Nov. 9, 1954 J. A. HARTMAN 2,693,742

SEPARATING AND STACKING MACHINE

Filed Feb. 9, 1951 6 Sheets-Sheet 1

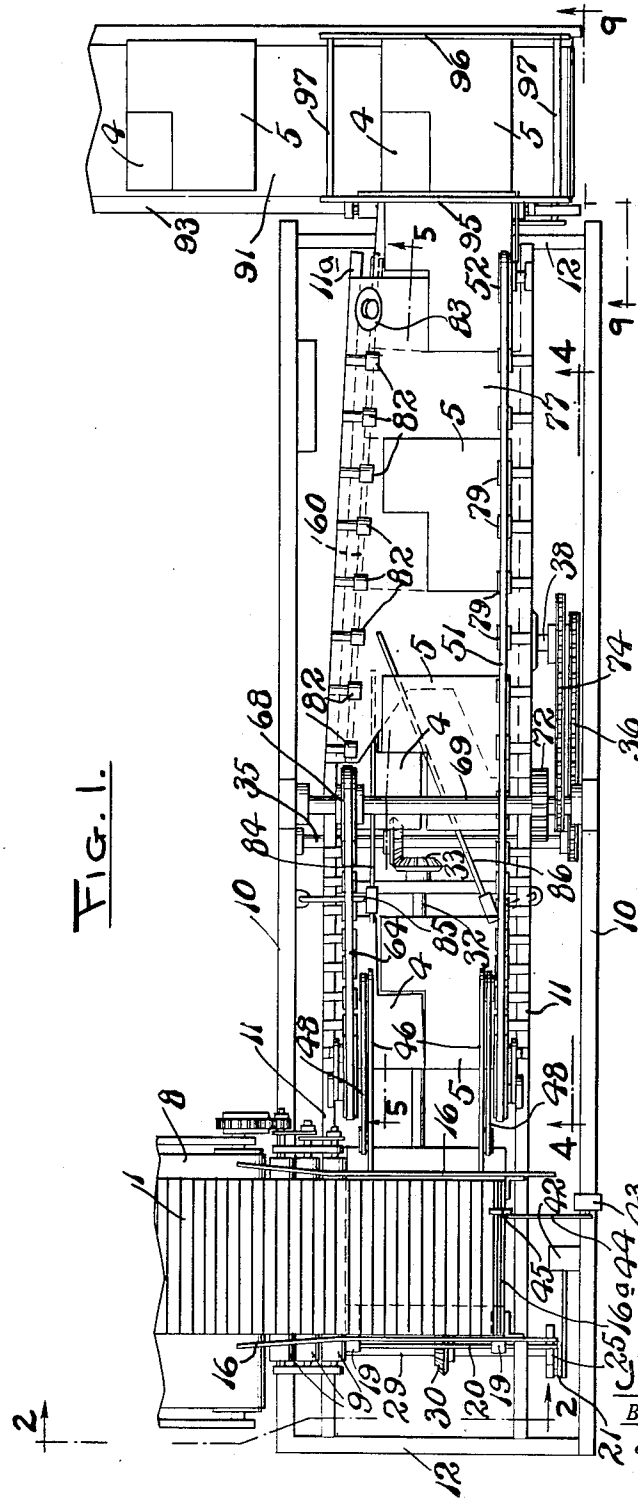


FIG. 1.

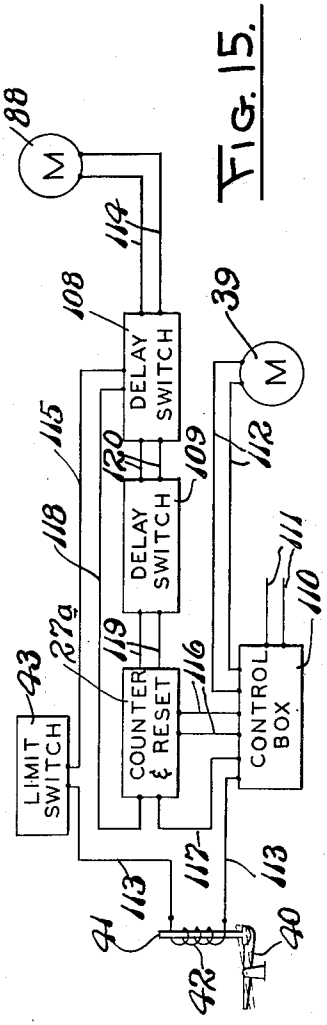



FIG. 15.

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SEPARATING AND STACKING MACHINE

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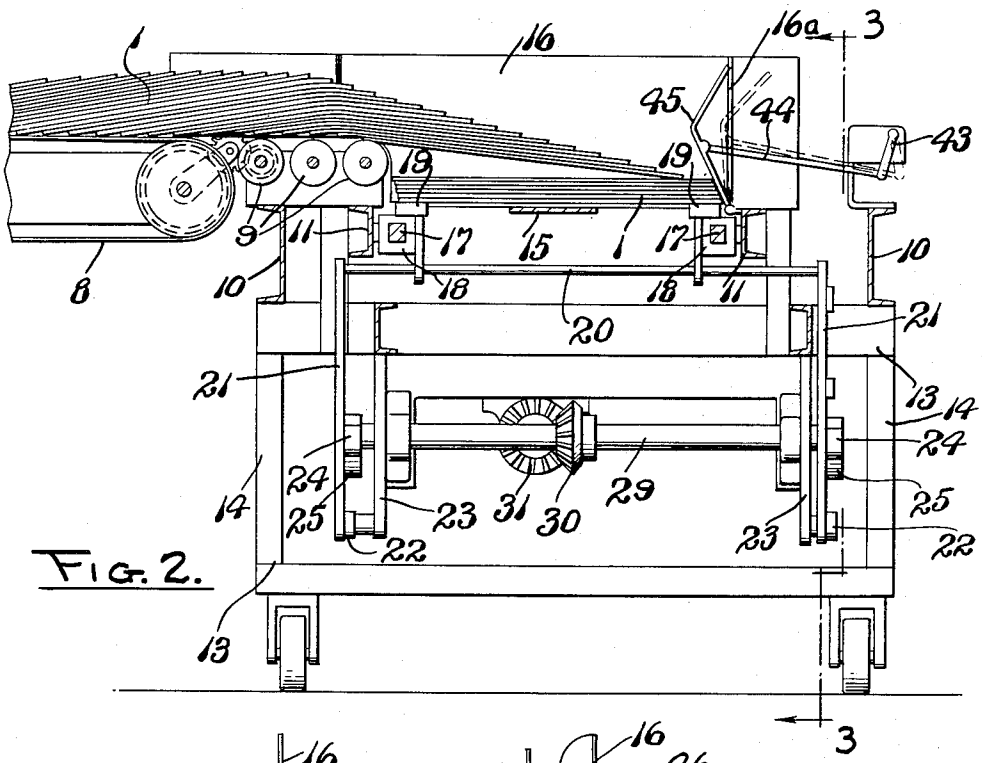



FIG. 2.

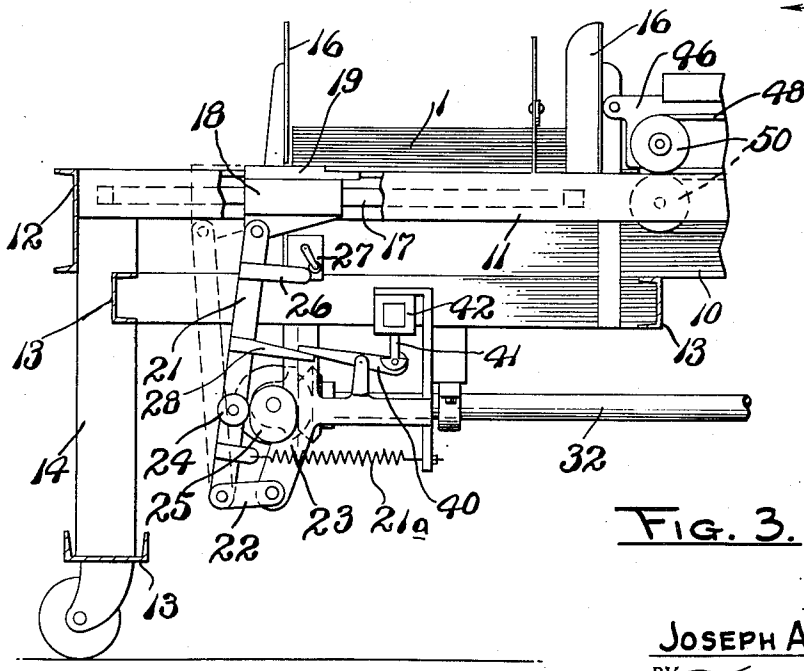



FIG. 3.

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SEPARATING AND STACKING MACHINE

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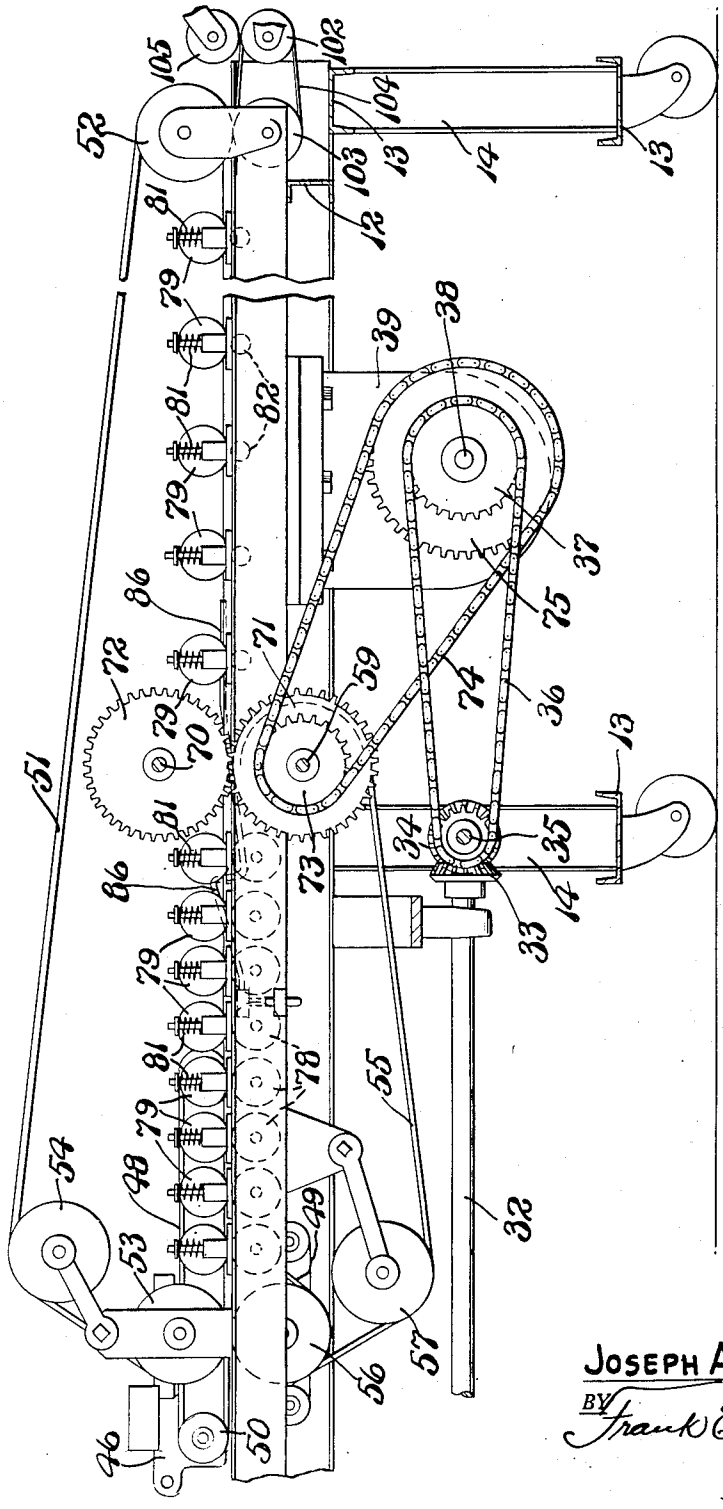



FIG. 4.

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SEPARATING AND STACKING MACHINE

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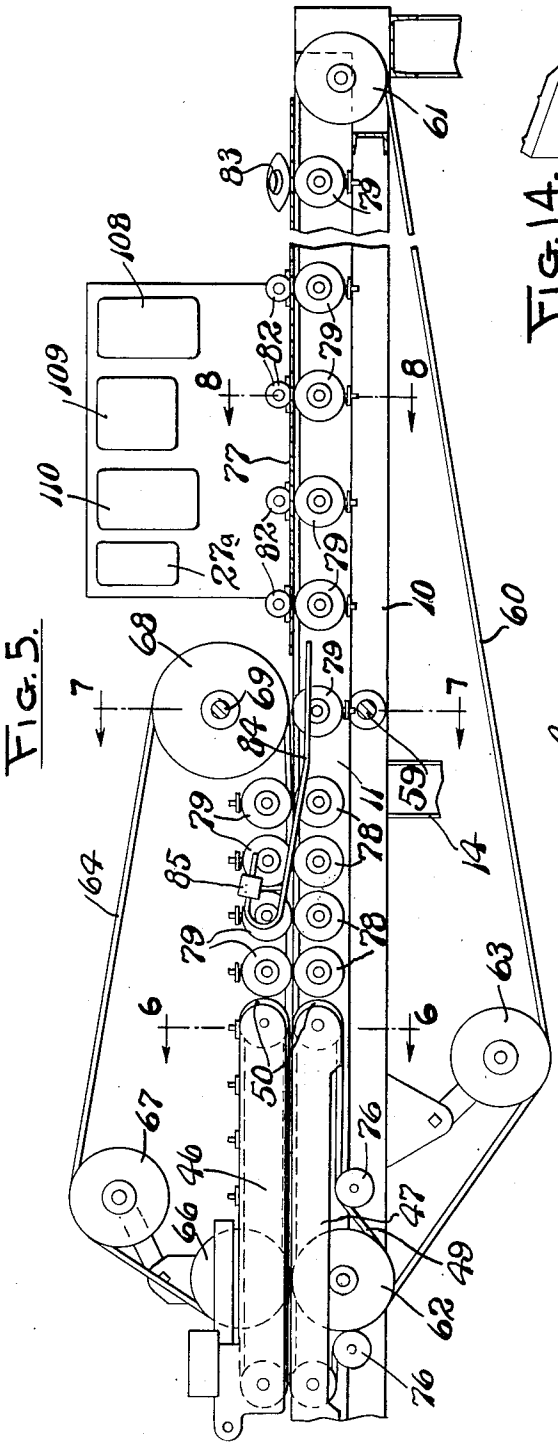


FIG. 5.

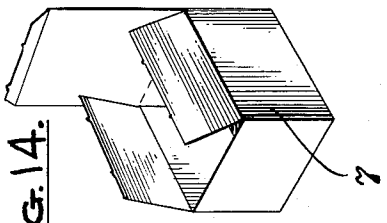


FIG. 14.

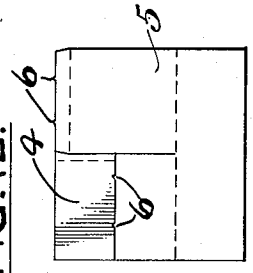
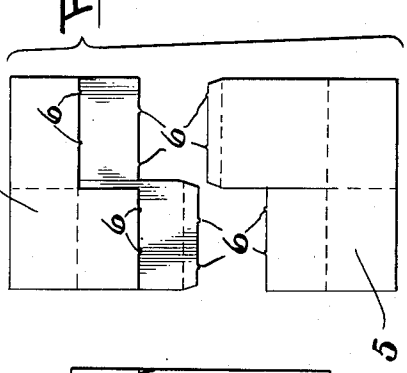


FIG. 13.



FIG. 12.



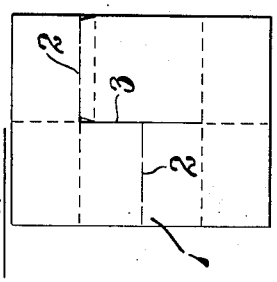


FIG. 11.

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SEPARATING AND STACKING MACHINE

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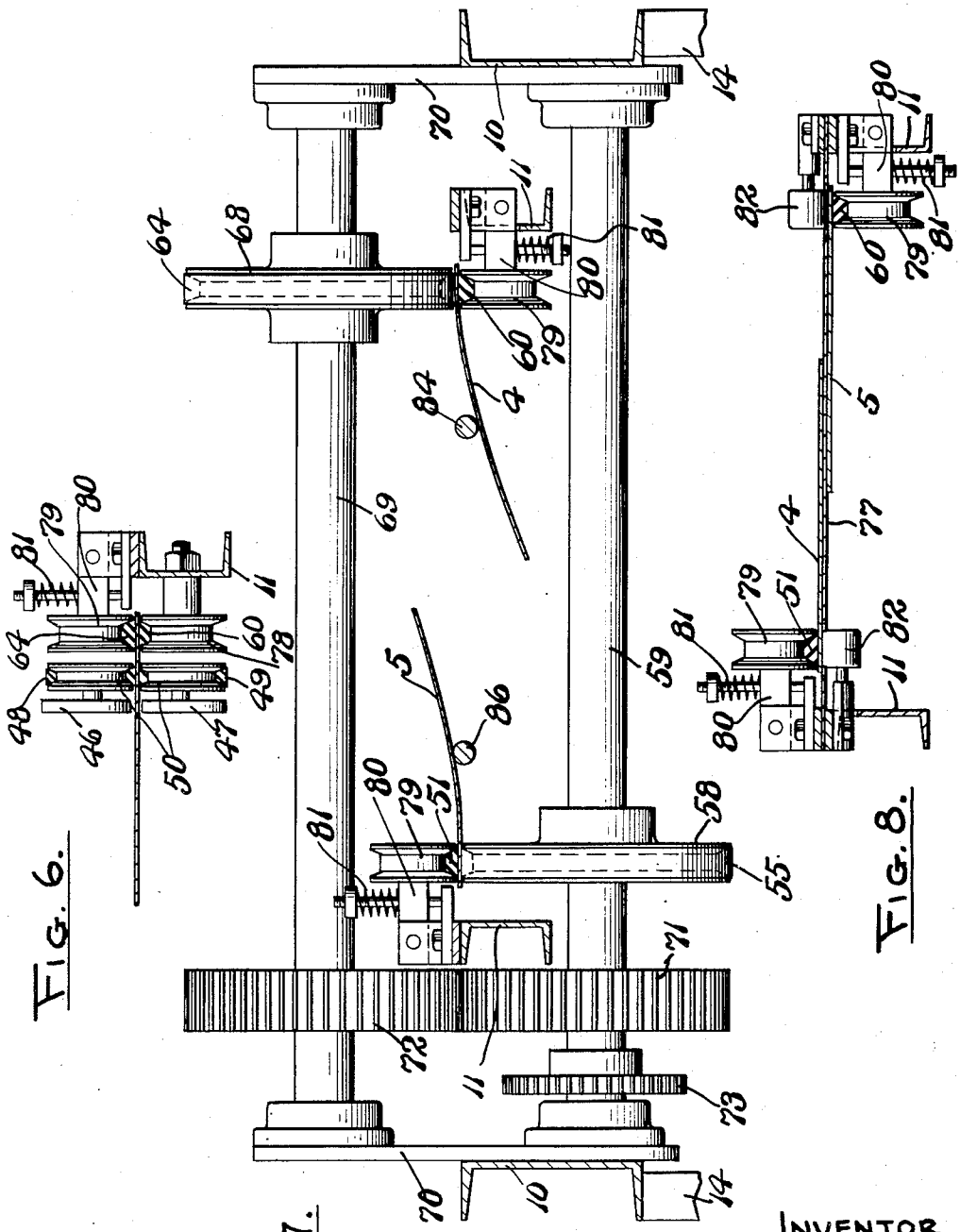


FIG. 6.



FIG. 8.



FIG. 7.

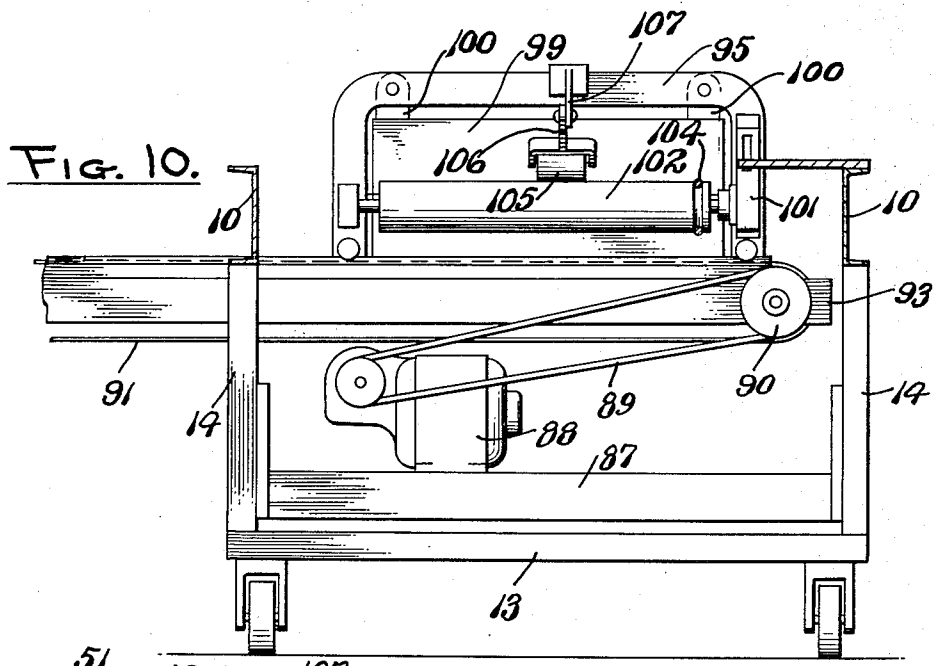
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SEPARATING AND STACKING MACHINE

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FIG. 10.



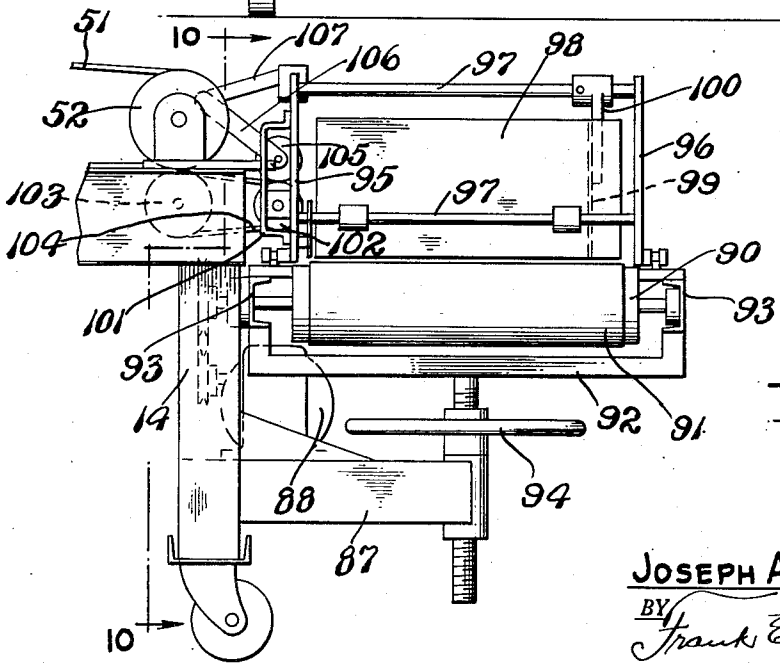




FIG. 9.

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United States Patent Office 2,693,742
Patented Nov. 9, 1954



2,693,742

# SEPARATING AND STACKING MACHINE

Joseph A. Hartman, Grand Rapids, Mich., assignor to American Box Board Company, Grand Rapids, Mich., a corporation of Michigan

Application February 9, 1951, Serial No. 210,249

6 Claims. (Cl. 93—36)

This invention relates to a novel, practical and very useful machine for separating into two parts, from each of which a complete paper board box may be made, a folded paper board structure, which has two opposed sides with cuts transversely in such sides, leaving small area connections at intervals in said cuts, which when pulled apart, separates the paper board structure into two parts each of identical structure, and each of which is a complete paper board box in folded flat condition ready to be immediately unfolded into useful operative form.

Such separation as heretofore done has been by workers, usually women, who have grasped the paper board structure at opposite edges and separated the two parts thereof from each other by outward pull at each of said edge portions, rupturing the spaced small integral connecting portions at the separating cuts provided in the opposite sides of the initial structure from which two complete boxes or cartons are made. The work of such separation, when manually done is hard and trying, and is disliked by those who have to do it. In addition, the labor cost of producing the boxes is increased over the cost of separation which is performed by the machine of my invention. With my invention such separation and the delivery of the separated box parts in a stacked relation at the outlet end of the machine, is expeditiously and satisfactorily accomplished, a separating machine of my invention being capable of doing the work of several workers and in a better and more efficient manner.

It is therefore, the object and purpose of the present invention to provide a very practical, useful and exceptionally efficient machine for the purpose stated, and by means of which economy of manufacture is attained with high quantity production.

An understanding of the invention may be had from the following description, taken in connection with the accompanying drawings in which,

Fig. 1 is a plan view of the machine of my invention, with fragmentary portions in plan of the conveyor for delivering the paper board structure to be processed at one end of the machine, and a second conveyor at the other end of the machine for carrying the separated boxes in folded form and stacked one upon the other away, when a predetermined number of such boxes has been delivered.

Fig. 2 is an end elevation partly in section of the machine shown in Fig. 1, the view being taken substantially in the vertical plane of the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary side elevation of the entrance end portion of the machine of my invention, with some parts of the outer frame members removed and other parts shown in transverse vertical section.

Fig. 4 is a fragmentary enlarged longitudinal vertical section and elevation, substantially on the plane of line 4—4 of Fig. 1.

Fig. 5 is a fragmentary longitudinal vertical section, substantially on the plane of line 5—5 of Fig. 1.

Fig. 6 is a fragmentary transverse section substantially on the plane of line 6—6 of Fig. 5.

Fig. 7 is a somewhat enlarged transverse vertical section, on the plane of line 7—7 of Fig. 5.

Fig. 8 is a similar transverse vertical section, on the plane of line 8—8 of Fig. 5.

Fig. 9 is a fragmentary side elevation of the rear end portion of the machine, the view being taken substantially at the plane of line 9—9 of Fig. 1.

Fig. 10 is an elevation and partial section of the receiving conveyor at the outlet end of the machine of my invention, the view being taken at substantially the plane of line 10—10 of Fig. 9.

Fig. 11 is a plan view of the two box connected paper board structure which is to be separated by the machine into two complete box parts.

Fig. 12 is a plan view of the two parts, each a complete paper board box, after such separation.

Fig. 13 is a plan view showing the two parts of Fig. 12, superimposed one upon the other as they leave the separating machine.

Fig. 14 is a perspective view of the paper board box or carton which is produced from each of the parts separated by the machine and,

Fig. 15 is a diagram of the electrical circuits and connections used in the operational control of the machine.

Like reference characters refer to like parts in the different figures of the drawings.

The paper board structure which is to be pulled apart and separated into two complete boxes or cartons, shown at 1 in Fig. 11, has upper and lower superimposed sides at the upper and lower ends of which (in Fig. 11) end closure flaps (not shown) are turned inwardly between the two upper and lower sides. Such sides are cut transversely upon the lines at 2 partially across, being connected at their inner ends by a connecting cut 3 at right angles thereto, the cuts in the two opposite sides of the paper board structure 1 being at different positions, and with the cuts at 2 not continuous but in successive short lengths, with shorter integral connecting portions which are pulled apart when (in Fig. 11) the upper and lower edge portions are grasped to separate them into two folded boxes or cartons 4 and 5 (in Fig. 12). The integral connecting portions which are ruptured on such pulling apart are shown at 6. The flaps which make the bottom of a carton are at the opposite ends of the two folded boxes 4 and 5, that is at the upper end of the folded carton 4 in Fig. 12, and the lower end in the box or carton 5. From each of the folded boxes or cartons thus separated from each other, a carton as at 7 in Fig. 14 may be made by pressing the bottom end closure flaps downwardly into a horizontal plane, such flaps automatically connecting together by suitable structure for such purpose, leaving the upwardly extending end closure flaps, shown in Fig. 14 open for the reception of material to be held within the carton until it is filled, after which the upper end is closed and sealed.

This structure of double box or carton is old and well-known and is produced on a machine for such purpose. With my invention from such machine which produces the double box structure indicated at 1, such structures are delivered one after the other at the entrance end of the separating machine of my invention. As shown in Figs. 1 and 2, an endless belt conveyor 8 horizontally located, and in which the belt moves slowly, carries the double box structures 1 from the machine in which they are fabricated in the overlapped relation best shown in Fig. 2 over rollers 9, into a receiving hopper or bin therefor in which they are received, stacked one over the other. Such receiving bin or hopper is at one end of the frame of the machine of my invention. The frame includes spaced parallel longitudinal side beams 10, inwardly of which are smaller generally parallel rails 11 both being of channel form. The beams 10 at their ends have cross frame members 12 connected therewith and there are also other cross members of the frame between the ends of the beams 10, supported at a proper height by under structure including cross beams 13 and posts 14. The frame preferably is mounted on rollers for movement from one place to another, which however are not essential to the invention.

The receiving hopper for the double box structures 1, which are to be separated into two parts, includes a horizontal bottom 15 lying in substantially the same horizontal plane as the upper flanges of the channel beams or bars 10 and 11. One of said inner bars 11 may be substantially parallel to its adjacent frame beam 10, and the other be parallel thereto for approximately half of the length of the machine and then located at an acute angle to its adjacent frame beam 10, converging at the delivery end of the machine toward the other beam or

channel bar **10**; or such angularly positioned beam, indicated at **11***a* in Fig. 1, may have a hinged connection to the front section **11** so as to be located in a desired angular position. Two spaced apart vertical sides **16** for the receiving hopper are mounted on and extend across the bars **10** and **11**. A vertical end plate **16***a* provides an end to prevent the double box structures **1** from moving too far. Thus when the articles at **1** are slowly moved by the conveyor **8** to the right in Fig. 2, they pass from said conveyor to rollers **9** which are driven by gearing connections and belts as shown in Fig. 1 from the end roller of the conveyor **8**, and are stacked in this hopper one over the other as shown in Fig. 2.

From the stack they are ejected, the lowermost double box structures **1** being successively moved outwardly underneath the inner or rear side plate **16** of the hopper. The feeding or ejecting of the lowermost double box structures **1** includes spaced horizontal guide bars **17** parallel to the beams **11** and secured thereto, upon which slidable members **18** are mounted for movement (Fig. 3), each at its upper side having a shoe **19** secured thereto, which is thinner at its rear portion than at its front, providing an engaging shoulder to engage the edge of the lowermost member **1** and move it on reciprocatory movement of the guide **18** and attached shoe at **19** in the proper direction. Each of the guide members **18** is pivotally connected at its front end to a horizontal rod **20**. The rod **20** at its ends is connected to the upper ends of two spaced bars **21** extending downwardly, each at its lower being connected by a link **22** with a bracket support **23** mounted upon the under frame of the machine. A distance above the lower end of each bar **21** a roller **24** is mounted which is adapted to be engaged by an eccentric or cam **25**. Near the upper end of one of the bars **21** a finger **26** projects to one side which in the rocking movements of the bar **25** operates a counter **27**. Between the roller **24** and the finger **26** a second bar or finger **28** is permanently secured extending in the same direction as the finger **26**, the purpose of which will be later described.

The cams **25** are secured at opposite ends of a horizontal cross shaft **29**, supported by bearings on the bracket supports **23**. A beveled gear **30** between its ends is driven by meshing engagement with a second bevel gear **31** on a longitudinal, generally horizontal shaft **32** (Fig. 4) which extends rearwardly underneath the frame of the machine. At its rear end it has a second bevel gear **33** in meshing engagement with a gear **34** on a cross shaft **35**, which is driven by a chain drive **36** from a chain driving wheel **37** on the shaft **38** of an electric motor **39**, mounted on and suspended from the machine frame. In the operation the motor **39** is driven continuously so that the shaft **29** and the eccentric cams **25** thereon are continuously rotated at a uniform speed. When the rollers **24** are bearing against the cams **25**, bars **21** are rocked back and forth with a consequent reciprocation of the shoes **19** to successively feed or eject the lowermost double box structures **1** to the rear.

A lever **40** (Fig. 3) is pivotally connected between its ends on an upwardly extending finger of the bracket **23**, pivotally connected with which is the lower end of an armature **41** of a solenoid **42**, which is interposed in a hereafter described electric circuit, one end of a circuit wire of such circuit being connected to one side of a limit switch **43** carried, as shown in Fig. 2, a spaced distance from the open end of the hopper which receives the structures **1**. The limit switch **43** is operated by a link bar **44** connected at one end to the switch, and at the other end to a bent lever **45** pivotally mounted on its lower end and extending upwardly at the back or closed end of said receiving hopper. When, as shown in Fig. 2, the lever **45** is in its full line position the switch at **43** is closed, solenoid winding **42** is energized and the lever at **40** instead of being tilted upwardly at its free end as shown in Fig. 3 is disposed in a substantially horizontal position, so that the free end of lever **40** and the end of the finger **28** will abut against each other. The rollers **24** are thus held at a sufficient distance from the cams **25** that the reciprocating shoes **19** and parts connected therewith do not operate. With the filling up of the hopper, the edges of the parts **1** coming against the bent lever **45** move it about its pivotal mounting toward the dash line position shown in Fig. 2, whereupon the solenoid winding **42** is deenergized, the switch **43** being actuated by the lever **45**, and the armature **41** moved to turn the lever **40**, moving it out of the path of movement of the finger **28**. The springs **21***a* acting on levers **21** bring the rollers **24** against the cams **25** and the reciprocating shoes **19** operate as long as the circuit opened by the limit switch remains open. But when the supply in the hopper diminishes, lever **45** returning to its full line position shown in Fig. 2, rollers **24** are held away from the cams **25**, and the feeding or ejecting is interrupted until there is a replenishment of the supply within the hopper which will move the lever **45** from the full line position shown in Fig. 2 to or toward the dash line position sufficiently to actuate the switch **43**.

The movement of the conveyor belt **8** is at a rate of speed such that the ejecting by the reciprocating movements of the shoes **19** is in excess of the supply coming to the hopper. This insures that the feeding or ejecting will always operate when there is a sufficient supply, will stop when the supply has diminished to a predetermined degree, and that the hopper will not overfill, which if it happened would interfere with the movement of the members **1** into the hopper. Such movement caused by the slow moving conveyor belt **8** is continuous and uninterrupted. The capacity of ejecting being greater than the rate of supply to the hopper no interference occurs. There is merely an interruption of the operation of the feeding mechanism. The rotation of the driving motor **39** and of the cams **25** being uniformly continuous, an immediate picking up operation of feeding or ejecting takes place when the hopper has been resupplied to a sufficient amount.

Connected to the rear side of the rear vertical hopper side **16** are two upper horizontal flat bars **46** in vertical planes, spaced from each other, and below them flat bars **47**. The bars are in pairs, and upon them, upper and lower endless belts **48** and **49** are mounted on pulleys **50**, the lower runs of the upper belts and the upper runs of the lower belts being adapted to lie against each other and run in the same direction, receiving the ejected double box structure **1** between them, to move them rearwardly.

At a side of the machine and above the upper side of the bars or beams **11**, an endless V-belt **51** runs around a rear roller **52** mounted at the rear end of the frame on the bar **11**, has a horizontal under run (Fig. 4) which is in substantially the same plane as the under run of the adjacent upper endless belt **48** previously described, passing around an idle roller **53** and thence upwardly and over a tension roller **54** which may be adjusted to tighten the belt **51**, as shown in Fig. 4. Such belt **51** (Fig. 1) is located a short distance outwardly from the adjacent belt **48**.

Underneath the front portion of the under run of the belt **51** is the upper run of a second shorter endless belt **55**, which passes around a grooved roller or pulley **56**, thence downwardly underneath an adjustable tension pulley **57**, then to the rear over a pulley **58** (Fig. 7) and, therefrom horizontally forward to the first mentioned pulley **56**. The pulley **58** with a V-groove therein to receive the V-belt **55** is connected or otherwise secured on a shaft **59** mounted on and extending between the frame sides **10**. Such shaft **59** is located intermediate the ends of the machine.

At the opposite side of the machine, which will be the upper side in Fig. 1, an under long endless belt **60** is mounted, going around a rear roller **61** mounted on the frame member **11** (Fig. 5), its horizontal upper run being located so that its upper side engages snugly the lower run of a shorter endless belt, later described, above it at its forward portion. The upper horizontal run of the belt passes over and downwardly around a pulley **62** and thence underneath an adjustable tension pulley **63**, extending upwardly and to the rear therefrom to the pulley **61**. The belt **60** and its mounting is similar in length to the belt **51**, but substantially reversed as to location, and while the upper belt **51** lies in a vertical plane substantially parallel to the side beam **11** adjacent it, such lower endless belt **60** first diverges outwardly for a part of its length until the inclined section **11***a* is reached, and then is directed to converge inwardly at its rear portion as shown in dotted lines in Fig. 1.

Above the front portion of the under long belt **60** is a shorter endless belt **64** of substantially the same length as the belt **55**, the under horizontal run of which rides snugly upon the forward portion of the upper horizontal run of the belt **60**. It passes around a front roller

66 directly over the pulley 62 (Fig. 5), thence upwardly over an adjustable tension pulley 67 and thence to the rear over a pulley 68 on a horizontal shaft 69 (Fig. 7) mounted upon and extending between posts or brackets 70 secured to and extending above the side bars or beams 10 of the frame (Fig. 7).

Shafts 59 and 69 have meshing gears 71 and 72, respectively, of the same pitch diameter. Shaft 59 has thereon a sprocket wheel 73 around which a drive chain 74 passes, it in turn being driven by a driving wheel 75 on the shaft 38 of motor 39. Accordingly, with the motor continuously running, shafts 59 and 69 run continuously, and the several endless belts which, in practice are V-belts, extending between and going around grooved pulleys therefor, also run continuously. The two belts 60 and 64 have their upper and lower runs snugly bearing against each other. Between them (Fig. 1) the outer edge portion of the folded or collapsed box or carton 4 of the two box structures 1 is gripped. Similarly the two endless belts 51 and 55, at the opposite side of the machine, have their lower and upper runs in snug engagement against each other, and the outer edge portion of the opposite collapsed box 5 gripped. The belt 48, adjacent the belt 64, parallels it in its divergence.

A double box 1, when fed or ejected by the movement of the jaws 19 in one direction, comes to the lower runs of the upper belts 48 and the upper runs of the lower belts 49 first, and immediately thereafter comes between the contacting runs of the upper belts 51 and 64 at each side edge and the contacting runs of the lower belts 55 and 60 at each opposite side edge, being firmly gripped at the opposite edges. The divergence of the belts at the front of the machine causes the connecting portions at 6 (Fig. 12) to be ruptured, so that the two parts 4 and 5, by the time they reach the rear end of the belt 64, are fully separated from each other and are thus independent of each other.

The bars 46 and 47 may be mounted for a limited longitudinal adjustment and the pulleys 56 and 62 are pulleys serving a double purpose, one to carry the belts 60 and 55 and the other providing driving engagement with the lower runs of the belts 49 which belts, engaged with pulleys 56 and 62, will be held in secure fixed engagement therewith through passing over the idle pulleys 76. The bars 46 and 47 may be adjusted when, for example, the rear side 16 of the receiving hopper is adjusted toward or away from the other parallel side 16 for different sizes of boxes processed in the machine.

Immediately back of the vertical plane of the shafts 59 and 69, a flat horizontal plate 77 is fixed extending between the bar 11 and the inclined bar section 11*a*, permanently secured thereto and reaching substantially to the rear ends of said bars 11 and 11*a* (Fig. 1). The upper run of the long endless belt 60 at one side of the machine passes underneath this plate. The lower run of the other long endless belt 51 rides over the upper side of the plate 77 (Fig. 8).

Mounted on the bars 11 forwardly of the plane of the shafts 59 and 69 are a plurality of spaced grooved rollers 78 which extend (Fig. 1) to within a short distance of the rear hopper side 16 over which the upper runs of the belts 60 and 55 ride (Fig. 6). Directly over such rollers 78 at the front portion of the machine are other like rollers 79 carried on supports 80 which are pivotally mounted on the adjacent bar 11, and are spring actuated by coiled springs 81 (Fig. 6) to press the lower run of the belt 64 downwardly against the belt 60 or the adjacent edges of the work processed. Also such rollers 79, spring pressed and actuated in the same manner (Fig. 4), but spaced greater distances apart extend back of the plane of the shafts 59 and 69 to act upon the lower run of the belt 51 substantially throughout its length. As shown in Fig. 5, like rollers 79 are back of the vertical plane of said shafts 59 and 69 under the plate 77 pressing upwardly against the rear portions of the upper run of the belt 60.

At the rear portion of the machine at the side thereof back of the short upper belt 64, small rollers 82, spaced from each other, and one over each of the under rollers 79 are mounted on the adjacent bar 11. Similar small rollers 82 are mounted underneath the upper spring actuated rollers 79, underneath which the lower run of the belt 51 passes (Fig. 8). The plate 77 has openings therein so that such rollers 82, when the machine is empty, snugly engage the belts 51 and 60; and when the machine is in operation, and the two separated box parts



4 and 5 pass, the first over, and the second under the plate 77, the edge portions of said collapsed boxes 4 and 5 are gripped and carried to the rear or delivery end of the machine. At the rear end of the plate 77 and in alinement with the small upper rollers 82, a beveled roller 83 mounted on an inclined axis is carried as shown in Fig. 1, the bevel side of which engages the under collapsed boxes 4 at their edge portions as they pass underneath, the plate 77 holding them in contact with the belt 60.

The two collapsed boxes 4 and 5 which are provided by the rupture of the narrow connecting sections at 6 (Fig. 12), as previously mentioned pass one underneath the horizontal plate 77 and the other above it. Collapsed boxes 4, in the structure shown, pass underneath the plate and the boxes 5 above it. This is caused by downward operating direction rods. One at 84 is mounted on a mounting bracket 85 connected with the side 10 of the frame nearest to it which, as shown in Fig. 5, directs the separated collapsed boxes 4, as they come to and pass under such direction rod, downwardly so that the edge portions thereof, which are not gripped by the belts and rollers, are carried downwardly (Fig. 7) to pass underneath the plate 77 and be carried thereunder to the rear.

A second direction rod 86 (Figs. 1 and 4), as shown in Fig. 4, at its front end is below the separated box 5, inclines upwardly to the rear and then turns abruptly downward for a short distance and, thereafter, upwardly and to the rear whereby when the boxes 5 leave such rod 86 they are above the plate 77. The intermediate abrupt downward formation of the rod 86, shown in Fig. 1, will be located at a point where the adjacent inner edge portions of the boxes 4 and 5 pass thereover, and serves to lift them if the connecting portions 6 have not been fully disrupted, aiding in the completion of such disruption or breaking if needed.

It is apparent that, thus far described, the joined together boxes, joined by the small connecting portions 6, continuously delivered into the receiving hopper of the machine, causes starting of operation of the feeding or ejecting mechanism when a sufficient number have been entered into the hopper to cause the actuation of the switch 43. The rollers 24 on the bars 21 are released by the solenoid operation of the lever 40, disengaging it at its free end from the end of the finger 28, and bear against the cams 25. Such cams 26 continuously rotate but operate the feeding or ejecting mechanism only when the rollers 24 are against them. The ejecting from the bottom of the hopper, being faster than the double boxes 1 are supplied to the hopper, as the quantity in the hopper is diminished and reaches a predetermined low, switch 43 is operated in the reverse direction, releasing the lever 40 which has been held by the armature of the solenoid 42 so that it moves at its free end into the path of movement of the free end of the finger 28 (Fig. 3) holding levers 21 and the rollers 24 carried thereby in a position such that the cams 25 freely operate without operating the feeding or ejecting mechanism.

Such a machine is complete for separating the two connected, complete boxes 4 and 5 from each other, carrying them to the delivery end of the machine and delivering them from the machine with one of the boxes superimposed over the other. It is apparent that because of the angular inclination of the bar 11*a* and the corresponding convergence of the lower belt 60 the under box 4 which is carried underneath the plate 77, when delivered, will be located directly underneath the upper box 5, which has been carried over the upper side of the plate 77. Such machine, if nothing further is added to it, will separate the boxes and deliver them one over the other at the delivery end of the machine, where they may be received by a worker and manually stacked.

However, with my invention, the elimination of the worker at the delivery end of the machine, for taking the separated boxes and stacking them in piles, is accomplished by a machine stacking of the boxes and their movement in piles of preselected numbers to a side of the box separating machine, to clear the delivery end of such machine for a succeeding pile or pack of the boxes.

At the rear or delivery end of the machine (Fig. 9), a relatively heavy supporting platform 87 is secured a short distance above the floor. On the platform is an electric motor 88 which (Fig. 10), when it is operating, through a belt drive 89 drives an end roller 90 of an endless conveyor belt 91, the upper run of which carries the delivered boxes in packs of a preselected number

laterally to a side of the separating mechanism. Such end roller **90** is suitably mounted upon the support or platform **87**, an under bar **92** having, at its ends side rails **93** for the conveyor frame, being adjustably mounted by means of a screw mounting indicated at **94** upon such platform **87**. The end of the conveyor belt **91**, at the delivery end of the box separating machine, may be vertically adjusted to the best position for receiving the superimposed separated boxes **4** and **5** as they leave the separating machine.

Two inverted U-shaped supports **95** and **96** (Fig. 1) spaced from each other are mounted, the former near the delivery end of the separating machine on the adjacent side bar **93** of the frame for the conveyor **91**, and the other spaced therefrom on the opposite bar **93**. Rods **97** extend between and are connected at their ends to the members **95** and **96**. The lower rod **97** near the end of conveyor **91** carries a vertical side **98**, and a vertical back **99** is suspended from brackets **100** carried by the upper rods **97** as shown in Fig. 9. A bottom is provided by the upper run of the conveyor belt **91**. It is apparent that the separated boxes **4** and **5** delivered in pairs one over the other from the rear end of the separating mechanism will deliver such boxes on to the conveyor belt **91**. Such belt is at rest during such delivery and until a preselected number of pairs of said boxes have been delivered to make a stack which, in practice, may be of fifty boxes provided by the separation of twenty-five of the double boxes indicated at **1**.

The vertical portions of the member **95** have attached at their side nearest the delivery end of the machine a U-shaped bracket **101** which, with the adjacent vertical leg of members **95**, provide guides for bearings or journals for a roller **102**. From the pulley **103**, driven by the belt **51** through the rear end pulley **52**, a short endless belt **104** passes around the roller **102** to drive it so that the pairs of separated boxes **4** and **5**, one lying over the other, leave the rear or delivery end of the separating machine in succession, passing over the roller **102**, and are delivered to the upper run of the conveyor belt **91**. A presser roller **105** of short length rides by gravity against the uppermost of each of said pair of separated boxes as they pass over the roller **102**. It is carried on a fork at the lower end of a link **106** pivotally connected to the arm **107** of a bracket fastened to the upper horizontal rail of the adjacent member **95**. Such light weight roller insures that the two boxes **4** and **5** of each pair leaving the separating machine will remain in close contact to each other and not aimlessly move when delivered to the conveyor belt **91**.

In the automatic and other control of the machine, a main control box **110** has leading thereto circuit wires **111** for current supply from which circuit wires **112** connect with the continuously running motor **39** (Fig. 15). The solenoid winding **42** is interposed in the length of a wire **113**, one end connected with the control box and the other with limit switch **43**. The motor **88** has its wires **114** connected with one delay switch **108**. A counter operated switch **27***a* has circuit wires **116** between it and the main control box and also a wire **117** connecting it with the control box and a second wire **118** connecting it with the delay switch **108**. A second delay switch **109** is connected in series with the counter and reset by wires **119** and with the first delay switch **108** by wires **120**.

Feeding the connected double box structures **1** through the machine is first dependent upon their controlled ejection from the receiving hopper for engagement and gripping by the several belts **48**, **49**, **51**, **55**, **60** and **64**. Such ejection is controlled by the release of the bars **21** so that the rollers **24** thereon may engage the cams **25**; and such release is controlled by the operation of the limit switch **43**. The limit switch **43** is operated to render the release of the bars **21** effective only when the number or supply of the structures **1** in the receiving hopper is sufficient that the operating member **45** (Fig. 2) for the limit switch is moved from full line to dash line position in Fig. 2. When a sufficient number of the double boxes **1** have been delivered there is an automatic operation of the limit switch. The feeding or ejecting of the lowermost connected double box structures **1** being faster than the delivery of them to the machine, intermittently the quantity or numbers in the hopper (Fig. 2) diminish so that the limit switch **43** is operated to interpose the stop of the lever **40** against the finger **28**. Thereupon, though the cams **25** continuously rotate, the rollers **24** being held away from them, there is no feeding or ejecting to the carrying and separating belts until the supply in the hopper has been replenished to again operate the switch **43**.

With the machine there is delivered to the conveyor belt **91** a predetermined number of the separated boxes which, for example, may be fifty of the single boxes made, of course, from twenty-five of the connected double box structures **1**. The motor **88** runs only momentarily to move the stack of boxes which have been delivered to it out of the way so a succeeding stack may be delivered. During such time of movement, irrespective of the supply of the connected double box structures **1** to the machine, and whether or not the limit switch is operated thereby so that it would normally result in ejecting the lowermost double box structures **1**, such feeding or ejecting must be stopped until the stack of boxes on the conveyor belt **91** has been thus moved. And as soon as such movement has occurred sufficiently to clear the delivery end of the box separating machine, motor **88** stops operating and the feeding or ejecting mechanism again comes into operation.

The counter and reset switch at **27***a* is operated by the counter when the preselected number, for example twenty-five of the double box structures **1** have operated the counter through one cycle. When this occurs feeding or ejecting is stopped by closing the limit switch circuit. The first reached delay switch **109** after a momentary delay is actuated to close the circuit of the motor **88**. The motor **88** runs its predetermined time, governed by the second delay switch **108** acting when a stack of boxes has been moved laterally to stop motor **88**. The delay in the operation of the switch **109** is short, only long enough to clear the machine of boxes. The delay in the switch **108** is longer, so that it does not become effective to break the circuit of motor **88** until the motor **88** has run long enough to move the conveyor belt **91** the required distance to clear the delivery end of the box separating machine of the stack of boxes which has been collected.

The delay switches **108** and **109** are delay action switches, well known in the electrical art, which close or open circuits at preselected periods of time after they have been actuated. The switch **109** does not close the circuit for the operation of the motor **88** until the machine is cleared of the separated boxes, there being no boxes in the machine between the receiving hopper and the delivery end of the machine. Therefore, the motor does not start to operate the conveyor **91** until a period of time after a completion of the selected number on the counter has taken place. In the normal operation of the machine, when the separated boxes are moving, not with continuous regularity but at times with pauses in movement, for the supply of the double box structures **1** to the machine to catch up with the feeding or ejection of them from the hopper, the times elapsing during such intermittent operations is not sufficient to bring the delay switch **109** into operation so as to start the motor **88**. When the last of the boxes of the total number, 50 for example, has passed, the feeding having been stopped through the operation of the counter, even though the limit switch **43** may be in operative condition, there is a sufficient time for the delay switch to close the circuit which includes the motor **88** to actuate the conveyor **91**.

The time which elapses between the actual operation of the delay switch **109** and when it goes into effect is shorter than the time elapsing between the actuation of the last delay switch reached, **108**, and when it goes into effect, to break the circuit in which the motor **88** is disposed. Such lapse of time, which starts when the last pair of boxes of the 50 passes by said switch **108**, is long enough that motor **88** may drive conveyor **91** to move the pack of 50 boxes laterally to entirely clear the delivery end of the box separating machine. Thereupon, the circuit which includes the motor **88**, is broken, the motor stopping; and the machine is ready for a resumption of its cycle of operations until a succeeding pack or pile of the boxes has been accumulated for a repetition of the movement of the conveyor **91**. At the resumption of such operations, a relatively large number of the double box structures **1** have been delivered to the hopper at the forward end of the box

separating machine, therefore, the feeding or ejection has caught up with and surpassed what has been delivered to the hopper before such cycle was resumed, plus those supplied during the time that such catching up was taking place.

The machine of my invention, which has been built and is in steady practical commercial operation, is very satisfactory for performing the functions and purposes for which it was built. While the bars **11** and **11***a* may be fixed with respect to the side frame beams **10** of the frame of the machine, in practice they are adjustably mounted so that they may be adjusted toward or away from each other and the plate **77** is longitudinally divided, whereby the machine may be set up for different dimensions of boxes, in conjunction with the adjustability of the rear side plate **16** of the receiving hopper. A very high quantity production of box separation occurs, in quantity equalling that which many workers who previously manually pulled them apart can attain in the same time. The boxes are not only separated but are delivered in the required numbers to make up packages of them to ship to users.

It is of course to be understood that the invention is not limited in its embodiment to the one specific structure shown. An essential of the invention is the convergence toward the outlet end of the machine of the box carrying belts. And while one angularly disposed side **11***a* of the frame (Fig. 1) is shown, there may be, at opposed sides of the rear or delivery end of the machine, two of such converging sides **11***a*, one at each side of the machine, instead of one side being straight and parallel to the main longitudinal frame members of the machine. This is an equivalent in securing convergence for the superimposing of one of the boxes pulled from the other of the connected double box structure, attained in substantially the same manner.

The invention is defined in the appended claims, and is to be considered comprehensive of all forms of structure coming within their scope.

I claim:

1. In a machine of the class described, an elongated horizontal supporting frame, spaced movable gripping and carrying means, one on each side of and lengthwise of the frame for gripping opposed edge portions of collapsed connected double box structures, said means at the sides of the machine diverging from adjacent one end of the machine for a part of the length of the machine and thereafter converging to the opposite end of the machine, means for driving said carrying and gripping means at uniform speed of movement, a receiving hopper at one end of said carrying and gripping means, means for continuously supplying said hopper with said double box structures, means for successively ejecting the lowermost collapsed double box structures from the hopper in succession to said carrying and gripping means, a conveyor at the opposite end of said carrying and gripping means on to which said collapsed double box structures after pulling apart thereof, are delivered, driving means for said conveyor normally at rest, a counter, means operated by said counter after said counter has been actuated by the passage of a preselected number of said double box structures for rendering the ejecting means inoperable and for rendering the driving means for said conveyor operable after the machine has been cleared of boxes, and thereafter, for stopping the driving means for said conveyor and rendering the ejecting means operable substantially simultaneous with said stopping.

2. In a structure of the class described, a supporting frame, two belt means for traversing the frame lengthwise thereof, one of said belt means being at one side of the frame and the other at the other side thereof and said two belt means being spaced from each other a preselected distance, said two belt means progressively diverging a part of the length of the machine and thereafter converging toward each other for substantially the remainder of the machine length, means for continuously driving said belt means in unison at both sides of the machine and means for successively feeding connected double box structures one after the other between said two belt means for the gripping of said structures at opposite side edge portions by said belt means and the exertion of a pulling force at each of said edge portions as said box structures are moved by said belt means through the diverging length thereof, thereby rupturing said double box structure at preselected lines between the gripped portions and pulling them apart, and means for directing the separated boxes at one side of the machine to move through the machine in one plane of movement and the separated boxes at the other side of the machine in a lower plane of movement whereby the converging end portions of said belt means superimpose the separated boxes of each connected box structure one over the other at the outlet end of the machine.

3. In a structure of the class described, a supporting frame, two belt means for traversing the frame lengthwise thereof, one of said belt means being at one side of the frame and the other at the other side thereof, and said two belt means being spaced from each other a preselected distance, said belt means progressively diverging from each other for a portion of their length and at the rear portion of the length of the machine converging toward each other, means for continuously driving said belt means in unison at both sides of the machine, means for successively feeding connected box structures one after the other between said two belt means at the diverging portions thereof for gripping said structures at opposite side edge portions by said belt means and the exertion of pulling force at each of said edge portions of said double box structures, rupturing said double box structures at preselected lines between the gripped portions, a horizontal plate between the spaced belt means located between the converging portions of said belts, and two box directioning rods over one of which boxes at one side of the machine separated from those at the other side of the machine pass, the boxes at the other side of the machine passing underneath the other rod so that the separated boxes at one side of the machine pass underneath said plate and the other boxes at the other side of the machine pass over said plate, said separated boxes being moved by the converging belts to superimpose the boxes passing over said plate over those passing underneath said plate at the delivery end of the machine.

4. In a machine of the class described, horizontal carrying means for receiving connected collapsed double box structures one after another, said carrying means having means for gripping said structures at opposite side edge portions thereof, means for continuously driving said box carrying and gripping means to move said double box connected structures horizontally, said box carrying means gripping one side of said box structure progressively diverging from the other box carrying and gripping means to exert a rupturing pull upon said double box structures, one after the other, in a direction at right angles to the gripped edge portions thereof, separating said double box structures at predetermined lines of separation, each into two independent collapsed boxes, said carrying means progressively converging in the length thereof after said boxes have been separated, combined with means for directing the separated box of each connected double box structure at one side of the machine to move in a plane horizontally spaced from the plane of movement of the other box separated from the first box, whereby the boxes are delivered in pairs superimposed one upon and over the other for each connected double box structure passed through the machine.

5. In a machine of the class described, an elongated supporting frame, moving gripping means mounted one adjacent each side of the frame and spaced transversely of the machine from each other, adapted at one end to successively receive connected, collapsed double box structures one after another, said movable gripping means progressively diverging one from the other away from the place where said double box structures are received, and converging toward each other from a point between the ends of the frame and the delivery end thereof, means for driving and moving said gripping means lengthwise of the frame whereby on movement thereof a transverse pull is exerted upon each double box structure in succession one after another to separate each into two independent boxes along preselected lines of separation, and thereafter carry said boxes to the converging portions of said moving and gripping means to move the separate independent boxes obtained from each collapsed double box structure laterally toward each other, and directional means in the path of movement of the separated boxes engaging said separated boxes and directing the boxes at one side of the machine to pass under the other boxes at the opposite side of the

machine, the boxes moving in different planes of movement one over the other, whereby the boxes are delivered from the machine in pairs with one box superimposed upon the other in each pair of such boxes.

6. A structure as defined in claim 5, and a plate at the rear portion of the machine between the converging parts of said movable gripping means over which one box of each of the collapsed connected double structure moves after separation from the other, the other box moving underneath said plate for delivery of said boxes from the machine simultaneously, with one over the other.



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