Aug. 7, 1945. G. H. HARRED 2,381,743

CARTON-BLANK HANDLING APPARATUS FOR WIRE-STITCHING MACHINES

Filed Oct. 7, 1943 6 Sheets-Sheet 1

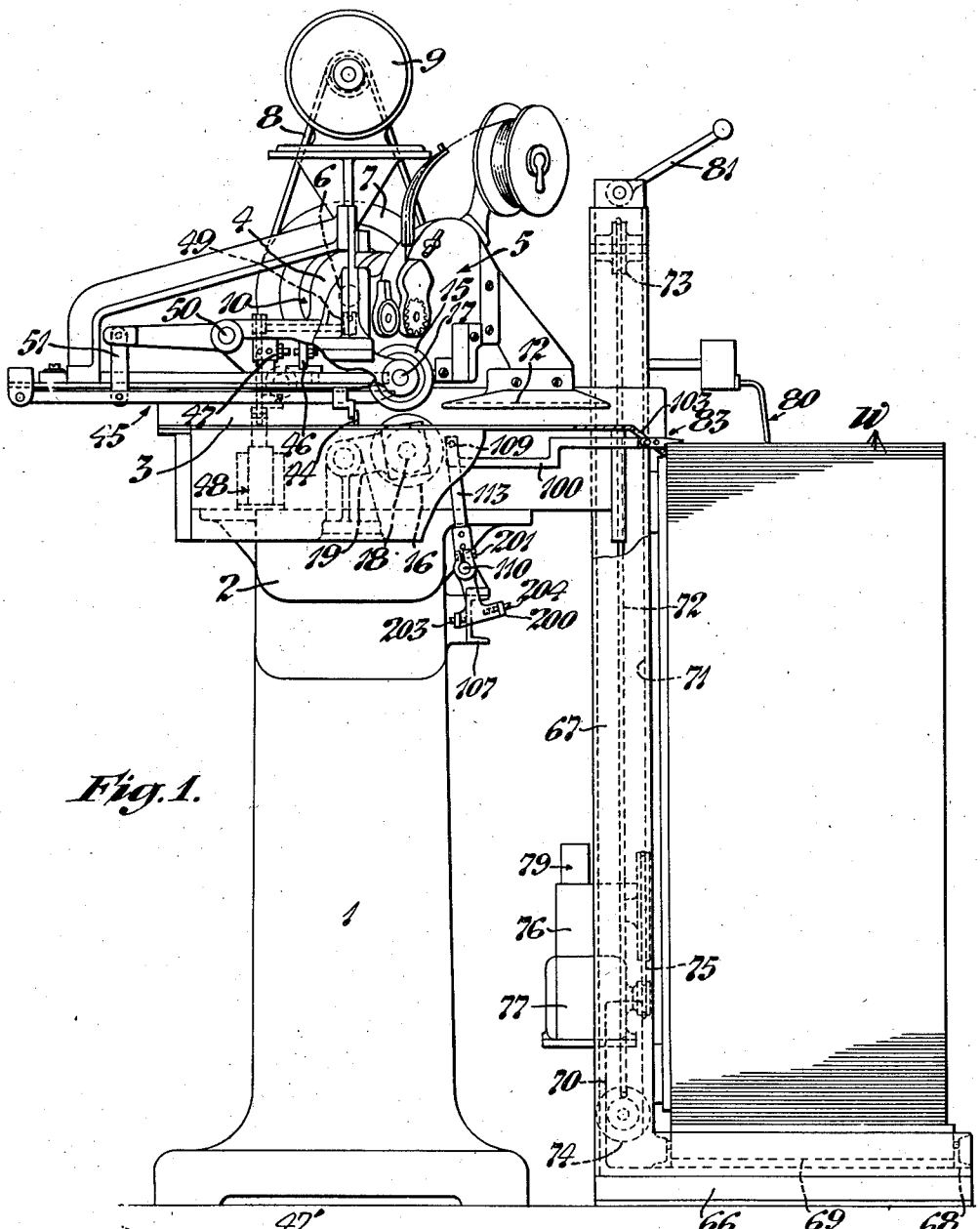


Fig. 1.

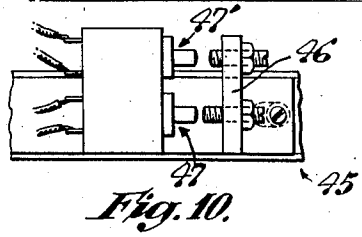


Fig. 10.

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CARTON-BLANK HANDLING APPARATUS FOR WIRE-STITCHING MACHINES

Filed Oct. 7, 1943 6 Sheets-Sheet 2

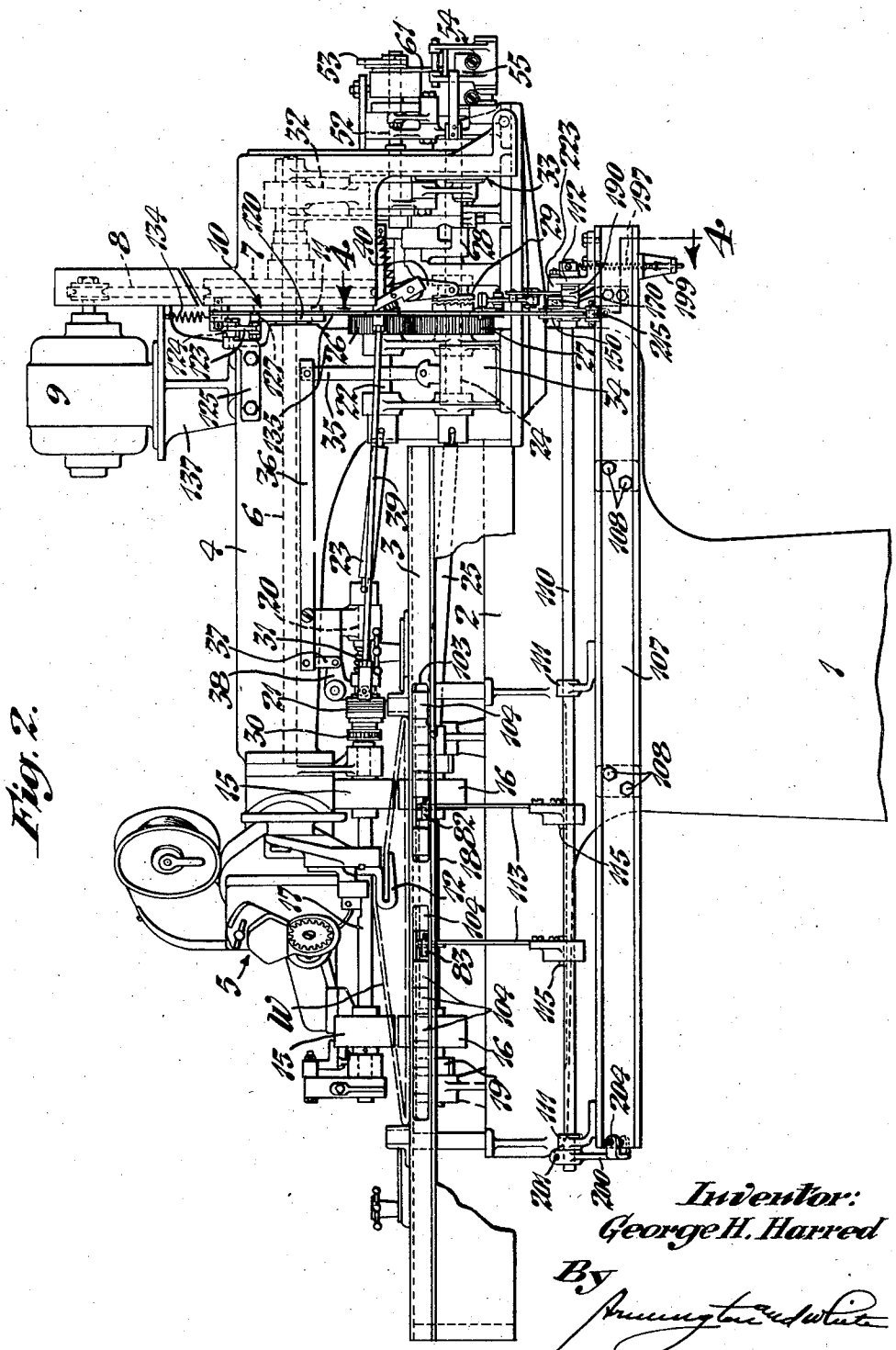


Fig. 2.

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CARTON-BLANK HANDLING APPARATUS FOR WIRE-STITCHING MACHINES

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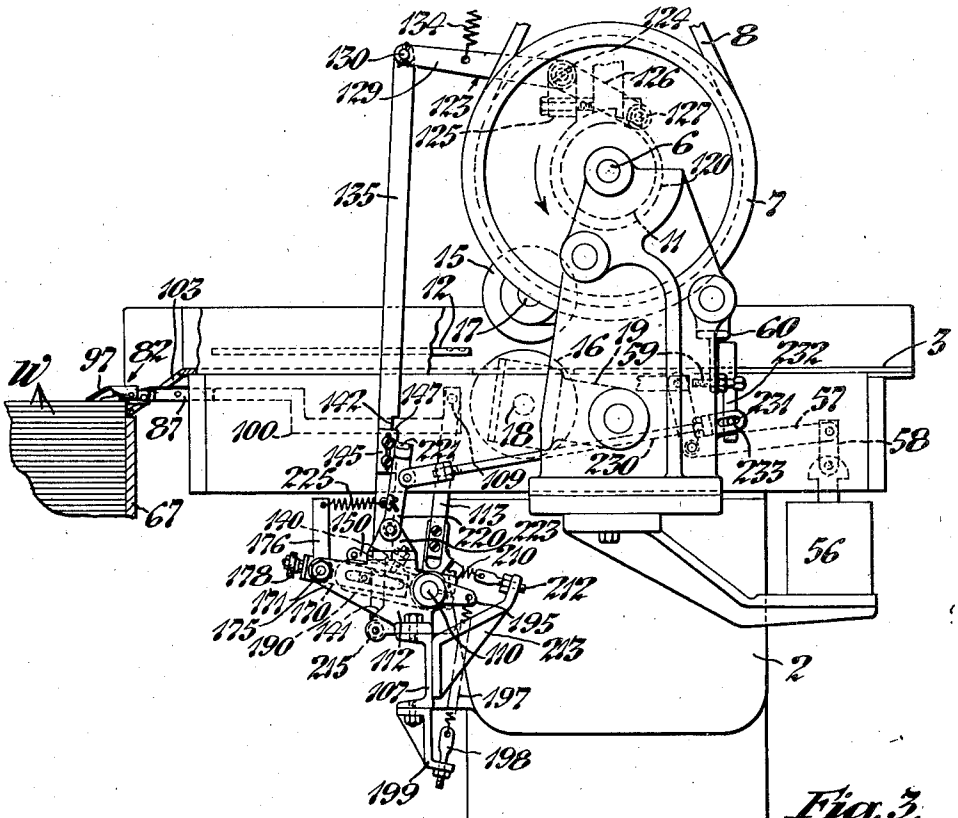


Fig. 3.

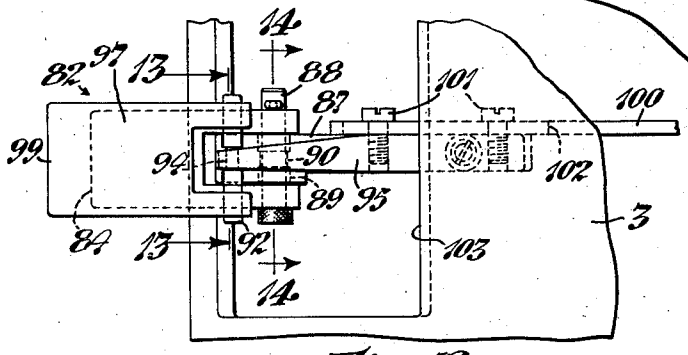


Fig. 12.

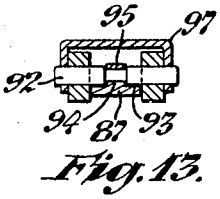


Fig. 13.

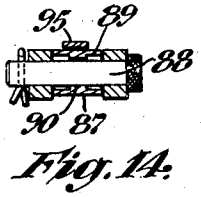


Fig. 14.

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CARTON-BLANK HANDLING APPARATUS FOR WIRE-STITCHING MACHINES

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Fig. 4.

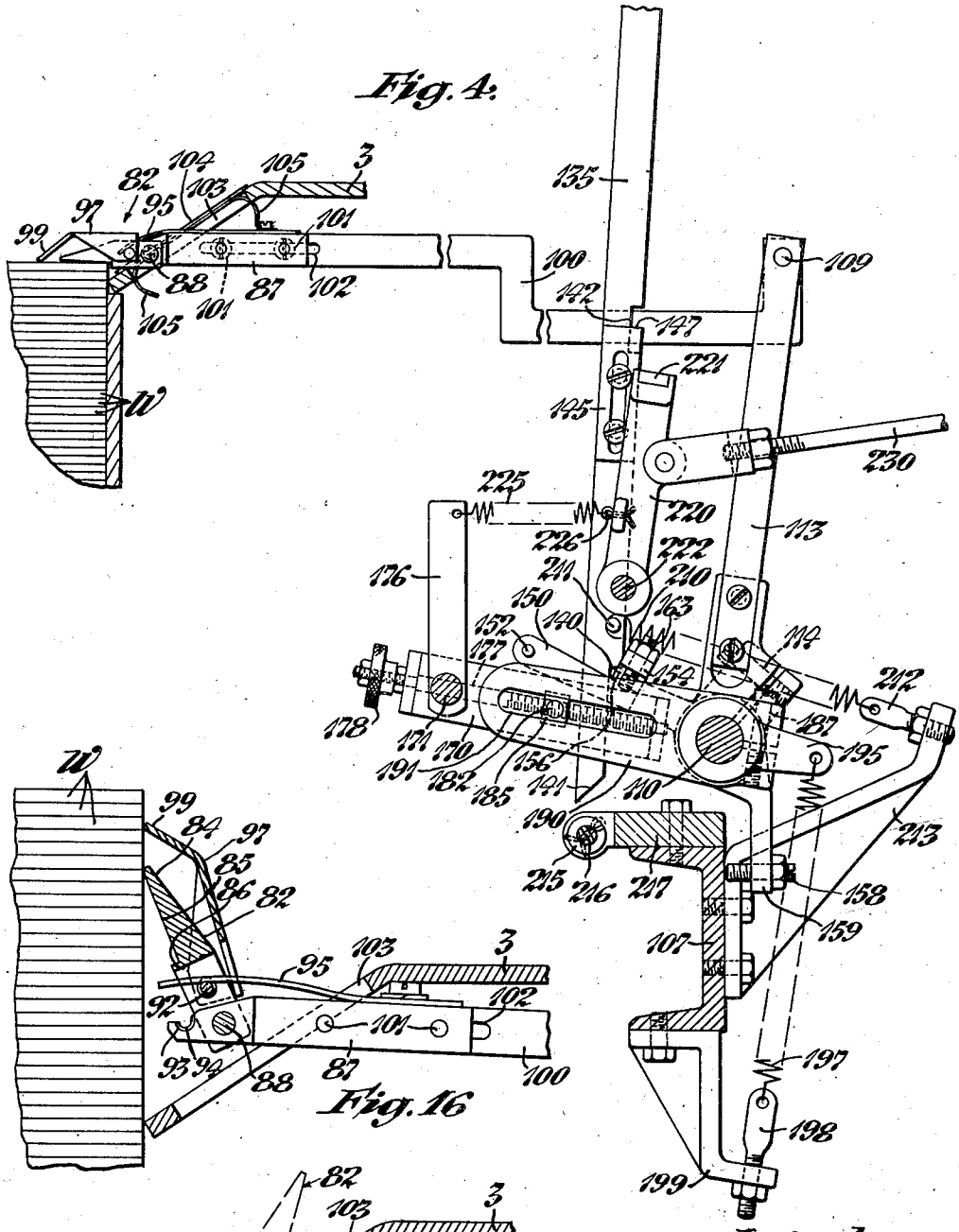


Fig. 16

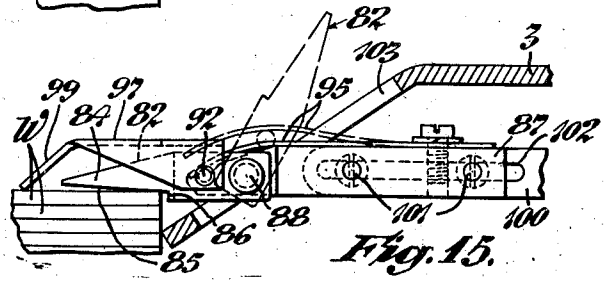


Fig. 15.

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CARTON-BLANK HANDLING APPARATUS FOR WIRE-STITCHING MACHINES

Filed Oct. 7, 1943 6 Sheets-Sheet 5

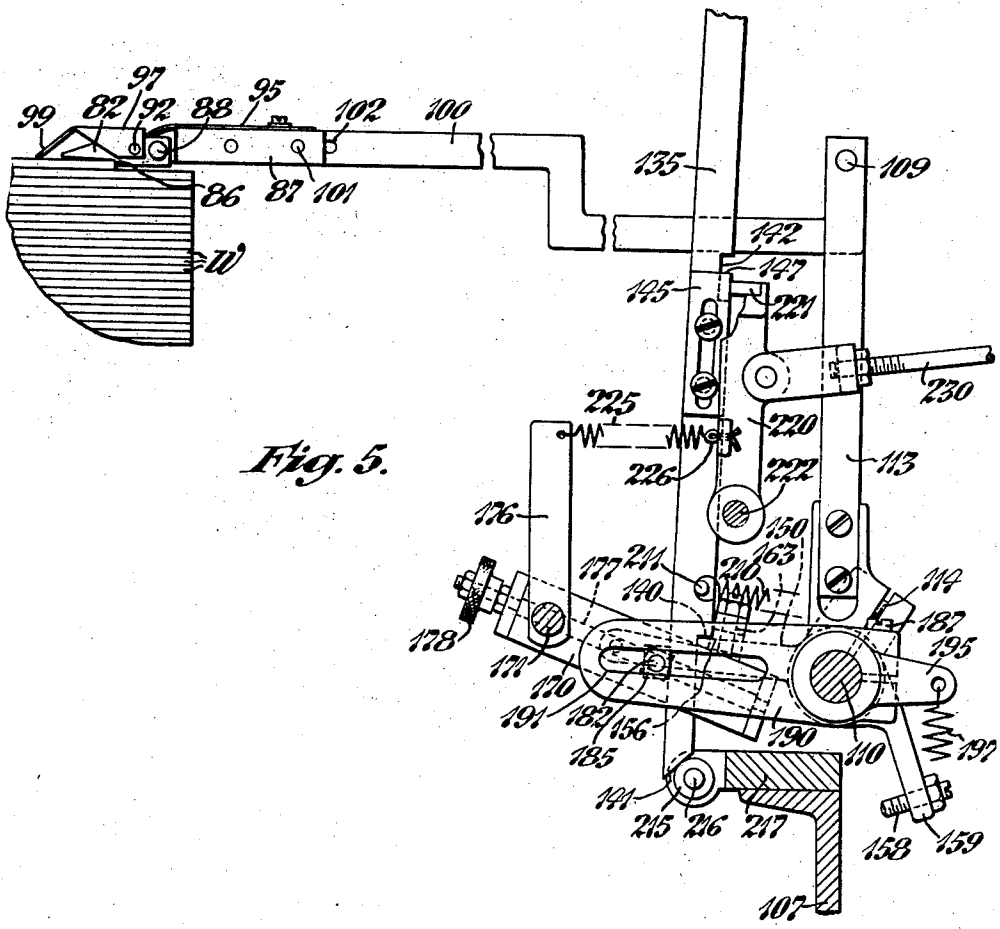


Fig. 5.

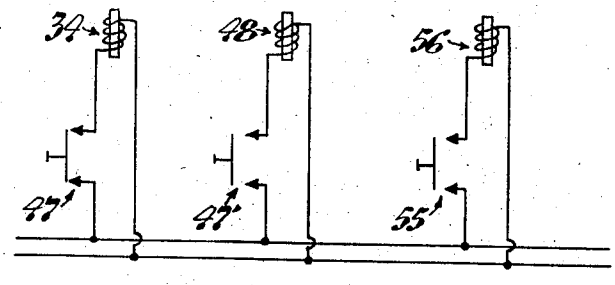


Fig. 11.

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CARTON-BLANK HANDLING APPARATUS FOR WIRE-STITCHING MACHINES

Filed Oct. 7, 1943 6 Sheets-Sheet 6

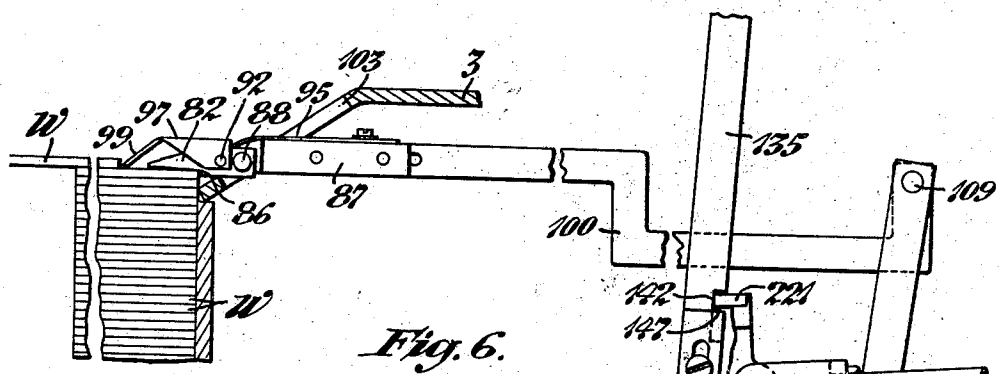


Fig. 6.

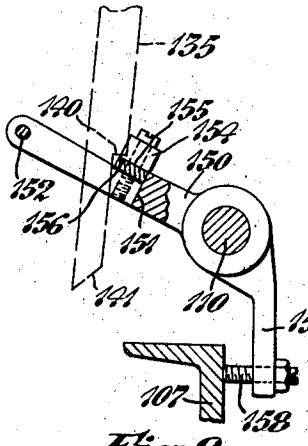


Fig. 8.

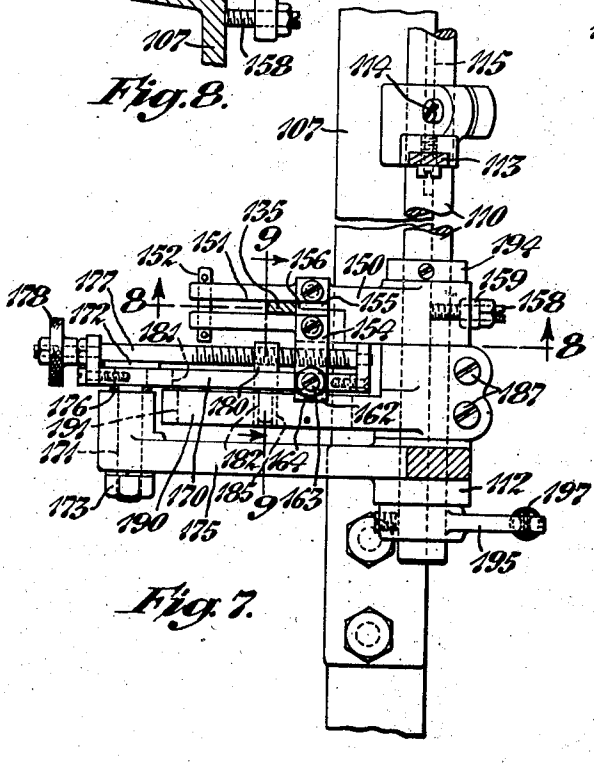


Fig. 7.

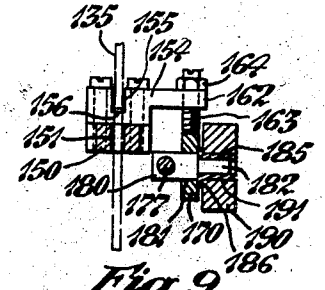


Fig. 9.

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Patented Aug. 7, 1945 2,381,743

UNITED STATES PATENT OFFICE

2,381,743

CARTON-BLANK HANDLING APPARATUS FOR WIRE-STITCHING MACHINES

George H. Harred, East Greenwich, R. I., assignor to Boston Wire Stitcher Company, Portland, Maine, a corporation of Maine

Application October 7, 1943, Serial No. 505,298

10 Claims. (Cl. 271—43)

The present invention relates to an apparatus for separating the top sheet or like object from a stack of sheets or similar articles to facilitate handling or feeding the same, and to the coordinate operation of such apparatus in timed relation to the operation of a machine or device with which it is used.

One object of the present invention is to provide an automatically-operated apparatus of the type indicated for displacing the top sheet of a stack with respect to the underlying sheets therein to adapt a single sheet to be grasped for manipulation.

Another object is to provide an apparatus of the type indicated having reciprocating contact-elements or fingers adapted to rest on the top of the stack with means engageable with the edge of the top sheet to slide it rearwardly with respect to the underlying sheets in the stack.

Another object is to provide contact-fingers of improved construction which are automatically adjustable in accordance with irregularities in the surface of the top sheet.

Another object is to provide contact-fingers of improved construction which are adapted to be displaced automatically to inoperative position when the stack of sheets is raised beyond its normal height whereby to safeguard against breakage of or damage to the parts of the sheet-separating mechanism.

Another object is to provide an apparatus of the type indicated having an elevator for supporting the stack of sheets and automatically lifting the stack progressively to maintain the top sheet at a predetermined level where it may be engaged by the contact-fingers.

Another object is to provide an apparatus of the type indicated which is adapted to be operated automatically in timed relation to the operation of the machine with which it is used to separate one sheet for each cycle of operation of the machine.

A particular object of the invention is to provide an apparatus of the type indicated for separating carton-blanks to adapt them to be folded and fed to a wire-stitching machine.

Another object is to provide an apparatus of the type indicated which is operated from the wire-stitching machine to separate one carton-blank during each cycle of operation of the wire-stitching mechanism regardless of the number of stitches applied.

Another object is to provide an apparatus of the type indicated which will separate the top carton-blank from the remaining blanks in the stack at a relatively slow rate of speed whereby to prevent the blank from being thrown rapidly therefrom while also insuring proper positioning of the blank for subsequent manipulation.

Another object is to provide an apparatus of the type indicated in which the means for operating the sheet-separating fingers is adjustable to regulate the amount of separation of the carton-blank from the stack in accordance with particular requirements.

Still another object is to provide a sheet-separating apparatus of the type indicated which is positive in operation to separate the top carton-blank from the underlying ones in the stack and adapted for cooperation with different types of elevators and wire-stitching machines commonly used to support and stitch carton-blanks.

Further objects of the invention are set forth in the following specification which describes a preferred form of construction of the apparatus, by way of example, as illustrated by the accompanying drawings. In the drawings:

Fig. 1 is an end elevational view of a machine for stitching carton-blanks showing the blank-separating apparatus of the present invention applied to use therewith;

Fig. 2 is a side elevational view of the wire-stitching machine illustrated in Fig. 1;

Fig. 3 is an elevational view of the end of the apparatus opposite from that illustrated in Fig. 1 showing the operating means for the fingers of the blank-separating unit as driven from the wire-stitching machine;

Fig. 4 is an enlarged transverse sectional view on line 4—4 of Fig. 2 with the fingers illustrated in a position the reverse of that shown in Fig. 1 and showing the operating means for the blank-separating fingers in inoperative position;

Fig. 5 is a view similar to Fig. 4 with the fingers illustrated in the same position as in Fig. 4 and showing the blank-separating fingers as having been moved through an operative stroke;

Fig. 6 is a view similar to Fig. 4 with the fingers illustrated in the same position as in Fig. 4 and showing the operating means as uncoupled from the blank-separating fingers to permit the latter to return to inoperative position and illustrating the operating means as latched to prevent further actuation thereof until the wire-stitching operation has been completed;

Fig. 7 is a part-sectional plan view of the operating means for the blank-separating fingers;

Fig. 8 is a detailed part-sectional view of one of the levers of the operating means taken on line 8—8 of Fig. 7;

Fig. 9 is a sectional view taken on line 9—9 of Fig. 7 showing the means for adjusting the effective stroke of the operating means;

Fig. 10 is a partial plan view of the pair of electrical switches operative from the gauge of the wire-stitching machine;

Fig. 11 is a diagram of the electrical circuit for the various electromagnets of the wire-stitching machine;

Fig. 12 is an enlarged detailed plan view of one of the blank-separating fingers;

Fig. 13 is a transverse sectional view on line 13—13 of Fig. 12;

Fig. 14 is a transverse sectional view on line 14—14 of Fig. 12;

Fig. 15 is a side elevational view of the blank-separating finger shown in Fig. 12 showing it in position to feed the uppermost blank laterally of those remaining in the stack and indicating in dash-lines the manner in which the finger is tilted upwardly manually for stacking the sheets on the elevator; and

Fig. 16 is a view similar to Fig. 15 showing the finger tilted upwardly by the sheets in the stack when the latter is raised beyond its normal operative position.

In stitching or similarly processing carton-blanks of corrugated paper-board, fiber-board or the like, it is the usual practice to stack a large number of blanks, one over another, on an elevator located adjacent the wire-stitching or other processing machine. The operator stands at the rear of the stack and separates the top sheet from the underlying sheets in the stack to feed it to the processing machine. When the sheets are in the form of flat carton-blanks to be stitched, the operator must fold the sides over the body-portion of the blank and feed the folded blank into the wire-stitching machine. The wire-stitching machine then operates automatically to intermittently feed the folded carton-blank forward and apply stitches to fasten together the overlapping edges of the sides. The operator continues to separate, fold and feed the carton-blanks and the elevator operates to gradually raise the stack whereby to continually maintain the top carton-blank at a predetermined level where it is most convenient to handle.

Due to the usual order and arrangement of the carton-blanks in the stack, it is sometimes difficult to separate the topmost carton-blank from the underlying ones in the stack. Such difficulty in separating the top carton-blank from the stack involves loss of time and interrupts the rhythm of the operator's motions, especially when new and unskilled operators are employed. Experienced operators acquire a knack for separating carton-blanks of usual shapes and sizes, but even skilled operators have difficulty in separating carton-blanks of unusual shapes and sizes.

General organization

The present invention provides an improved sheet-separating apparatus for cooperation with an elevator and is operated automatically in timed relation to the operation of the machine with which it is used for continuously separating the top sheet from the underlying sheets in the stack whereof to facilitate their handling and increase production. In the particular apparatus illustrated in the present drawings, the sheet-separating unit is adapted to operate in conjunction with a wire-stitching unit for stitching the seams of carton-blanks. The sheet-separating mechanism comprises, in general, a pair of spaced fingers adapted to rest on the top surface of a stack of sheets, carton-blanks or other like articles. Each finger has a depending shoulder or abutment which engages across the edge of the top carton-blank and is of less depth than the thickness of the blank. The fingers are mounted for lateral rocking movement to adapt them to adjust themselves for any irregularities in the top surface of a blank and are also capable of longitudinal tilting movement to insure proper engagement of their depending shoulders with the edge of the top carton-blank. Upon reciprocation of the fingers through an operative stroke their shoulders will engage the edge of the top carton-blank and slide it rearwardly relative to the stack, or toward the operator, to cause its rearward portion to overhang the side of the stack in position to be easily and quickly grasped by the operator. As each carton-blank is separated from the stack and fed to the wire-stitching machine by the operator the elevator operates automatically to raise the stack and maintain the top carton-blank at a level where the shoulders on the fingers will engage its edge. The fingers are adapted to be automatically displaced from operative position should the stack of carton-blanks be raised above the normal height whereby to guard against breakage of or damage to the fingers and associated parts of the blank-separating mechanism.

The sheet-separating fingers are carried by arms which are rocked by gravity to cause the fingers to engage the upper surface of the top carton-blank. The arms are reciprocated by means driven from the wire-stitching machine to move the fingers simultaneously through an operative stroke and the arrangement of their operating means is such as to cause the fingers to be reciprocated once only for each cycle of operation of the wire-stitching mechanism, regardless of the number of stitches applied.

In a preferred form of construction the operating means for the sheet-separating fingers is driven directly from the shaft which operates the wire-stitching machine and comprises an operating bar which is connected to actuate the fingers; the bar being disconnected automatically at the completion of an operative stroke of the fingers to release the arms carrying the fingers. A spring or equivalent means connected to operate the arms then acts to slide the latter in the opposite direction to move the fingers through a return stroke. A latch is actuated automatically to engage the operating means at the end of the operative stroke of the fingers to retain it inoperative until a cycle of operation of the wire-stitching machine has been completed. Upon completion of the cycle of operation of the wire-stitching machine, stopping means for the latter operate to release the latch to permit the operating means for the fingers to be returned to initial position. Return of the operating means to initial position resets the mechanism for subsequent operation at the beginning of another cycle of operation of the wire-stitching machine.

In accordance with the present invention means are provided for minutely and accurately adjusting the range of movement of the separating fingers whereby to regulate the extent of separation of the carton-blank from the stack. The adjusting means consists in a novel and ingenious device for changing the position of the pivotal connection of the operating levers to thereby regulate the extent of rocking motion imparted to the arms carrying the carton-separating fingers.

The present invention also provides means for imparting a relatively slow movement to the sheet-separating fingers during their operative stroke whereby to guard against overfeeding or violent throwing of the top carton-blank beyond the desired position. Through this provision the top carton-blank will invariably be located in position to be conveniently grasped by the operator for feeding it to the wire-stitching mechanism.

Wire-stitching machine

The wire-stitching unit as herein shown is in the form of a self-contained machine substantially identical with that illustrated and described in my United States Letters Patent No. 2,305,419, issued December 15, 1942. Suffice it to state herein that the wire-stitching unit illustrated in Figs. 1 to 3 comprises a pedestal 1 mounting a platform 2 at its upper end on which a table 3 is supported. Bolted to or otherwise supported at one end of the platform 2 is a frame or casing which extends upwardly and laterally to provide a horizontal arm 4 overlying the table 3. A wire-stitching head 5 is mounted at the outer end of the horizontal arm 4 for operation by a drive-shaft 6 extending through the arm and projecting outwardly beyond its rearward end. The wire-stitching head 5 may be of any suitable construction and, as herein illustrated, is of a type shown and described in United States Letters Patent No. 1,760,031, issued May 27, 1930, to H. G. Allen. In the operation of this type of wire-stitching machine, during the first half-revolution of the drive-shaft 6 a length of wire is cut from a supply, bent into a U-shaped staple, driven into the work and clinched on the under side thereof; and during the second half-revolution of the drive-shaft 6 the parts of the stitching mechanism are returned to initial position and another length of wire is fed into the head. A fly-wheel 7 is mounted for rotation on the projecting end of the drive-shaft 6 and adapted to be continuously driven by a belt 8 from a suitable prime mover, herein illustrated as an electric motor 9. A clutch, indicated generally at 10 in Fig. 2, is provided adjacent the fly-wheel 7 for connecting the latter to the drive-shaft 6 for the wire-stitching head 5. Depending from the stitching head 5 is a combined flap-guide and clinching anvil 12 of usual construction.

The work, usually in the form of a carton-blank W, is fed by upper and lower sets of cooperating fed-rolls 15 and 16 which are driven continuously to advance the blank to the wire-stitching head 5 and then to intermittently step-feed it between stitches. The upper pair of feed-rolls 15 are mounted fast on a shaft 17 journaled in suitable bearings depending from the head 5 and the lower pair of feed-rolls 16 are fast on a suitable shaft 18 carried by a rockable cradle 19, see Figs. 1 and 2. Connected to the shaft 17 is a shaft 20 having a friction-disk clutch 21 thereon. The shaft 20 is connected to a shaft 22 at the rear by means of a coupling rod 23 having universal joints at its ends. The shaft 18 is connected to a shaft 24 by means of a similar coupling rod 25, also having universal joints between the shafts. The two shafts 22 and 24 are connected by intermeshing gears 26 and 27 and the end of the shaft 24 is adapted to be connected to the end of a shaft 28 by means of a toothed clutch 29.

The shaft 20 normally is driven from the prime-mover or motor 9 by suitable connections, shown more in detail in Patent No. 2,305,419, including a chain 30 for driving a sprocket-wheel formed as a part of the disk-clutch 21, the latter being held in driving engagement by means of a spring 31. By disengaging the clutch 21 and engaging the clutch 29 the continuous high-speed drive for the shaft 20 is disconnected and the latter is driven from the shaft 28. The shaft 28 is rotated intermittently in timed relation to the operation of the wire-stitching mechanism by an eccentric on the shaft 6 operating through a pitman 32 and a one-way clutch 33. The clutches 21 and 29 are operated simultaneously by an electromagnet 34, see Fig. 2, acting through a link 35, lever 36, link 37 and bell-crank shifting fork 38 to disengage the clutch and then, through the connecting rod 39 and shifting fork 40, to engage the clutch 29. Thus, the shafts 17 and 18 and opposed pairs of feed-rolls 15 and 16 normally are continuously driven at high speed to feed the work into the stitching head and upon energization of the electromagnet 34 the clutch 21 disconnects the high-speed driving means from the prime-mover and connects the intermittently-operating driving means thereto. The opposed pairs of feed-rolls 15 and 16 then are driven intermittently in timed relation to the operation of the wire-stitching head 5 to properly space the stitches along the seam of the carton.

The initiation of a cycle of operation of the wire-stitching mechanism in the head 5 is controlled by the movement of the carton-blank W as it is advanced by the feed-rolls 15 and 16 and engages the depending abutment 44 of a gauge 45. The gauge 45 is mounted for sliding movement by the engagement of the work therewith, a post 46, see Fig. 1, carried thereon being arranged to close a switch 47, see also Fig. 10. As indicated in the diagram, Fig. 11, the switch 47 is connected in circuit with the electromagnet 34 which, upon energization, will act to operate the clutches 21 and 29 to disconnect the high-speed continuous drive from the feed-rolls 15 and 16 and connect the intermittently-operating low-speed drive thereto. The carton-blank W will continue its forward movement due to momentum and the post 46 will then operate a second switch 47', also indicated in Fig. 10, which is connected in circuit with an electromagnet 48. As shown in Fig. 1, the electromagnet 48 is connected through a suitable linkage to a clutch-operator 49 for actuating the clutch 10 to connect the fly-wheel 7 to the drive-shaft 6 for the wire-stitching head 5. The wire-stitching mechanism in the head 5 then will be operated to apply stitches to the carton-blank while the shaft 28 is driven intermittently from the shaft 6 through the pitman 32 and one-way clutch 33 to step-feed the work between stitches.

Upon operation of the wire-stitching mechanism in the head 5 a rock-shaft 50 is turned, see Fig. 1, to operate through a link 51 to lift the abutment 44 of the gauge 45 out of the path of movement of the carton-blank W and perform several other functions namely: rock the cradle 19 to cause the lower feed-rolls 16 to firmly grip the work against the upper rolls 15, apply a brake to the shaft 17 mounting the upper pair of feed-rolls 15 and maintain the switch 47 closed whereby to permit release of the gauge 45, these operations being explained in detail in my prior patent referred to above.

A control-shaft 52, see Fig. 2, is adapted to be turned with a step-by-step movement by the reciprocating pitman 32 and a radial arm 53 at

the outer end of the control-shaft is arranged to engage and rock a pivoted frame 54 to close a switch 55. The switch 55 is arranged in circuit with an electromagnet 56, see Figs. 3 and 11. The plunger-armature of the electromagnet 56 is connected to one end of a bell-crank lever 57 by a link 58 and the opposite arm of the bell-crank is engageable with an adjustable abutment 59 on a pivoted stopping member 60 for arresting the stitching operation. Upon operation of the stopping member 60 the control-shaft 52 is released and returned automatically to its initial position. Adjacent the end of the return movement of the control-shaft 52 a second arm 61 at the end thereof engages with and rocks the pivoted frame 54 to release the switch 55 and deenergizes the electromagnet 56. The arm 61 is fixed permanently on the control-shaft 52 but the arm 53 is mounted for angular adjustment with respect to the fixed arm to adapt it to arrest the stitching operation after any predetermined number of stitches have been applied. While a particular construction of the wire-stitching machine is herein illustrated and described, it will be understood that other types of stitching or stapling devices or similar sheet-processing units may be substituted therefor within the purview of the invention.

Elevator

The elevator unit employed in conjunction with the processing unit is of conventional type commonly used for supporting a stack of sheets as shown in Fig. 1 and adapted to operate automatically to raise the stack progressively to position the top sheet at a predetermined level convenient for handling or manipulation. When the elevator is used in cooperation with a wire-stitching unit the sheets may be in the form of carton-blanks W which are scored to provide panels constituting the sides of the carton to be formed. One end of each carton-blank W has a tab which is adapted to overlie the edge of the opposite side or panel to provide an overlapping seam when the blank is folded in the manner indicated by dash-lines in Fig. 2.

The elevator may be of usual construction comprising a base 66 supporting upright standards 67 at its sides which straddle the table 3 of the wire-stitching machine. A platform 68 surmounting the base 66 is in the form of an open rectangular frame mounting a series of rollers 69. The platform 68 has brackets 70 at its sides which are slidable in guideways 71 in the standards 67. The platform 68 is raised and lowered with respect to the base 66 by means of a pair of cables 72 attached at one end to the brackets 70 and extending upwardly over sheaves 73 at the upper ends of the standards 67. The cables 72 may be operated in any suitable manner to raise the platform 68 gradually with the stack of carton-blanks W supported thereon. With the type of elevator illustrated in the present drawings the cables 72 are operated by a hydraulic motor 74 mounted on the base 66. Motive fluid is supplied by a pump 76 driven by an electric motor 77 by means of a belt 75 and the delivery of the fluid to the hydraulic motor 74 is controlled by a valve, indicated generally by the reference character 79 in Fig. 1. When the valve 79 is opened the hydraulic motor 74 will be operated to draw on the cables 72 and lift the platform 68. When the valve 79 is closed, the pressure of the motive fluid causes it to open a by-pass valve so that the fluid is merely circulated by the pump 76.

The control-valve 79 may be operated by any suitable feeler-means 80 arranged to rest on the top carton-blank W of the stack. The feeler 80 operates when the topmost carton-blank W is below a predetermined level to open the valve 79 and thereby supply motive fluid to the hydraulic motor 74 to cause it to lift the platform 68 and to stop the motor when the top carton-blank is raised to the proper level. The feeler 80 may be arranged to control the valve 79 of the hydraulic motor 74 mechanically or it may close a switch in an electric circuit and operate the valve 79 electromagnetically in a manner well known to those versed in the art. The platform 68 may be lowered manually by turning the handle 81, see Fig. 1, which operates to release the motive fluid trapped in the hydraulic motor 74.

Sheet-separating unit

In accordance with the present invention the sheet-separating unit is provided for sliding the topmost carton-blank rearwardly with respect to the underlying blanks in the stack to adapt it to be grasped readily by the operator. The sheet-separating unit is self-contained and adapted to be mounted between the wire-stitching machine and the elevator. In a preferred form of construction the sheet-separating unit comprises a pair of laterally-spaced fingers 82 and 83, see Fig. 2, which normally rest on the top surface of the stack of carton-blanks W and are adapted to be reciprocated to slide the top carton-blank rearwardly thereof. As the fingers 82 and 83 are of identical construction only one will be described in detail. As shown in Figs. 3, 4, 12, 15 and 16, the finger 82 comprises a nose-portion 84 having a flat bottom face 85 and an inclined upper face. Adjacent the rearward end of its nose-portion 84 the finger 82 has a downwardly projecting shoulder 86 of a depth slightly less than the thickness of a carton-blank W. At the rear of the shoulder 86 the finger 82 is bifurcated to provide spaced arms for straddling the forward end of a bar 87. The finger 82 is mounted on its bar 87 for lateral rocking movement or upward tilting movement by means of a pin 88 extending between the sides of its bifurcated end and through an aperture 89 at the end of the bar. As shown in Fig. 14, the outer ends of the aperture 89 in the bar 87 are counterbored, thus forming a circular flange 90 at the center with its bore slightly larger in diameter than that of the pin. By this form of construction the pin 88 is adapted to turn in the aperture 89 and the flange 90 forms a fulcrum on which the pin may tilt longitudinally. The fingers 82 and 83 thus are adapted to adjust themselves to the inclination of or other irregularities in the upper surface of a carton-blank W with which they contact to insure proper engagement of their shoulders 86 with the edge thereof.

The finger 82 is limited in its downward rocking movement toward the topmost carton-blank W by means of a pin 92 extending across its bifurcated end and adapted to engage in a recess 93 in the end of the bar 87, see Fig. 16. As shown in this latter view, the recess 93 is of semi-circular contour and enlarged at its ends whereby to form a central abutment 94, see also Fig. 13. The abutment 94 acts as a fulcrum upon which the pin 92 may rock longitudinally to permit lateral tilting of the finger 82. The finger 82 is rocked in counterclockwise direction to engage its lower face with the topmost carton-

blank W by means of a leaf-spring 95, see Fig. 15, having one end fastened to the top of the bar 87 and its free end arched downwardly to engage the pin 92. A sheet-metal guide-member 97 is pivoted on the ends of the pin 92 projecting through its side wings and is provided with an inclined end 99 which functions as a ramp for raising the forward edge of a folded carton-blank and guiding it across the fingers 82 as it is fed to the wire-stitching machine.

The fingers 82 and 83 are adapted to be reciprocated simultaneously through an operative stroke to slide the topmost carton-blank W of the stack rearwardly or toward the operator from the position illustrated in Fig. 4 to that shown in Figs. 5 and 6. For this purpose the bars 87 mounting the fingers 82 and 83 are attached to the outer ends of reciprocable arms 100, being adjustably fastened thereto by screws 101 passing through a longitudinal slot 102 in the arms and screwed into holes in the bars. The bars 87 are movable longitudinally through slots or openings 103, see Figs. 2, 3 and 4, in the inclined marginal portion of the table 3. As shown in Fig. 2, the openings 103 are relatively extended and to prevent the margins of the folded carton-blank W from entering thereinto or catching against the edges thereof a plurality of sheet-metal plates 104 may be employed to cover portions of the slots. As shown in Fig. 4, spring-fingers 105 attached to the under side of each plate 104 engage with the edges of the openings or slots 103 to adapt the plates to be adjusted therealong or to be removed from the table 3. The arms 100 and bars 87 may be actuated by any suitable operating means, and in the present embodiment of the invention the operating means is driven mechanically from, and in timed relation to, the operation of the wire-stitching unit.

Referring to Figs. 1 and 2, the operating means for the fingers 82 and 83 is mounted on a channel-iron rail 107 fastened to bosses or pads on the side of the stitching machine pedestal 1 by means of screws 108. A shaft 110 mounted to oscillate in bearings 111 and 112, see Fig. 2, supported on the upper flange of the channel-iron rail 107 carries a pair of upright crank-arms 113 secured fast thereto. As shown in Figs. 1, 2 and 6, the inner ends of the arms 100 are pivoted to the upper ends of the crank-arms 113 by means of pins 109. As shown in Figs. 6 and 7, the crank-arms 113 are provided with split hubs encircling the shaft 110 and adjustably secured in position longitudinally thereof by means of binder-screws 114; the arms 113 being held rotatively with the shaft by a key 115 shown in Figs. 2 and 7. The rocking motion of the shaft 110 in clockwise direction, as viewed in Fig. 1, is transmitted through the crank-arms 113, arms 100 and bars 87 to move the fingers 82 and 83 from the position shown in Fig. 4 to that shown in Fig. 5; while the rocking motion of the shaft in counterclockwise direction will move the fingers back to the initial position shown in Fig. 1.

In the present embodiment the rock-shaft 110 is arranged to be operated from the main drive-shaft 6 of the wire-stitching head 5. Referring to Figs. 2 and 3, a cam 120 is fixedly mounted on the periphery of the driven element 11 of the main clutch 10 on the shaft 6. The cam 120 is formed with an eccentric periphery throughout substantially 360 degrees with its point of greatest radius terminating in a radial shoulder, as shown in Fig. 3. The cam 120 is adapted to rock a bell-crank lever 123 pivoted on a stud 124 carried by a bracket 125 attached to the side of the arm 4 of the wire-stitching machine, see Figs. 2 and 3. As shown in Fig. 3, the bell-crank lever 123 has one arm 126 overlying the main shaft 6 and carrying a follower-roller 127 which is engageable with the periphery of the cam 120. The opposite arm 129 of the bell-crank 123 extends substantially horizontally from the pivot-stud 124 and carries a pin 130 for pivotally connecting it to the upper end of an operating bar 135 which depends therefrom. The bell-crank lever 123 is maintained in position with its roller 127 engaging the cam 120 by means of a helical spring 134 having one end hooked through a hole in the arm 129 of the lever and its opposite end anchored to the support 137 of the motor 9, see Fig. 2.

The operating bar 135, above mentioned, is reduced in width at its lower end to provide a shoulder or abutment 140 at one side thereof and the terminal portion of the bar is beveled to provide an inclined cam surface 141. Above the abutment 140 the bar 135 is provided with a notch 142 and arranged for longitudinal adjustment on the side of the bar is a detent-plate 145 having its upper end overlying a portion of the notch. The upper edge of the plate 145 thus forms an adjustable detent-shoulder 147 which cooperates with a detent-lever, to be later described, in maintaining the operating bar 135 in lowermost position during the wire-stitching operation.

During the wire-stitching operation the bell-crank lever 123 is oscillated by the cam 120 to impart substantially vertical reciprocatory movement to the operating bar 135. This reciprocating motion of the bar 135 is translated into oscillating movement of the rock-shaft 110 by means of a novel and ingenious system of levers as next described.

Loosely mounted on the rock-shaft 110 is a lever 150 having a bifurcated end in the opening 151 of which the lower end of the operating bar 135 is received, see Figs. 7 and 8. As shown in these views, a pin 152 extending across the sides of the opening 151 at the outer end of the lever 150 serves to prevent displacement of the bar 135 therefrom. Fastened to the top of the lever 150 adjacent the inner end of the opening 151 is a plate 154 having a slot or groove 155 in its top to provide a contact-shoulder 156, see Figs. 8 and 9. The shoulder 156 is adapted to be engaged by the shoulder or abutment 140 on the operating bar 135, as indicated in Fig. 5, during the downward movement of the latter to cause the lever 150 to rock in counterclockwise direction. At a later stage in the sheet-feeding operation the operating bar 135 is released from engagement with the lever 150 to permit the latter to return to initial position by the actuation of means to be later described. The return movement of the lever 150 is limited by the engagement of a set-screw 158 carried by a depending tail 159 on the lever with the side of the channel-iron 107, see Fig. 6.

The plate 154 on the lever 150 is formed with a lateral extension 162, see Figs. 6, 7 and 9, which carries an abutment in the form of a set-screw 163 threaded through a hole in the extension and held in adjusted position by a check-nut 164. The set-screw or abutment 163 is adapted to engage with one end of an intermediate lever 170 to rock the latter during the sheet-feeding operation. The lever 170 is of U-shape in plan view, see Fig. 7, and rockably mounted on a stud 171 carried at the outer end of an arm 175 extend-

ing laterally from and forming part of the bearing-bracket 112, previously described. As shown in Fig. 7, the stud 171 is provided at one end with a head 172 and its opposite end is reduced to extend through a hole in the arm 175. A sheet-metal finger 176, see Fig. 6, carried by the stud 171 is clamped against the face of the arm 175 by means of a nut 173 screwed onto the reduced end of the stud and set up against the opposite face of the arm. The intermediate lever 170 is pivoted on the stud 171 between the head 172 and the finger 176. Rotatably mounted in the opposite ends of the lever 170 is an adjusting screw 177 provided with a thumb-nut 178 on its outer projecting end. An internally threaded block 180 on the screw 177 extends laterally through a longitudinal opening 181 in the side of the lever, see Figs. 6, 7 and 9, with its reduced cylindrical end forming a crank-pin 182 which is received in the circular bore of a block 185. The block 185 is slidably mounted in a longitudinal opening 191 in a third lever or arm 190 and has a flange 186 disposed between this lever and the lever 170 to retain it in place, see Fig. 9. The lever 190 is provided with a split hub which is clamped to the rock-shaft 110 by means of binder-screws 187.

It will be apparent from the foregoing description that when the lever 150 is rocked downwardly under the action of the operating bar 135 its set-screw 163 will act against the top of the lever 170 to rock the latter downwardly on the pivot-stud 171. Through the means of the crank-pin 182 and block 185 the lever 190 fixed on the rock-shaft 110 will also be tilted downwardly to rock the shaft in counterclockwise direction, as viewed in Fig. 5. In this manner the crank-arms 113 will be rocked to move the arms 100 and bars 87 from the position shown in Figs. 3 and 4 to that indicated in Fig. 5 whereby to cause the sheet-separating fingers 82 and 83 to move through an operating stroke to slide the uppermost carton-blank rearwardly with respect to the underlying ones in the stack.

In accordance with the present invention the extent of sliding movement imparted to the sheet-feeding fingers may be regulated accurately to meet particular requirements. This is accomplished by adjusting the position of the crank-pin 182 and block 185 toward or away from the axis of the rock-shaft 110. To alter the location of the pin 182 the adjusting screw 177 is rotated in its bearings in the lever 170 by turning the thumb-nut 178. Rotation of the adjusting screw 177 in either direction acts to shift the position of the internally-threaded block 180 and its companion block 185 toward or away from the fulcrums of the levers 170 and 190 whereby to change the effective leverage or mechanical advantage and the extent of movement imparted to the sheet-feeding fingers 82 and 83.

The two levers 150 and 190 are positioned on the rock-shaft 110 adjacent one side of the bearing bracket 112, see Fig. 7, and held axially in place by a collar 194 secured to the shaft, see Fig. 7. An arm 195 has its hub secured to the shaft 110 abutting the opposite side of the bearing bracket 112, the arm and collar 194 thus taking the axial thrust of the shaft in either direction. The arm 195 has an aperture at its end into which is hooked one end of a helical spring 197, the opposite end of the spring being anchored to a pin 198 adjustably mounted in an angular bracket 199 fastened to the under side of the channel-iron 107, see Figs. 3 and 4. The spring 197 thus serves as the means for rocking the shaft 110 in clockwise direction as viewed in Fig. 3 to return the crank-arms 113, arms 100, bars 87 and feeding fingers 82 and 83 to inoperative position. This return movement of the parts is limited by a stop-member 200 fast on the forward end of the rock-shaft 110, see Figs. 1 and 2. The stop member 200 comprises an arm having a split hub which is adjustably clamped to the shaft 110 by a binder-screw 201. The member 200 has spaced lateral fingers at its lower end which straddle the forward end of the rail 107 and carry set-screws 203 and 204. The stop-screws 203 and 204 are adapted to engage with the opposite sides of the channel-iron rail 107 to limit the rocking movement of the shaft 110 in either direction. The set-screw 203 is adapted to engage the side of the rail 107 to limit the return movement of the shaft 110 under the action of the spring 197 whereby to locate the shoulders 86 of the sheet-feeding fingers 82 and 83 in position to properly engage the edge of the topmost carton-blank in the stack, see Fig. 1. The stop-screw 204 is adapted to engage the side of the rail 107 only when the sheet-feeding fingers 82 and 83 are moved beyond their normal range of movement due to momentum of the parts, thereby preventing overfeeding of the carton-blanks.

The operating bar 135 normally is swung in a direction to maintain its abutment-shoulder 140 directly above and in alinement with the contact shoulder 156 on the lever 150 by means of a coil spring 210, see Fig. 4. One end of the spring 210 is hooked around a pin 211 on the bar 135 while its opposite end passes through a hole in a pin 212 adjustably mounted in an angular bracket 213 fastened to the side of the channel-iron 107.

In accordance with the present invention the fingers 82 and 83 are reciprocated only once for each cycle of operation of the wire-stitching unit regardless of the number of stitches applied. During the applying of the first stitch or staple to a carton-blank being stitched the fingers 82 and 83 are moved forwardly to feed the topmost carton-blank from the stack into position to be subsequently grasped by the operator for feeding this blank into position to be stitched. In order to prevent continuous operation of the fingers 82 and 83 during the applying of a series of stitches to the work it is necessary that the operating bar 135 be displaced from operative engagement with the lever-arm 150. This displacement of the operating bar 135 is effected during its downward movement through the engagement of its lower beveled end or cam-face 141 with an abutment in the form of a roller 215, seee Figs. 4 and 5. The roller 215 is rotatably mounted on a pin 216 extending between the sides of a bifurcated plate-like bracket 217 fastened to the top of the channel-iron or rail 107, see Figs. 2 and 5. During the downward movement of the operating bar 135, its abutment-shoulder 140 engages with the contact-shoulder 156 on the lever 150 and swings the latter downwardly and through the system of levers and arms, before described, the fingers 82 and 83 are moved through an operative stroke to feed a carton-blank into position to be grasped by the operator. As the operating bar 135 approaches its lowermost position, the cam-face 141 will engage with the abutment-roller 215 to cause the bar to be rocked on its pivot-pin 130 toward the left against the action of the spring 210 in the manner indicated in

Fig. 6, whereby to disengage its abutment-shoulder 140 from the contact-shoulder 156 on the lever 150. The lever 190 mounted fast on the shaft 110 thus will be caused to return to first position under the influence of the spring 197. The lever 190, through its pivotal connection 185, 182 with the intermediate lever 170, will rock the latter from the position shown in Fig. 5 to that indicated in Fig. 6. As the right-hand end of the lever 170 swings upwardly its upper edge will act against the set-screw 163 on the lever-arm 150 to also rock the latter upwardly to the position shown in Fig. 6.

To prevent continued operation of the operating bar 135 means are provided for latching the bar in its lowermost position until the last stitch of the series has been applied to the work. As shown in Figs. 2, 3 and 4, this latter means consists in a latching arm 220, see Figs. 5 and 6, having a lug 221 at its upper end and being pivoted on a stud 222 carried by an arm 223 formed as part of the bearing bracket 112, see Figs. 2 and 3. The latching arm 220 normally is rocked in counterclockwise direction, as viewed in Fig. 3, to maintain its lug 221 in engagement with the side of the operating bar 135 by means of a coil spring 225, see also Fig. 4. The spring 225 has one end fastened to a cotter-pin 226 on the arm 220 with its opposite end hooked through a hole in the finger 176, previously described as being mounted on the pivot-stud 171. As the operating bar 135 moves downwardly the lug 221 on the latching arm 220 will ride along its edge and finally snap into the detent notch 142 in the bar to engage its detent-shoulder 147. The bar 135 thus will be latched in lowermost position to withhold the follower-roller 127 on the bell-crank lever 123 from engagement with the operating cam 120 on the drive-shaft 6. As shown in Fig. 3, the latching arm 220 is connected to the stopping member 60 of the wire-stitching mechanism by means of a link 230, a pin 231 on an arm 232 carried by the stopping member extending through a longitudinal opening 233 in the link to permit the latching arm to swing to latching position without rocking the stopping member. As the last stitch of a series is applied to a carton-blank W, the stopping member 60 is rocked in counterclockwise direction, as viewed in Fig. 3, and through the link 230 the latching arm 220 is rocked to disengage its lug 221 from the latching shoulder 147 on the operating bar 135. The bar 135 thus will be released and drawn upwardly by the action of the spring 134 to re-engage the roller 127 on the bell-crank lever 123 with the periphery of the cam 120 and return the shoulder 140 on the bar to a position directly above the contact-shoulder 156 on the lever-arm 150. As the operating bar 135 is returned to first position, its edge will ride along the side of the plate 154, see Fig. 8, carried by the lever-arm 150. Due to frictional contact between the bar 135 and the lever 150, which is loosely mounted on the rock-shaft 110, the bar 135 would tend to rock the arm upwardly beyond its normal operating position. To prevent such action the abutment 158 carried by the tail 159 of the lever 150 is adapted to engage the side of the rail 107 to limit the upward rocking movement of the lever and locate its contact-shoulder 156 in position to be engaged by the shoulder 140 on the bar 135 when the sheet-feeding mechanism is again operated. A preferred form of apparatus having been described in detail the method of operation thereof is as next explained.

Mode of operation

The apparatus is prepared for operation by first assembling the carton-blanks W one over another on the elevator platform 68 to form a stack as illustrated in Figs. 1 and 16. To facilitate the loading operation and to guard against damage to the sheet-separating fingers 82 and 83, the latter are adapted to be displaced from operative position by swinging them upwardly on the pivot-pins 88 to the position indicated by dash-lines in Fig. 15. As the fingers 82 and 83 are tilted upwardly, the stop-pins 92 carried thereby will ride along the under side of the leaf-springs 95 and eventually come to rest against the top of the bars 87 to yieldingly hold the fingers in retracted position. After the carton-blanks W have been stacked to the proper height on the platform 68 of the elevator, the fingers 82 and 83 may be returned to operative position with their bottom faces seating on the top of the stack and their shoulders 86 in position to engage the topmost carton-blank in the stack, see Figs. 2 and 15. The bars 87 and arms 100 are free to pivot as a unit on the pins 109 at the upper ends of the crank-arms 113 to maintain the fingers 82 and 83 seating upon the topmost carton-blank W, see Fig. 4.

As the nose-portions 84 of the fingers 82 and 83 engage with the upper surface of the top carton-blank W the fingers are adapted to rock both longitudinally and laterally on the pin 88 and abutments 90 and 94 in the manner previously explained to insure that their shoulders 86 will engage positively with the edge of the topmost carton-blank. Thus, the fingers are adapted to rest on the upper surface of the stack with their shoulders 86 invariably in proper position to engage the edge of the topmost carton-blank W without chance of their riding thereover. The guide-members 97 which overlie and project from the forward ends of the fingers 82 and 83 constitute inclined ramps for guiding the folded carton-blanks W upwardly and across the fingers as they are fed forwardly across the table 3 and toward the wire-stitching unit. The feeler 80 is set in position for contacting the upper surface of the stack of blanks W on the elevator, see Fig. 1, and the control handle 81 then is rocked manually to render the hydraulic pump 76 and motor 74 operative to raise the stack until it comes under control of the feeler to maintain the top carton-blank at a predetermined level. If by inadvertence or otherwise the stack of carton-blanks is raised beyond its normal height, that is, to a point where its uppermost carton-blank W is positioned above the range of movement of the fingers 82 and 83, the latter will be carried upwardly with the stack as the arms 100 tilt on the pins 109. If the stack of sheets continues to rise the bars 87 on the arms 100 will eventually engage the under side of the table 3, as shown in Fig. 16, and the fingers 82 and 83 thereafter will be tilted upwardly on the pivot-pins 88 against the action of the leaf-springs 95 whereby to guard against damage to the fingers and associated parts of the mechanism.

The wire-stitching unit is rendered operative by closing the circuit for the electric motor 9 which drives through the belt 8 to rotate the fly-wheel 7. The electric circuits to the electromagnets 34, 48 and 56 also are rendered operative by closing suitable line-switches, not herein shown, and the energization of the electromagnets is thereafter controlled by the switches 47, 47' and 55 shown in the diagram, Fig. 11. The opposite pairs of feed-rolls 15 and 16 thus will be driven

continuously at high speed from the motor 9 operating through the belt 8, chain 30 and other connections including the clutch 21 to drive the shafts 20 and 17. The shaft 20 operates through the coupling rod 23 to drive the shaft 22 and through the intermeshing gears 26 and 27 drives the shaft 24, coupling rod 25 and shaft 18 mounting the lower pair of rolls 16. The clutch 21 is held in driving engagement by the spring 31 to connect the continuously-operating driving means to the shaft 20 and the clutch 29 is held disengaged by the connecting rod 39 and shifting lever 40.

The operator starts a stitching operation by withdrawing the top carton-blank W in the stack from under the fingers 82 and 83, folding the side panels of the blank to overlie its body portion and then feeding the folded blank forwardly into the bite between the upper and lower feed-rolls 15 and 16. The folded carton-blank W then will be fed forward by the feed-rolls 15 and 16 to carry its edge into engagement with the depending abutment 44, see Fig. 1, of the gauge 45. The engagement of the forward edge of the folded carton-blank with the depending abutment 44 of the gauge 45 as the blank is carried forward by the feed-rolls 15 and 16 will cause the gauge to slide forwardly and engage the post 46 with the switch 47, see Fig. 1, to close the circuit including the electromagnet 34.

Upon energization of the electromagnet 34, see Fig. 2, its plunger-armature will operate through the link 35, lever 36 and link 37 to rock the bell-crank shifting fork 38 to release the clutch 21 so as to disconnect the high speed continuous drive from the shaft 20. The movement of the bell-crank shifting fork 38 will be transmitted through the connecting rod 39 and shifting lever 40 to engage the clutch 29 simultaneously with the disengagement of the clutch 21. Due to the momentum of the folded carton-blank W, the gauge 45 will continue to slide forwardly a short distance to cause the post 46 to close the second switch 47', see Figs. 1 and 11, to energize the electromagnet 48. Upon energization of the electromagnet 48 its plunger-armature will actuate the clutch-operator 49 to engage the main clutch 10 whereby to connect the fly-wheel 7 to the drive-shaft 6 for the wire-stitching head 5. The wire-stitching mechanism in the head 5 then will operate to apply a stitch to the carton-blank W.

During the operation of the wire-stitching mechanism to apply the first stitch in a series, the eccentric on the drive-shaft 6 will reciprocate the pitman 32 to actuate the one-way clutch 33 connected thereto through an idle stroke. During the second half-revolution of the drive-shaft 6, while the parts of the wire-stitching mechanism are being returned to initial position, the pitman 32 will actuate the one-way clutch 33 through an operative stroke to rotate the shaft 28. The shaft 28, being connected to the shaft 24 through the clutch 29, will drive through the coupling rod 25 to rotate the shaft 18 mounting the lower pair of feed-rolls 16. The shaft 24 also will drive through the intermeshing gears 27 and 26 to rotate the shaft 22 which, operating through the coupling rod 23, will rotate the shaft 20 and shaft 17 connected thereto to drive the upper pair of feed-rolls 15 mounted thereon. The rotation of the feed-rolls 15 and 16 thus will advance the work W a predetermined increment of movement corresponding to the required spacing between the stitches applied in series. The wire-stitching mechanism and the intermittently-driven feed-rolls 15 and 16 consequently will operate in timed relationship to stitch the seam of the carton-blank W.

The carton-blank separating means is operated from the wire-stitching means in the manner as next explained. Upon rotation of the drive-shaft 6 for the wire-stitching head 5 to apply the first stitch to the work, the cam 120 on the shaft, see Fig. 3, acting on the roller 127 will rock the bell-crank lever 123 to cause the operating-bar 135 depending therefrom to be lowered. Because of the fact that the periphery of the cam 120 has a gradual increase in radius throughout substantially 360 degrees of its circumference, the downward movement imparted to the bar 135 by the cam will be relatively slow and continuous during one complete revolution of the shaft 6. That is to say, the bar 135 will be lowered slowly during the applying of the first stitch to the work and the subsequent feeding of the work into position to receive a second stitch in the series.

As the operating bar 135 is lowered, its abutment-shoulder 140 will be held in engagement with the contact-shoulder 156 on the lever 150, see Fig. 4, by the spring 210 and the lever thus will be rocked on the shaft 110 from the position shown in Figs. 3 and 4 to that indicated in Fig. 5. The abutment screw 163 on the lever 150, acting against the top of the lever 170, will rock the latter on its pivot-stud 171 to the position shown in Fig. 5. During this rocking movement of the intermediate lever 170 its crank-pin 182 will cooperate with the block 185 to tilt the lever 190 downwardly to the position shown in Fig. 5 with the block sliding in the longitudinal opening 191. The lever 190, being fixed on the rock-shaft 110, will rock the latter in counter-clockwise direction, as viewed in Fig. 4, to swing the crank-arms 113 in the same direction or to the position shown in Fig. 5. The arms 100 and bars 87 connected to the crank-arms 113 thus will be moved toward the left to cause the fingers 82 and 83 to feed the top carton-blank W laterally to cause its rearward edge to project beyond the edge of the underlying blanks in the stack and into position to be readily grasped by the operator, see Fig. 6.

As the operating bar 135 approaches its lowermost position its beveled cam-face 141 will engage the abutment-roller 215 and the bar thus will be rocked to the position indicated in Fig. 6 to pry its abutment-shoulder 140 away from the contact-shoulder 156 on the lever 150. With the levers 150, 170 and 190 thus released from actuation by the bar 135 the spring 197, acting through the arm 195, will rock the shaft 110 in clockwise direction, as viewed in Fig. 3, to return the levers and shaft 110 to inoperative position with the abutment 203 on the stopping member 200, see Fig. 1, engaging against the side of the rail 107 to limit this return movement. During the return movement of the levers and rock-shaft 110 the fingers 82 and 83 will be retracted to inoperative position with their shoulders 86 relocated in position to engage the next succeeding carton-blank W in the stack supported on the elevator.

After being disengaged from the lever 150 the operating bar 135 will continue to be moved downwardly under the action of the cam 120 on the drive-shaft 6 and adjacent the end of its movement in this direction the notch 142 in its side will be brought into alinement with the latching lug 221 on the latching arm 220, see Fig. 6. The

spring 225 acting on the arm 220 will rock the latter in counterclockwise direction to the position shown in Fig. 6 to cause its lug 221 to overlie the shoulder 147 on the bar 135. After the cam 120 has been rotated through substantially 360 degrees, the operating bar 135 normally would be raised by the bell-crank lever 123 but this upward movement is prevented by the engagement of the lug 221 on the latching arm 220 with the shoulder 147 on the bar. Thus, the bar 135 will be latched in its lowermost position to prevent further actuation thereof during continued rotation of the main shaft 6 and cam 120 in applying the remainder of the stitches in the series to the carton-blank. In other words, at this juncture the cam 120 will continue to be operated during the rotation of the shaft 6, but the follower-roller 127 on the bell-crank lever 123 will be held away from the periphery of the cam so that the latter will have no effect on the operating bar 135.

During the operation of the wire-stitching mechanism in the head 5, the control-shaft 52, see Fig. 2, is turned through a predetermined increment of movement for each stitch applied to the work until the radial arm 53 at the end of the shaft comes into engagement with and rocks the pivoted frame 54 to close the switch 55. This closing of the switch 55 will energize the electromagnet 56, see Fig. 3, which, operating through its plunger-armature connected to the link 58 and the bell-crank 57, will rock the pivoted stopping member 60 to arrest the stitching operation. The stopping member 60 will operate through the pin 231 and link 230 to rock the latching arm 220 from the position shown in Fig. 6 to that shown in Fig. 4 to release the operating bar 135. Upon release of the operating bar 135, the spring 134 will rock the bell-crank lever 123 back to initial position as shown in Fig. 3 to cause the follower-roller 127 to be reengaged with the periphery of the cam 120 whereby the bar will be raised with its shoulder 140 positioned above the contact-shoulder 156 on the lever 150. The parts of the operating mechanism thus will be returned to initial position and the rotation of the main drive-shaft 6 arrested after a cycle of operation of the wire-stitching unit. It will be understood that the operating mechanism for the blank-separating fingers 82 and 83 will be operated only once for each cycle of operation of the wire-stitching mechanism, regardless of the number of stitches in the series applied to the seam of the blank. When carton-blanks W of different sizes and shapes are to be stitched with different numbers of stitches, the arm 53 on the control-shaft 52, see Fig. 2, may be adjusted with respect to the arm 61 to apply a series of any predetermined number of stitches during a stitching operation before the stopping member 60 is actuated; but regardless of the relative adjustment of the arms the sheet-separating fingers 82 and 83 will be operated only once for each cycle of operation of the wire-stitching mechanism.

The operator may continue to fold and feed the carton-blanks W one after another as they are separated from the top of the stack by the fingers 82 and 83 which are operated once at the beginning of each cycle of operation of the stitching mechanism to displace each uppermost carton-blank rearwardly with respect to the underlying blanks in the stack. It will be understood that the wire-stitching unit will operate to feed, stitch and discharge the carton-blanks W at a rate at least as fast as the operator can grasp, fold and advance the carton-blanks to the feed-rolls 15 and 16. In other words, the operator cannot overfeed the stitching unit regardless of how fast he operates. However, by having the top carton-blank W jogged or displaced rearwardly with respect to the underlying blanks in the stack the operator can more easily and quickly grasp the blank. Thus, no time is wasted in separating the top carton-blank W from the underlying ones in the stack and there will be no interruption of the rhythm of the operator's motions so he may fold and advance the blanks at maximum efficiency. When all the carton-blanks W of the stack have been stitched, the operator may rock the handle 81 for manually controlling the valve 79 of the hydraulic drive for the elevator platform 68 to cause it to be lowered to receive another stack of blanks W to be stitched.

Wire-stitching machines of the type shown herein are generally employed for stitching the flaps of carton-blanks of different sizes and shapes composed of paper or fiber board of various grades, weights and thicknesses. It is therefore necessary that the stitching mechanism be made adjustable to permit the machine to operate on a wide variety of carton-blanks, these adjustments being effected by means disclosed in my prior patent referred to above. It is also important that the carton-blank separating mechanism of such machines be made adjustable so that it will operate with equal efficiency on different types of carton-blanks. It has been found in practice that the extent of movement of the separating fingers necessary to feed the top carton-blank to the required position depends upon several factors. For example, it has been determined that when the separating mechanism is operating on relatively large, heavy blanks the separating fingers must be moved through a greater stroke than when small light-weight carton-blanks are being delivered to the operator. It has also been found that carton-blanks or other sheets having comparatively rough outer surfaces offer greater resistance to sliding movement along the top of the stack than blanks made from stock having a lower coefficient of friction. The operating means for the separating fingers 82 and 83 is actuated through a relatively short stroke to initially slide the top blank rearwardly of those remaining in the stack and the blank continues to slide through the remainder of the required distance under momentum. When operating on relatively light-weight carton-blanks and those having smooth surfaces the inertia of the blanks is practically nil and thus only a relatively short stroke of the separating fingers is necessary to set up momentum in the blanks which will cause them to move to the required position. On the other hand, blanks of relatively heavy or rough stock are subject to greater inertia, offering greater resistance to sliding movement and for this reason it is necessary to initially feed the cartons with the fingers 82 and 83 through a greater distance.

In accordance with the present improvements, means are provided for adjusting the extent of movement imparted to the separating fingers 82 and 83 to adapt them to feed different types of carton-blanks into position to be grasped by the operator. As before explained, the adjusting means comprises the screw 177, crank-pin 182 and block 185 carried thereby. When it is desired to adapt the feeding fingers 82 and 83 to move only a relatively short distance the thumb-nut 178 on the adjusting screw 177 is turned in

a direction to cause the block 180 and crank-pin 182 to be shifted toward the pivotal axis of the stud 171 and away from the axis of the rock-shaft 110. On the other hand, when it is required that the fingers 82 and 83 be moved through a greater distance the adjusting screw 177 is turned to feed the crank-pin 182 and block 185 to a position nearer the axis of the rock-shaft 110 and farther away from the axis of the pivot-stud 171. Through this provision the effective leverage or mechanical advantage of the levers 150, 170 and 190 may be adjusted with precision to impart the required movement to the sheet-feeding fingers 82 and 83 without altering the range of movement of the operating bar 135.

It will be observed from the foregoing specification that the present invention provides a sheet-separating unit in cooperation with an elevator and processing unit for separating the top sheet from the underlying sheets in the stack whereof to facilitate its handling and manipulation by the operator. The sheet-separating unit of the present invention is adapted for use to displace the topmost carton-blank relatively of the underlying blanks in a stack and to operate only once for each cycle of operation of the wire-stitching machine with which it is used, regardless of the number of stitches applied in series to the blank. The operating mechanism for the sheet-separating fingers is adapted for accurate adjustment to regulate the range of movement imparted to the fingers in accordance with different requirements.

While a preferred embodiment of the sheet-separating unit is herein illustrated and described as adapted for use in conjunction with an elevator and wire-stitching unit, it is to be understood that various modifications may be made in the structure and arrangement of the apparatus and its method of application without departing from the spirit or scope of the invention. Therefore, without limiting myself in this respect, I claim:

1. A device for separating the top sheet of a stack of horizontally arranged sheets from the underlying sheets in the stack comprising fingers adapted to rest on the top of the stack and constructed and arranged to engage across the edge of the top sheet, means for reciprocating said fingers, means for pivotally connecting the fingers to the reciprocating means, a spring overlying the fingers and acting thereon to rock them into operative position for engaging across the edge of the top sheet, and means for limiting the rocking movement of the fingers under the action of the spring, said spring adapted to maintain the fingers in elevated position after they have been rocked upwardly.

2. In an apparatus of the type indicated, means for supporting a stack of horizontally-disposed sheets to be stitched, means constructed and arranged to engage across the edge of the top sheet in the stack, means for moving said sheet-engaging means to displace the top sheet relative to the underlying sheets in the stack, and means for actuating the sheet-displacing means comprising a reciprocating member, means for reciprocating said member, and manually-adjustable means for regulating the extent of reciprocation of the sheet-displacing means.

3. In an apparatus of the type indicated, means for supporting a stack of horizontally-disposed sheets to be stitched, means constructed and arranged to engage across the edge of the top sheet in the stack, means for reciprocating said sheet-engaging means to displace the top sheet in the stack relative to the underlying sheets, an operating member, means for reciprocating said operating member, a lever adapted to be rocked by said operating member, an intermediate lever for reciprocating the sheet-engaging means from the movement of the operating member, and means connecting said levers and adjustable toward and away from the axes of the latter to control the extent of reciprocation imparted to the sheet-engaging means.

4. In an apparatus of the type indicated, means for supporting a stack of horizontally disposed sheets to be stitched, means for engaging the edge of the top sheet of the stack, means for reciprocating said sheet-engaging means to displace the top sheet with respect to the underlying sheets in the stack comprising an operating bar, means to reciprocate said bar, a lever rockable by said bar, an intermediate lever rockable by the first lever and carrying a crank-pin, a rock-shaft, a third lever fast on said rock-shaft and engaged by the crank-pin on the intermediate lever, a crank-arm carried by the rock-shaft, and means connecting the reciprocating means for the sheet-engaging means to be actuated by the crank-arm.

5. In an apparatus of the type indicated, means for supporting a stack of horizontally-disposed sheets to be stitched, means engageable with the top sheet of the stack and movable to displace it with respect to the underlying sheets in the stack, and means for actuating the sheet-displacing means comprising a reciprocable operating bar, a lever, means on the bar for rocking the lever during movement of the bar in one direction, an intermediate lever rockable by the first lever and mounting a crank-pin, a rock-shaft, a third lever fast on said rock-shaft and engaged by the crank-pin on the intermediate lever, a crank-arm carried by the rock-shaft, and means connecting the sheet-displacing means to be actuated by the crank-arm.

6. In an apparatus of the type indicated, means for supporting a stack of horizontally-disposed sheets to be stitched, means for displacing the top sheet relative to the underlying sheets in the stack, said last-named means comprising means engageable with the edge of the top sheet and movable horizontally across the stack, a rock-shaft, a crank-arm on the rock-shaft, means connecting the crank-arm to operate the sheet-engaging means, a reciprocable operating bar, a lever adapted to be rocked by the operating bar, an intermediate lever operated from the first lever, a crank-pin on the second lever, a third lever fast on the rock-shaft and engaged by the crank-pin on the intermediate lever to oscillate the rock-shaft to actuate the sheet-engaging means, and means for adjusting the position of the crank-pin relative to the fulcrums of the intermediate and third levers to regulate the effective leverage thereof whereby to control the extent of oscillation of the rock-shaft and movement imparted thereby to the sheet-engaging means.

7. An apparatus for separating the top sheet of a stack of horizontally-arranged sheets from the underlying sheets of the stack comprising means engageable across the edge of the top sheet in the stack, a member for reciprocating said sheet-engaging means, a crank-arm for actuating the reciprocating member, a lever for rocking said arm, an intermediate lever rockable about an axis spaced from the axis of the first lever, means for rocking the intermediate lever, a sliding connec-

tion between the first lever and intermediate lever, and manually-operable means for adjusting said sliding connection relative to the axes of said levers to control the extent of reciprocation imparted to the sheet-engaging means.

8. An apparatus for separating the top sheet of a stack of horizontally-arranged sheets from the underlying sheets of the stack comprising means for engaging across the edge of the top sheet, a rockable arm for reciprocating said sheet-engaging means, a lever for rocking said arm, an intermediate lever rockable about an axis spaced from the axis of the first lever, an adjusting screw extending longitudinally of the second lever, a crank-pin adjustable longitudinally of the intermediate lever by means of the adjusting screw and slidably engaging the first lever, and means to rock the second lever to oscillate the first lever and rock the arm to reciprocate the sheet-engaging means.

9. An apparatus for separating the top sheet of a stack of horizontally-arranged sheets from the underlying sheets of the stack comprising means adapted to engage across the edge of the top sheet, means for reciprocating said sheet-engaging means, a rockable arm for actuating said reciprocating means, a lever for rocking said arm, a reciprocable bar for rocking said lever, resilient means for maintaining said reciprocable bar in position to rock the lever, and means engageable by said reciprocable bar at a predetermined point in its reciprocation to cause it to release the lever.

10. An apparatus for separating the top sheet of a stack of horizontally-arranged sheets from the underlying sheets including means for engaging across the edge of the top sheet, means for reciprocating said sheet-engaging means, a lever for actuating said reciprocating means, an intermediate lever for rocking the first lever, a third lever adapted to rock the intermediate lever, a reciprocable bar for rocking the third lever, a spring for normally maintaining said bar in position to rock the third lever, and camming means for moving said bar against the action of the spring to release it from the third lever.

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