 48 from the stacked sheets, and permit their ready removal. Such clearing movement is powered by air cylinder assemblies 113, the lower ends of which (not shown) are affixed to the frame of the machine directly beneath the shaft 88 carrying the pinions 91.

Bearing blocks 114 are fixed to the upper ends of the piston rods 116 of the air cylinders 113. The bearing blocks 114 carry the outermost ends 117 of the shaft 88. It will thus be recognized that when air is admitted into the pistons 113 behind the rods 116, the rod will be driven upwardly, carrying with it the blocks 114, the shaft 88 being rotated by the meshed engagement of the pinion gears 91 and racks 92.

Upward movement of the shaft 88 will be communi-

cated to the side plates **86** and to the lowermost inclined arms of the squaring belt assembly supported within the side plates and the other mechanisms therewith associated.

Optionally, the air cylinders **113** may be employed as an additional counterbalancing means by maintaining within the cylinders a head of pressure sufficient to reduce the weight of the lower end of the squaring belt assembly against the sheets, the pressure being insufficient prematurely to lift the pistons.

As best shown in FIG. 6, there is preferably provided a safety apparatus effective to activate the air cylinders **113** prior to the formation of a completed stack, in the event that a sheet or sheets of corrugated board should be jammed, distorted or improperly fed into the area adjacent the squaring plate or alignment bar. This safety apparatus includes a cover plate **118** fixed to a pivot leaf **119** fulcrumed at **120**, the fulcrums **120** being secured to the side plates **86**. The leaf **119** includes a cutout portion **121** of inverted U configuration. A locator pin **122**, extending inwardly from the side plates **86**, is disposed within the cutout portions to provide a heightwise guide for the pivotal assembly.

The leaf **119** includes an upwardly directed trip finger **123**, which finger is positioned, upon upward pivotal movement of the leaf, to engage against the movable contact **124** of a microswitch **125** supported on a side plate **86** by brackets **126**. It will be appreciated, as best shown in dot and dash, FIG. 6, that should a skewed sheet curl under the peripheral portion **49** so as to engage against the forwardly extending plate **118**, the sheet will carry the plate and its associated leaf **119** pivotally about the fulcrum point **120** so as to engage the trip finger **123** against contact **124**, thereby energizing the air cylinders to the lifting function, whereby associated circuitry will stop the feed mechanism and enable manual or mechanical clearing of the offending sheet or sheets. The rollers will start rolling, pushing the stack out sidewise.

The squaring plate portion **50** of the alignment bar **46** is of comb-like configuration, including teeth or fingers extending downwardly between the rollers of the roller table **13**. Optionally there may be provided a similar comb-like auxiliary backstop plate **127** which will function, when the lowermost edge of the squaring plate **50** is lifted to a position substantially above the upper surfaces of the roller table **13**, to prevent undue movement of the lead edges of the sheets beyond the vertical plane of the squaring plate **50**. Preferably, plate **127** is aligned in close trailing proximity to the squaring plate, the position of the plate **127** being shiftable longitudinally by extension or contraction of the plate control rods **128**.

The apparatus incorporates a pair of horizontally directed adjustable compression springs **129** which bear against extensions of the side guide bars **63** and tend to urge the bars to the left, as viewed in FIG. 3. The springs **129** function primarily as dampers. When the squaring belt assembly is returned to its lowermost position by release of air from the cylinders **113**, the downward movement of the lowermost portion of the assembly in its final stages will be softened by the compression of the springs **129** against the guide bars **63**.

OPERATION

The operation of the device is as follows:

Columns of sheets from the sandwich conveyer **10** are advanced to the slowdown conveyer **11**, passing beneath the guide **17**. With the gate **20** open, as shown in FIG. 4, the shingled sheets moving past the gate are lengthwisely accelerated by passing between rollers **18**, **19**, being fed in the same linear direction as is imparted by the sandwich and slowdown conveyers.

Assuming that the gate **20** is moved to closed position, as the leading ends of the adjacent pair or set of box blanks B abut against the closed gate, the force of such abutment, though slight, may cause such leading edges to skew so that the adjacent side edges of such blanks may interleave. Thereupon, when the gate is again lifted, the sheets will again be advanced by the rollers **18**, **19**, but possibly with their edges interleaved.

Referring to FIG. 6, as the blanks or sheets pass between the lowermost peripheral portion **49** of the squaring belt **48**, the top surfaces of the sheets are frictionally engaged and urged by the moving belt against the squaring plate **50** of the alignment bar **46**.

It will be understood that there is a lost motion or frictional rubbing action between the lowermost peripheral portion **49** of the belt and sheets aligned against the squaring plate **50**, such that continued force is exerted against the sheets even after the lead edges are stopped from further advance.

It will also be understood that even if the sheets should be impinged against the plate **50** under substantial force, there is no tendency for the sheets to rebound by reason of the above noted continuous force urging the sheets toward the plate.

Should an adjacent pair or set of sheets have their side margins overlapped as they are impinged against the plate **50**, the apparatus will, in most instances, laterally separate and remove the sheets from the interleaved condition, so that the adjacent sheets will be in truly parallel relationship with no interleaving.

Specifically, the maintenance of the lowermost peripheral portion **49** in a precisely horizontal plane, by the meshing of the pinion gears and racks, will, in the event of an overlapping of adjacent sheets, result in a condition in which the lowermost peripheral portion **49**, instead of engaging in a linear contact area extending transversely across the entirety of the width, will instead engage merely the high point, i.e., the overlapping portion of the uppermost sheet. By reason of this selective engagement and the fact that the engaged sheet portion will normally be skewed, rather than perfectly square, a sidewise urging force is exerted against the overlapping sheet. This sidewise urging force is magnified by the combinaiton of the straightening effects resulting from only the leadmost corner of the skewed sheet being pressed against the alignment bar, as well as the upward shifting moment or vector developed from engaging a linearly moving component of the belt against an angularly oriented portion of the sheet.

The straightening force imparted to a skewed sheet or sheets is effective to laterally shift the adjacent sheet or sheets since the adjacent sheets are unweighted, the peripheral portion **49** engaging only the highest point (i.e. the overlap area) rather than the entirety of the upper surfaces of the sheets as is the case where there is no interleaving.

The outward force exerted against the sheets is of course, accompanied by a continued forward urging force, the net result being that interleaved sheets will be laterally spread from each other and continuously urged toward the squaring plate **50**.

As sheets progressively are fed beneath the peripheral portion **49**, the squaring belt assembly will be progressively raised and the upper portion of the assembly will be shifted to the left, as viewed in FIG. 4. When a sufficient leftward movement is achieved, the switch mechanism **104** will be activated by the cam **103** engaging the follower **105**, resulting in the gate **20** moving downwardly so that after the sheets beneath the gate have been advanced thereby, the gate will finally close, preventing additional sheets from passing to the stacker.

It will be understood that during the "down" cycle of the gate **20**, the conveyer **11** need not be shut off but that a supply of sheets may be permitted to accumulate adjacent the gate.

As previously explained, the air cylinders **113** will be energized, lifting the peripheral portion **49** from contact with the uppermost sheets in the accumulated stacks. By means of conventional electrical controls, after the

gate has closed and a slight period of time has elapsed to permit the final sheets to be deposited on the stacks formed on the squaring table **13**, a suitable drive mechanism (not shown) associated with the rollers R defining the squaring table, is actuated, to cause the stacks on the squaring table to be moved laterally onto the right angle takeoff conveyer **15**.

When all of the stacks have been cleared from the table **13**, as sensed preferably by a photoelectric detector, the high pressure head is relieved from the air cylinders, permitting the squaring belt assembly to be lowered, while raising the gate mechanism **20**, to allow the accumulated boards behind the gate to be fed to the roller table **13**.

From the foregoing it will be evident that by the present invention there is disclosed a sheet feed apparatus for corrugated cardboard or like stiff sheets which, for the first time, is capable of assuring that stacks of said sheets are in non-interleaved condition, facilitating their removal and further processing.

Unlike the haphazard stacking apparatuses heretofore known, the device of the present invention is capable not only of assuring that non-interleaved sheets do not become criss-crossed or overlap, but also that interleaved sheets are spread, squared and separated adjacent the alignment bar station, thereby correcting deficiencies which may exist in prior stages of the apparatus.

The device makes efficient use of transverse space and does not require spreader mechanisms or similar expedients, the net effect of which is to space the advancing sheets substantial distances from each other, so as to reduce the possibility of interleaving. Obviously, to increase the lateral spacing between adjacent advancing sheets will reduce the number of sheets which may be simultaneously accommodated and thus reduce the efficiency of the apparatus.

Adjustment of the apparatus to accommodate sheets of various lengths, and stacks of various heights, may be readily carried out. In both instances, adjustment may be effected by powerized means.

It will be evident that variations may be made from the specific structure of the illustrated apparatus without departing from the spirit of the invention. Accordingly, the invention is to be broadly construed within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. Apparatus for forming a plurality of side-by-side disposed lead edge aligned stacks of corrugated boards, comprising a support table adapted to receive said sheets as they are linearly discharged one atop the other, an alignment bar extending transversely of said table and positioned to engage the lead edges of sheets on said table, a squaring belt assembly means adapted to engage the upper surfaces of the uppermost sheets on said table and advance the latter against said bar, said assembly including a drive belt extending transversely across said table, the lowermost portion of said belt being tangent to and frictionally engaging the upper surface of the uppermost sheets on said table and being parallel with said bar, guide means supporting said belt while permitting movement of said lowermost portion in a plane normal to said table, and means for lifting said assembly to clear said lowermost portion from said sheets responsive to accumulation of a predetermined quantity of sheets adjacent said bar.

2. The apparatus of claim **1** wherein said drive belt is arrayed about a lower roller member, said lower peripheral portion of said belt being disposed beneath said roller member.

3. The apparatus of claim **1** wherein said guide means comprises a roller carriage within which said roller is rotatably supported, the apparatus including counterbalance means for controlling the downward pressure exerted by said peripheral portion against said uppermost sheet.

4. The apparatus of claim **1** wherein said guide means includes stabilizer means for preventing said lower portion from tilting within said plane whereby the latter is constrained to remain parallel to said table.

5. The apparatus of claim **1** wherein said squaring belt assembly means includes spaced parallel arm members, upper and lower parallel rollers rotatably mounted between said arm members, means for driving one of said rollers, a belt member arrayed about said rollers, said arms being inclined relative to said table, vertical guide means engaging the lower portions of said arms and permitting movement thereof in a vertical plane only, horizontal guide means engaging the upper portions of said arms and permitting movement thereof in a horizontal plane only, a powerized lift mechanism operatively connected to said lower ends of said arms for shifting said belt assembly upwardly to clear said peripheral portion from contact with said sheets on said table responsive to a selected amount of horizontal movement of said upper portions of said arms.

6. A straightener apparatus for eliminating interleafed conditions between the sheets of a row of adjacent stacks of front edge aligned corrugated sheets, comprising a horizontal support table upon which plural side-by-side disposed sheets are simultaneously deposited, a carriage mounted for longitudinal adjustment relative to said table to accommodate sheets of a variety of sizes, said carriage including vertical guide track means and a transversely extending alignment bar forming an end stop on said table, a horizontal guideway mounted on said carriage in spaced parallel relation to said table, a squaring belt assembly supported on said carriage and including a spaced, parallel pair of inclined arms defining a frame, first mounting means connecting the upper edge of said frame to said horizontal guideway for horizontal sliding movement and pivotal movement about a horizontal axis, second mounting means connecting the lower edge of said frame to said vertical guide track means for vertical and pivotal movement with respect thereto, upper and lower rollers adjacent the upper and lower ends, respectively, of said frame, a drive belt arrayed about said rollers, said belt extending transversely across substantially the entire width of said table, the lowermost portion of said belt projecting below said frame and being parallel with said projecting below said frame and being parallel with said table and bar, and drive means rotating one of said rollers to drive said belt in a direction to advance said lowermost portion toward said bar.

7. The straightener apparatus of claim **6** wherein said drive means for said roller includes a driven, elongated chain member arrayed on said carriage, said chain member having an elongated drive section disposed parallel with and adjacent said horizontal guideway, a sprocket mounted to said frame and meshed with said drive section, said sprocket being shiftable lengthwisely relative to said drive section of said chain throughout all horizontal movements of said frame relative to said carriage.

8. The apparatus of claim **7** and including means operatively associated with said lowermost inclined end for preventing tilting of said end within said vertical plane.

9. The apparatus of claim **8** and including lift means operatively associated with said second mounting means for bodily lifting said belt clear of sheets aligned against said bar.

10. The apparatus of claim **8** and including adjustably positioned switching means on said carriage activated responsive to preselected relative horizontal movement between said first mounting means and said horizontal guideway for energizing said lift means.

11. The apparatus of claim **10** wherein said switching means comprises a switch on said stationary carriage, a bracket on said upper end of said frame, said switch and bracket including cam and follower members shifted into tripping engagement of said switch responsive to said horizontal movement of said upper end of said frame.

12. The apparatus of claim 6 wherein said bar includes a horizontal top plate member positioned to overlie the lead edges of said sheets against said bar, pivot connection means hinging the trailing edge of said plate member to said bar, and malfunction switch means actuated responsive to upward pivoting movement of said plate relative to said bar, induced by a sheet extending above the lowermost portion of said belt, for interrupting movement of said drive belt.

13. The apparatus of claim 12 and including lift means operatively connected to said second mounting means and actuable to lift said second means in said vertical guide, said lift means being energized responsive to actuating of said malfunction switch means.

14. The apparatus of claim 12 and including hold-down plate means adjacent the junction of said top plate and said bar for preventing sheets adjacent said bar from engaging and pivoting said plate member.

15. The method of forming a series of columns of side-by-side disposed, linearly advanced corrugated sheets into a plurality of non-interleafed side-by-side disposed stacks, comprising the steps of feeding said sheets onto a horizontal support member, interposing a stop bar across said support member in position to engage the lead edges of said sheets, advancing the lead edges of successive sheets over the trailing edge of preceding sheets on said support member, yieldingly urging a drive member continuously advancing toward said bar against the upper surfaces of said sheets with limited force, said drive member engaging said sheets at a linear locus of contact which is maintained parallel to said support surface and said bar, said driving force being applied to said sheets for a period of time after the lead edges of said sheets have been stopped by engagement with said bar.

16. A stacker apparatus for forming a plurality of side-by-side disposed, lead edge aligned, discrete stacks of corrugated paper comprising in-feed conveyer means for serially, linearly advancing a plurality of side-by-side sheets in shingled array at a first rate of speed, a temporary storage table in advance of said conveyer, a vertically movable gate interposed between said conveyer and

said table to interrupt discharge of sheets, sheet accelerator rollers operating at a speed in excess of said first rate and positioned to receive said side-by-side sheets from said in-feed conveyer and lengthwisely advance said sheets onto said table in said linear direction relative to the trailing sheets remaining on said in-feed conveyer, an alignment bar extending transversely across said table, a squaring belt assembly spaced vertically of said table and upstream of said bar in proximate spaced relation thereto, said belt assembly including a sheet drive belt having a lower-most peripheral portion parallel with said bar, guide means supporting said belt in a plane normal to said table while maintaining said peripheral portion against tilting within said plane, said peripheral portion being continuously advanced toward said bar, counterbalancing means urging said peripheral portion downwardly into contact with the upper surface of the uppermost sheets on said table with a predetermined desired force, and means for bodily lifting said bar and said belt assembly above said sheets on said table responsive to the presence of a selected height of sheets adjacent said bar.

17. The apparatus of claim 16 in which means are provided to lower said gate means when said bodily lifting means is activated.

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ANDREW R. JUHASZ, Primary Examiner

J. F. COAN, Assistant Examiner

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