Nov. 3, 1964 J. H. THORP 3,155,220

INTERMITTENT BOOK FEED MECHANISM

Filed Sept. 23, 1960 5 Sheets-Sheet 1

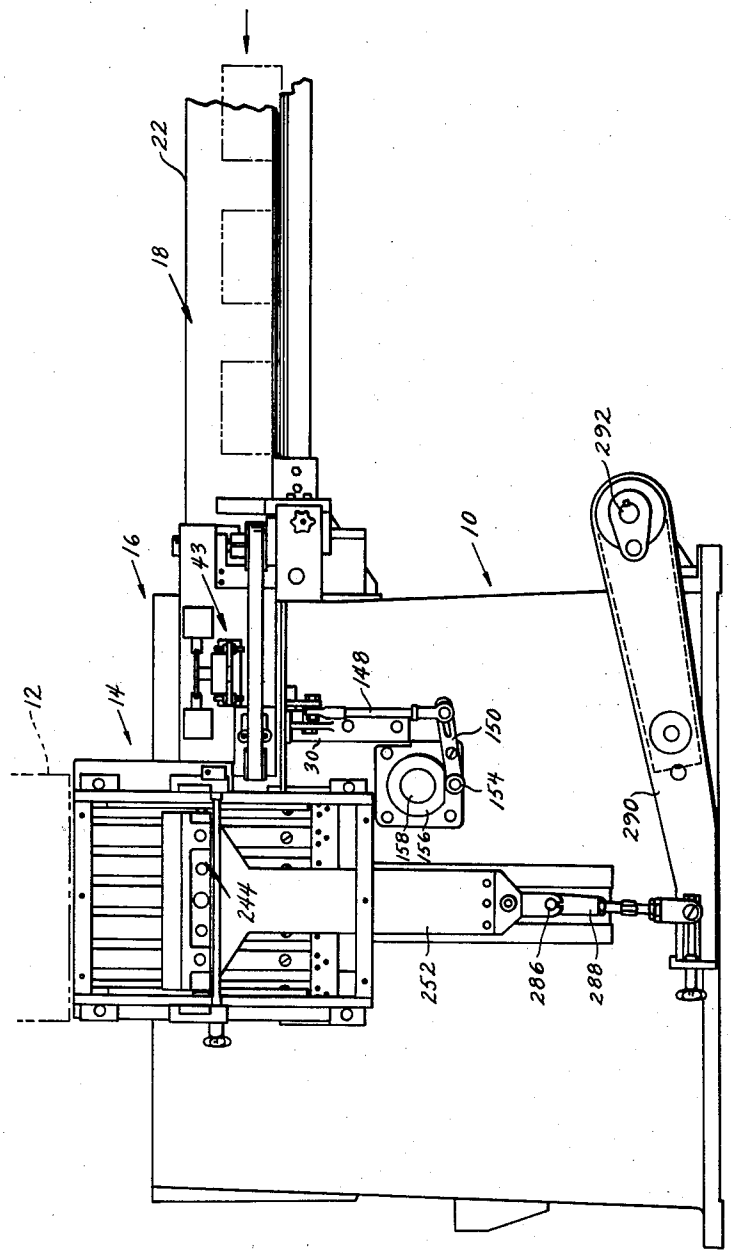


FIG. 1

INVENTOR.
JAMES H. THORP
BY Teller & McCormick
ATTORNEYS

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FIG. 2

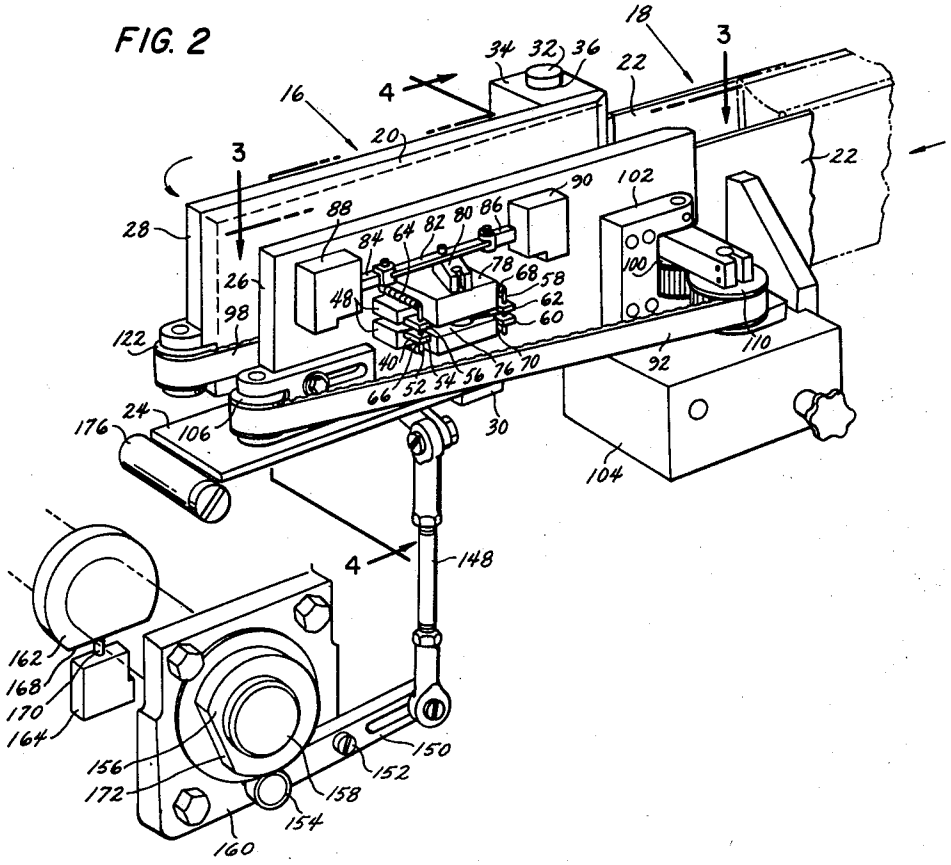
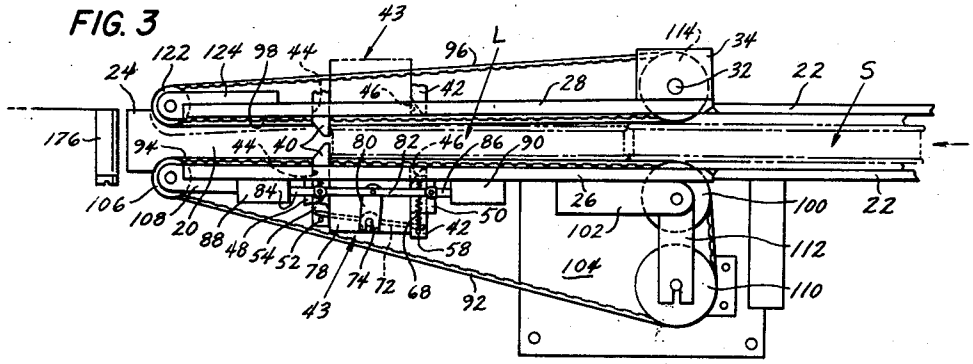


FIG. 3



INTERMITTENT BOOK FEED MECHANISM

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FIG. 4

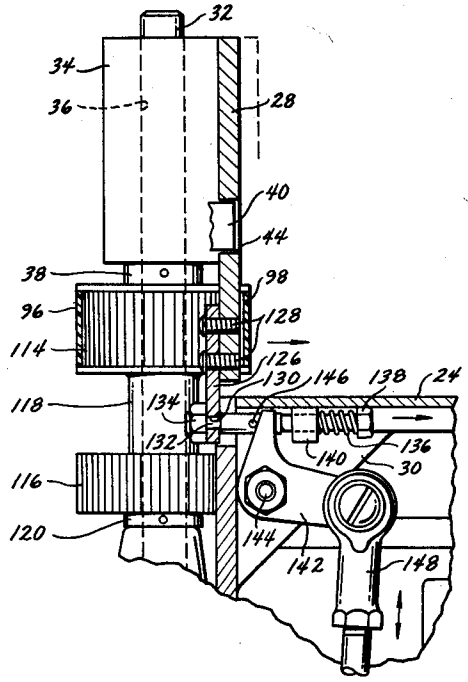


FIG. 5

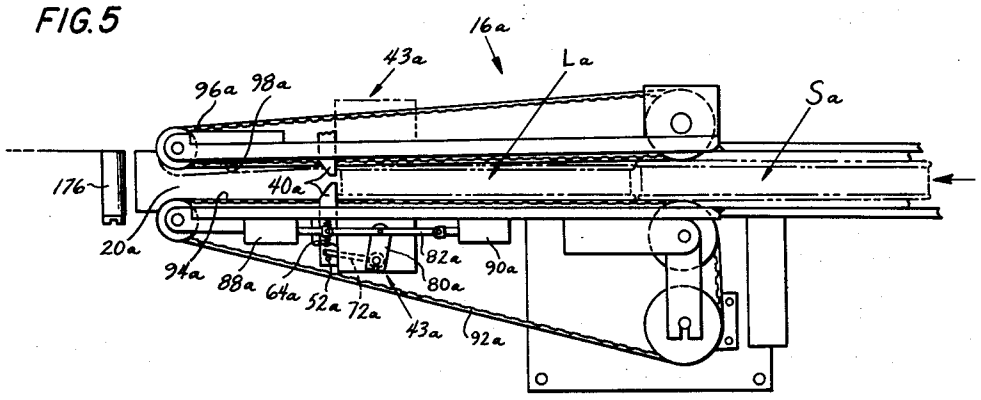
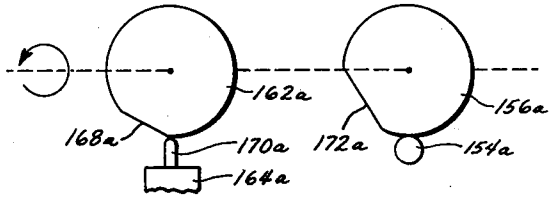


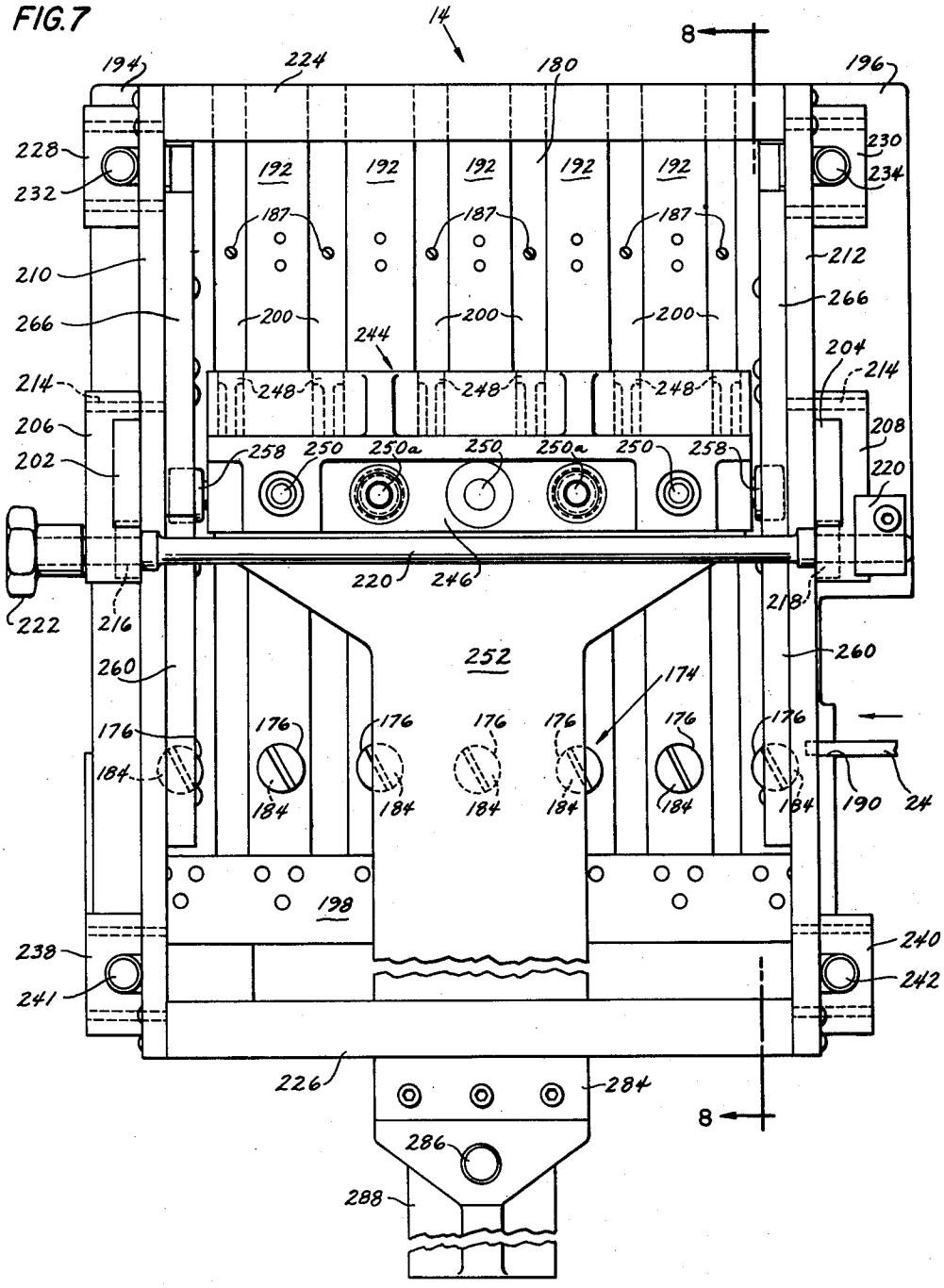
FIG. 6



INTERMITTENT BOOK FEED MECHANISM

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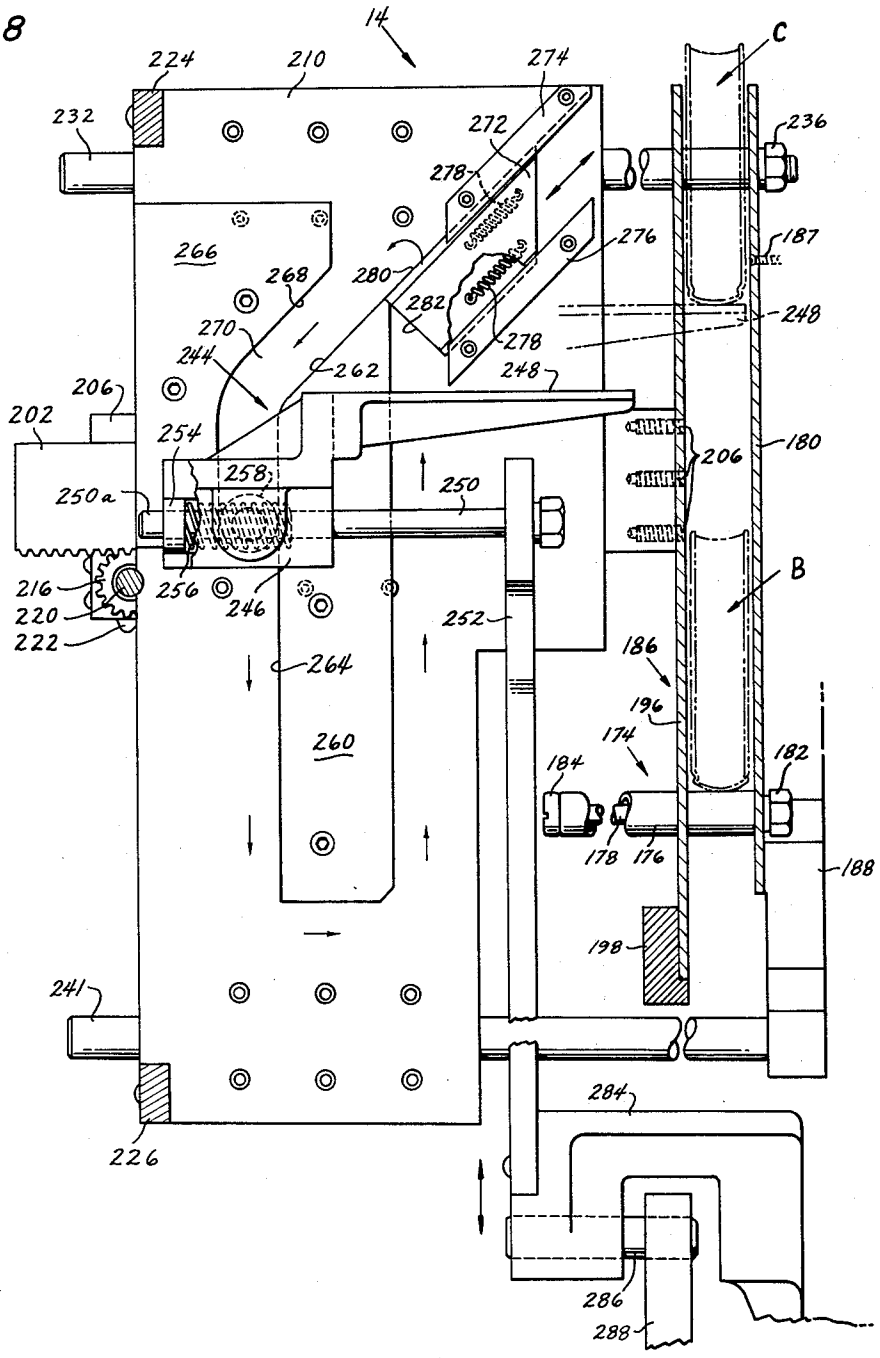
FIG. 7



INTERMITTENT BOOK FEED MECHANISM

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FIG. 8



United States Patent Office

3,155,220

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3,155,220

INTERMITTENT BOOK FEED MECHANISM

James H. Thorp, Hartford, Conn., assignor to The Smyth Manufacturing Company, Bloomfield, Conn., a corporation of Connecticut

Filed Sept. 23, 1960, Ser. No. 58,029
8 Claims. (Cl. 198—34)

This invention relates to an intermittent book feed mechanism adapted to receive books in succession from a continuous feed conveyor and to elevate the books one at a time and at regular intervals to a book receiving device. More specifically, the invention relates to a feed mechanism of this general type which is particularly adapted for, but which is not limited to, use in a book forming and pressing machine of the general type disclosed in the copending application of Carl Schramm, Serial No. 751,452, filed July 28, 1958, now Patent No. 3,016,550, and entitled Book Forming and Pressing Machine.

Intermittent book feed mechanisms of the general type referred to have heretofore been provided, but they have not been found entirely satisfactory. For example, the above-mentioned Schramm application discloses a mechanism of this general type wherein books from a continuous feed conveyor are received in succession in a channel between parallel passes of a pair of endless conveyor belts. The books are arrested in their movement through the channel by movable stop means and are then permitted to pass one at a time at the urging of the conveyor belts. On discharge from the channel, the books are received in succession by an elevator which lifts the books in succession to a book receiving device. The elevator is adapted to receive a book only when a preceding book has been delivered to the book receiving device and when the elevator has thereafter completed its return or downward stroke. Thus, an indirect but nonetheless mandatory limitation is imposed on the maximum attainable operating speed of the conveyor belts and their associated stop means. There is also a direct limitation on the operating speed of the said belts and stop means, this resulting from the fact that the books are held by the stop means with the conveyor belts passing over and in feeding engagement with the covers thereof. Obviously, high speed operation of the conveyor belts, such as would increase the overall speed of operation of the mechanism, may result in book covers which are burned or otherwise marred by the conveyor belts during the time when the books are held by the stop means.

It is the general object of the present invention to provide an intermittent book feed mechanism of the type mentioned which is capable of feeding books in succession more rapidly and more positively than has heretofore been possible, but in which the books are nevertheless handled with extreme care to the end that burns and other deleterious effects on the covers thereof are avoided.

A more specific object of the invention resides in the provision of a book feed mechanism of the type mentioned which includes a device adapted to positively stop and feed books one at a time and at regular intervals as to a receiving table, the said device including alternately operative stop and feed means both particularly adapted to handle books rapidly and carefully without damage to their covers.

Another specific object of the invention resides in the provision of a book feed mechanism which includes an elevator operatively associated with a receiving table and adapted to lift books therefrom for delivery to a book receiving device, provision being made for the delivery of books to the receiving table at any time during the latter portion of upward strokes and during return or

downward strokes of the elevator to the end that the maximum operating speed of the feed mechanism may be substantially increased.

The drawings show two embodiments of the invention and such embodiments will be described, but it will be understood that various changes may be made from the constructions disclosed, and that the drawings and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

FIG. 1 is a fragmentary front view of a book forming and pressing machine incorporating an intermittent book feed mechanism embodying the present invention.

FIG. 2 is an enlarged perspective view of a book stop and feed device forming a part of the feed mechanism of the present invention.

FIG. 3 is a plan view of the book stop and feed device of FIG. 2.

FIG. 4 is a fragmentary vertical transverse section taken generally as indicated by the line 4—4 in FIG. 2.

FIG. 5 is a plan view similar to FIG. 3, but showing a stop and feed device employed in a book feed mechanism constituting an alternative embodiment of the invention.

FIG. 6 is a schematic view of a pair of control cams usable with the book stop and feed device of FIG. 5.

FIG. 7 is an enlarged front view of a book elevator assembly forming a part of the book feed mechanism of FIG. 1.

FIG. 8 is a vertical transverse section taken generally as indicated by the line 8—8 in FIG. 7.

Environment and General Arrangement

As mentioned above, the intermittent book feed mechanism of the present invention is otherwise usable but is particularly adapted for use in the book forming and pressing machine disclosed in the above-identified Schramm application. As is fully described in said application, the said machine is adapted to form and press books after their covers have been secured as by pasting but before the paste has fully set. The forming and pressing operations are carried out at and between a plurality of stations arranged in a circular path and the books are transported from station to station on a rotary turret which carries the book forming and pressing equipment. Presser units, forming part of this equipment, and which may be characterized as book receiving devices, are rotated in succession to a loading station for receipt of books. A single book is delivered to a presser unit at the loading station and the unit thereafter retains the book during intermittent movement through the several stations in the machine until a final station is reached where the book is discharged by the presser unit fully formed and pressed.

In FIG. 1, the book forming and pressing machine of the Schramm application is partially shown with a main housing thereof indicated generally at 10. The aforementioned rotary turret and the forming and pressing equipment carried thereby are located at an upper portion of the machine and are not shown, but the position of a presser unit disposed at the aforementioned loading station is indicated generally by the broken line 12. Located below the loading station of the machine is an elevator assembly 14 and operatively associated with said assembly is a book stop and feed device indicated generally at 16. The elevator assembly 14 and the book stop and feed device 16 constitute the principal elements of the intermittent book feed mechanism of the present invention and said elements serve cooperatively to feed books one at a time and at regular intervals to the loading station of the book forming and pressing machine.

Books are delivered to the feed mechanism in succession by a continuous feed conveyor indicated generally at 18 and which may be loaded manually or by automatic loading means. The book stop and feed device 16 initially receives the books from the conveyor 18, arrests their movement for timed intervals, and feeds the same individually and in succession to the elevator assembly 14. At the elevator assembly the books are lifted successively to the loading station where they are received and held by presser units located at the position 12. As will be seen, operation of the feed mechanism is rapid and positive and yet care is taken to avoid damage to the book covers. Books are of course delivered successively to the loading station in suitably timed relation with the operation of the forming and pressing machine so that each presser unit is supplied with a book as it reaches the position 12 at the loading station.

Book Stop and Feed Device

Referring now particularly to FIGS. 2 and 3, it will be observed that the book stop and feed device 16 receives books successively from the continuous feed conveyor 18 in an elongated channel 20 having an inlet end located adjacent said conveyor and a discharge end. The continuous feed conveyor 18 is equipped with spaced longitudinal guide plates 22, 22 between which the books pass in longitudinal alignment. The books may be in end abutting relationship between the guide plates 22, 22, or they may be spaced apart longitudinally as shown in FIG. 1. As shown, the books are arranged in edgewise fashion on the continuous feed conveyor 18 with their binding edges facing downwardly and the books are so received in the channel 20 of the stop and feed device 16. While this arrangement of the books is essential when the feed mechanism of the present invention is used in the book forming and pressing machine shown, the said mechanism can be readily adapted to handle books arranged in various other attitudes or positions as may be required in other book handling machines.

In the presently preferred form of the stop and feed device 16, the elongated book receiving channel 20 is defined by an elongated flat base plate 24 and by similar flat elongated first and second side plates 26 and 28. The base plate 24 is fixedly supported as by means of a bracket 30, best shown in FIGS. 1 and 4, mounted on the machine housing 10 and one end of said plate is located adjacent the discharge end of the continuous feed conveyor 18 so as to receive books therefrom. The first side plate 26 is fixedly supported by means not shown along one edge portion of the base plate 24 and, preferably, said side plate 26 is adapted for transverse adjustment so as to accommodate books of varying thickness in the channel 20. The second side plate 28 is preferably supported for horizontal swinging movement about a vertical axis adjacent the discharge end of the continuous conveyor 18. As shown, said second side plate extends adjacent an opposite side edge portion of the base plate 24 and is supported for horizontal swinging movement about a vertical shaft 32. That is, an enlargement 34 on the side plate 28 adjacent the discharge end of the conveyor 18 is provided with a vertical bore 35 which loosely receives the shaft 32. As best shown in FIG. 4, a collar 38 is fixedly mounted on the shaft 32 and supports the enlargement 34 vertically for horizontal swinging movement of the side plate 28 about the shaft. Swinging movement of the side plate 28 is effected by means and for a purpose to be set forth hereinafter.

It will be apparent that a book entering the channel 20 of the stop and feed device 16 will initially slide along the base plate 24 at the urging of the continuous feed conveyor 18. When the rear edge of the book reaches the end of the conveyor 18, the book will nevertheless continue to slide through said channel at the urging of succeeding books therebehind. Thus, whether books on the conveyor 18 are in end abutting or longitudinally spaced

relationship, books within the channel 20 of the stop and feed device will assume an abutting end-to-end relationship for discharge in succession from said channel. In accordance with the present invention, the discharge of books from the channel 20 is controlled by book stop and feed means so that books are discharged from the channel one at a time and at regular intervals. The stop means is movable from an external position into said channel to engage and hold a lead book at a feed position against the urging of the books therebehind. The feed means is normally out of engagement with a lead book at the feed position, but said means is movable into engagement with such a book to transport the same toward the discharge end of the channel. As will be seen, the stop means and the feed means are operated alternately so that successive lead books are first held in the channel 20 and are then discharged therefrom.

In the book stop and feed device 16 shown in FIGS. 2 and 3, the aforesaid stop means includes first and second stop means or, more specifically, a first or front pair of stop fingers 40, 40 and a second or rear pair of stop fingers 42, 42. Preferably, and as shown, all of said fingers are of like construction. Each of the fingers is movable transversely into and out of the book receiving channel 20 and the two fingers of each pair are movable in unison but in opposite directions. The fingers 40, 40 are movable transversely into and out of the channel 20 through suitable openings 44, 44 in the side plates 26 and 28 respectively and the fingers 42, 42 pass through similar openings 46, 46 in said plates during transverse movement of the same.

In FIG. 3 a support and operating means 43 for one of the fingers 40, 40 and one of the fingers 42, 42 is shown adjacent the side plate 26 and it will be understood that an identical support and operating means 43 is provided for the remaining two stop fingers 40 and 42 adjacent the second side plate 28. Said support and operating means includes a guide and support member 48 for said one finger 40 and a similar guide and support member 50 for said one finger 42. The fingers 40 and 42 are slidably held in their respective guide and support members 48 and 50 and each of said fingers has a bifurcated outer end portion. The bifurcated outer end portion of the finger 40 carries a small vertical pin 52 which extends through vertically spaced arms 54 and 56 of said portion and which projects above and below the same. A similar vertical pin 58 extends through the bifurcated outer end portion of the finger 42 and said pin projects above and below vertically spaced arms 60 and 62 of said finger portion. Small coil springs 64 and 66, attached respectively to upper and lower end portions of the pin 52, have their opposite ends attached to the side plate 26 and serve to bias the said one finger 40 into the channel 20. Similar small coil springs 68 and 70, attached respectively to upper and lower end portions of the pin 58, have their opposite ends attached to the side plate 26 and serve to bias the said one finger 42 into the channel 20.

In FIG. 3 it will be seen that the small vertical pins 52 and 58 of the support and operating means 48 shown have an actuating arm 72 operatively associated therewith. Said arm is fixedly connected at approximately its midpoint with a vertical drive pin 74 so as to be swung about the axis of the pin within a horizontal groove 76 in a mounting block 78. A crank arm 80, connected at one end with the drive pin 74, is connected at its opposite end with a drive link 82 which, in turn, is connected at opposite ends with push rods 84 and 86 of solenoids 88 and 90. Said solenoids 88 and 90 can be energized alternately to reverse the positions of the stop fingers 40 and 42. When the solenoids are energized and de-energized respectively as required to move the drive link 82 to the position shown in FIG. 3, the actuating arm 72 is held in the position shown. In this position of the actuating arm, the finger 40 is urged into the channel 20 by the aforementioned springs 64 and 66, the actuating arm serving to

limit the inward movement of the finger by engagement with the pin 52. The finger 42, on the other hand, is retracted from the channel 20 as shown by engagement of the arm 72 with the pin 58. When energized and de-energized conditions of the solenoids 88 and 90 are reversed, the drive link 82 is moved leftwardly, the actuating arm 72 is swung in a counterclockwise direction, and the stop finger 40 is retracted from the channel 20 while the finger 42 is moved into the channel by spring pressure. From the foregoing, it will be apparent that the solenoids 88 and 90, together with their counterparts in the support and operating means not shown, may be operated to move the front stop fingers 40, 40 and the rear stop fingers 42, 42 to the positions shown. In this position of the fingers, the front stop fingers 40, 40 engage and hold a lead book, such as the book L, at a feed position in the channel 20 against the urging of the books therebehind. The said solenoids may then be operated to cause the front fingers 40, 40 to be withdrawn from the channel 20 and the aforementioned feeding means may be moved into feeding engagement with the lead book L to transport the same toward the discharge end of the channel 20. As will be seen, the feed means transports a lead book toward the discharge end of the channel 20 at a rate in excess of the rate of movement of books into said channel. Thus, during discharge of the lead book L from the channel 20, a gap will occur between the same and a succeeding book S shown in FIG. 3. The rear fingers 42, 42 are held against the sides of the lead book L by spring pressure as the book passes thereby and said fingers snap into the gap between said book and the book S whereby to engage the leading edge portion of the book S and to arrest the movement of the same into the channel 20. On further operation of the solenoids urging the front fingers 40, 40 into the channel and returning the rear fingers 42, 42 to their retracted positions shown in FIG. 3, the book S will be moved into the channel by line pressure until it engages the front stop fingers 40, 40 as to be held at the feed position in the channel.

The movable feed means which transports books from the feed position toward the discharge end of the channel 20 may take a wide variety of forms. In the presently preferred form, said means comprises a first endless conveyor belt 92 which has one or an inner pass 94 disposed longitudinally in the channel 20 adjacent the first side plate 26. Said means preferably also comprises a second endless conveyor belt 96 which has one or an inner pass 98 disposed longitudinally in the channel 20 adjacent the second side plate 28. Preferably and as shown, the conveyor belts 92 and 96 are of the cog type and said belts are supported and driven by suitable pulleys so that their inner passes 94 and 98 move in the same direction and at the same speed toward the discharge end of the channel 20. The rate of movement of the inner passes 94 and 98 of the belts toward the discharge end of the channel 20 is preferably in excess of the rate of movement of books into the channel 20 to provide for the aforementioned gap between a lead book L and a succeeding book S during discharge of the lead book.

As best shown in FIG. 3, the first conveyor belt 92 is supported by and is operatively engaged with an idler cog pulley 100 mounted on a bracket 102 on the side plate 26 adjacent the inlet end of the channel 20. A pulley 110 drives the belt 92 and is connected with suitable driven means not shown but which may be conveniently located in a gear box 104 therebeneath. An arm 112 extends from the pulley 110 to the bracket 102 to adjustably support the latter and to thereby provide the lateral adjustment of the side plate 26. Adjacent the discharge end of the channel 20 the belt 92 is mounted on and is supported by a freely rotatable cog pulley 106 carried by a bracket 108 on the side plate 26.

The second endless conveyor belt 96 is supported on and is driven by a cog pulley 114 disposed adjacent the inlet end of the channel 20. In FIG. 4 it will be observed that the pulley 114 is rotatably mounted on the aforementioned vertical shaft 32 below the collar 38 thereon. Said pulley is formed integrally with a drive gear 116 and a connecting sleeve 118 and the unit comprising the pulley, the drive gear, and the sleeve is supported vertically on the shaft 32 by a collar 120 fixedly secured to the shaft. The drive gear 116 is driven by suitable means not shown within the gear box 104 so that the pulley 114 will be rotated in synchronism with the aforementioned drive pulley 110. Adjacent the discharge end of the channel 20, the second conveyor belt 96 is engaged with and supported by a freely rotatable cog pulley 122 best shown in FIGS. 2 and 3. The pulley 122 is supported by a bracket 124 secured to the second side plate 28.

From the foregoing, it will be apparent that the second side plate 28 may be swung horizontally about the shaft 32 to move the inner pass 98 of the second conveyor belt 96 into and out of feeding engagement with a book L at the feed position within the channel 20. In the position shown, the side plate 28 and the pulley 122 thereon hold the inner pass 98 of the conveyor belt 96 out of feeding engagement with a book L at the feed position. Said inner pass 98 and the inner pass 94 of the first conveyor belt 92 may pass lightly over and in engagemtnt with the covers of the book L, but such engagement is insufficient for positive feeding of the book and does not result in burning or other detrimental effects on the covers thereof. When the side plate 28 is swung horizontally inwardly so as to move the inner pass 98 of the conveyor belt 96 approximately to the position indicated by broken line in FIG. 3, said inner pass is placed in feeding engagement with a book L at the feed position in the channel 20. This engagement is such that the book is positively gripped between the pass 98 of the belt 96 and the inner pass 94 of the belt 92 for transport to a discharge end of the channel 20.

In order that successive lead books may be discharged from the channel 20 at regular intervals after delivery to the feed position, the side plate 28 must be swung inwardly and outwardly in timed relation with the operation of the aforementioned stop fingers 40, 40 and the stop fingers 42, 42. The presently preferred means for intermittently swinging the side plate 28 and the inner pass 98 of the conveyor belt 96 inwardly and outwardly will now be described with particular reference to FIG. 4. In said figure it will be observed that the side plate 28 has a short arm 126 attached thereto by suitable screws 128, 128. The arm 126 depends below the side plate 28 and has an aperture 130 therein which receives an outer end portion of a horizontal drive pin 132. A stop nut 134 on the outer end portion of the pin 132 engages an outer surface of the arm 126 and tends to pull said arm and swing the plate 28 inwardly at the urging of a spring 136. The spring 136 is disposed between a stop nut 138 on the inner end portion of the pin 132 and a bracket 140 on the base plate 24 which slidably holds the said pin. One end portion of a bell crank 142 which is pivotally supported by a horizontal pin 144 engages a small transverse lug 146 on the drive pin 132 and holds the same in an inner position as shown against the urging of the spring 136. The bell crank 142 is swung about the pivot pin 144 by means of a vertically reciprocable link 148 to allow the drive pin 132 to move to an inner position at the urging of the spring 136, and to urge the said drive pin to the outer position shown against the spring bias.

Returning now to FIG. 2, it will be seen that the link 148 is connected with a horizontal cam lever 150 so as to be reciprocated vertically thereby. The cam lever 150 is pivotally supported by a pin 152 and carries a cam roller 154 at an end portion opposite the vertical link 148. The cam roller 154 is operatively associated with a first disc type cam 156 mounted on a shaft 158 which is journaled in a support plate 160. Said shaft 158 also carries a second disc cam 162 operatively associated with a micro-

switch 154. The microswitch 164 is connected, by suitable electrical means not shown, with the solenoids 88, 88 and 90, 90 for operating the front stop fingers 40, 40 and the rear stop fingers 42, 42. The shaft 158 may form a part of the forming and pressing machine and said shaft may be driven by power operating means for the machine as best illustrated in FIG. 1.

Observing that the cam shaft 158 rotates in a counterclockwise direction as shown, cyclic operation of the stop and feed device 16 will be readily understood. In the position of the shaft 158 shown, a flat 168 on the cam 162 is in engagement with an actuating plunger 170 of the microswitch 164 and said switch is in a first position wherein it connects solenoids 88, 88 and 90, 90 so that the fingers 40, 40 and 42, 42 are moved to the positions shown in FIG. 3. In this position of the stop fingers, a lead book L is held at the feed position with a succeeding book S disposed therebehind as described above. Simultaneously, a flat 172 on the cam 156 is approaching the cam roller 154 but has not yet engaged the same. Accordingly, the cam roller 154 is in a downward position and the cam lever 150, the vertical link 148, the bell crank 142, the drive pin 132 etc., and the swingable side plate 28 are in the positions shown in FIGS. 3 and 4. Thus, the inner passes 94 and 98 of the conveyor belts 92 and 96 pass lightly over and in engagement with the opposite covers of the lead book L at the feed position, but said belt passes are not in feeding engagement with the covers.

On further rotation of the cam shaft 158, the flat 168 on the cam 162 will pass the actuating plunger 170 of the microswitch 164 causing said plunger to be depressed to move the switch to a second position. In the second position of the microswitch 162, the solenoids 88, 88 and 90, 90 are operated so as to retract the front stop fingers 40, 40 and free the rear stop fingers 42, 42 for inward movement at the urging of the aforementioned springs associated therewith. Said fingers 42, 42, however, engage the opposite covers of the lead book L at the urging of the springs and they are prevented from entering the channel 20. Approximately at the time the microswitch is moved from its first to its second position, the flat 172 on the cam 156 engages the cam roller 154 allowing the same to move upwardly and effecting clockwise rotation of the cam lever 150 about its pivot pin 152. This results in a downward movement of the link 148, in clockwise rotation of the bell crank 142 in FIG. 4, and in inward movement of the drive pin 132, inward movement of the swingable side plate 28, and in inward movement of the inner pass 98 of the second conveyor belt 96. The said inner pass 98 is thus placed in feeding engagement with the lead book L at the feed posititon and urges the same against the inner pass 94 of the belt 92 for transport of the book to the discharge end of the channel 20. The stop fingers 42, 42 snap into the gap between the lead book L and a succeeding book S whereby to arrest movement of the book S in the channel 20. After a short interval of time, the flat 172 on the cam 156 passes the cam roller 154 and the swingable side plate 28 and the inner pass 98 of the conveyor belt 96 are swung to their outer positions. When the flat 168 on the cam 162 again engages the actuating plunger 170 on the microswitch 164, the fingers 40, 40 and the fingers 42, 42 are again moved to the positions shown in FIG. 3 and the book S is urged to the feed position by line pressure for a succeeding cycle of operation.

Now, with regard to the timing of the operation of the book stop and feed device 16, it will be observed that the inner belt passes 94 and 98 must be maintained in feeding engagement with a lead book, such as the book L, until the book has been fully discharged or accelerated for discharge by momentum from the channel 20. Thus, if said two belt passes are parallel with respect to each other throughout their length, the side plate 28 must be held at its inner position to hold the belt pass 98 in feeding engagement with a lead book until it has been discharged

or substantially discharged from the channel. This may present a problem in that a succeeding book, such as the book S, may reach a position in the channel 20 wherein the inner belt passes 94 and 98 are in feeding engagement therewith prior to complete discharge of the book L. Particularly in the case of short books, a rapid advancement of a succeeding book S into engagement with the rear stop fingers 42, 42 may result and there may be a short period of time wherein the inner passes 94 and 98 of the belts 92 and 96 slide over the covers of such a book in feeding engagement with the covers thereof and with the book stationary. This obviously may result in book covers which are burned or otherwise marred by the belts.

One method of avoiding burning or marring of the covers of succeeding books held by the stop fingers 42, 42 involves shortening the interval of time during which the inner pass 98 of the belt 96 is held at its inner position. This may be accomplished by arranging the inner passes 94 and 98 of the belts 92 and 96 so that they converge slightly toward the discharge end of the channel 20. Such arrangement of the inner passes of the conveyor belts is provided for in the embodiment of the invention shown and, more specifically, said inner passes are arranged adjacent the discharge end of the channel 20 so as to be in feeding engagement with a book disposed therebetween even when the side plate 28 and the inner belt pass 98 reside at their outer positions. Thus, it is only necessary for the said side plate and belt pass to be held at their inner positions for a relatively short period of time and until a lead book L is transported from the feed position a predetermined short distance toward the discharge end of the channel 20. Once the book has been transported through this predetermined distance, the inner belt passes will complete the discharge movement of the book regardless of the position of the belt pass 98.

In FIG. 5 there is shown a book stop and feed device 16[a] constituting a part of an intermittent book feed mechanism which forms an alternative embodiment of the present invention. The book stop and feed device 16[a] is identical with the book stop and feed device 16 with the exception of the construction and operation of the stop fingers and the means for operating the same. More specifically, only one stop means, or one pair of stop fingers 40[a], 40[a], is provided in the stop and feed device 16[a]. The fingers 40[a], 40[a] are moved into and out of a book receiving channel 20[a] by two similar operating means 43[a], 43[a], only one of which is shown. The operating means 43[a] shown comprises solenoids 88[a] and 90[a], drive link 82[a], crank arm 80[a], actuating arm 72[a], small vertical pin 52[a], and upper and lower springs 64[a] and 66[a] (the latter not shown). Each of the elements of the operating means 43[a] is identical with the corresponding elements of the operating means 43 except for the actuating arm 72[a] which may be foreshortened due to the absence of a second or rear pair of stop fingers.

In operation of the stop and feed device 16[a], the fingers 40[a], 40[a] are disposed in the channel 20[a] at the positions shown at the beginning of a cycle of operation. The fingers are withdrawn from the channel momentarily and feed means comprising inner passes 94[a] and 98[a] of conveyor belts 92[a] and 96[a] are brought into feeding engagement with a lead book, such as the book L[a], to transport the same from the channel 20[a]. As the book L[a] passes the fingers 40[a], 40[a], the solenoids 88[a] and 90[a] and their counterparts in the operating means 43[a], not shown, are operated to permit the said fingers to move inwardly against the opposite covers of the book at the urging of their biasing springs. As the trailing edges of the covers of the lead book pass the fingers 40[a], 40[a], the said fingers snap into the gap between said book and a succeeding book S[a] whereby to engage and hold the book S[a] at the feed position in the channel 20[a].

In FIG. 6 two cams 162ª and 156ª are shown schematically operatively associated respectively with a microswitch 164ª and a cam roller 154ª. Each of said elements, with the exception of the cam 162ª, may be identical with the corresponding elements of FIG. 2 in construction and operation. The cam 162ª has a flat 168ª which is like the flat 168, but which is substantially shorter than said flat. The flat 168ª provides for extension of an actuating plunger 170ª of the switch 164ª for a small portion of the cycle of operation of the device. The length of said flat 168ª is such that the solenoids 88ª and 90ª, and their counterparts, will be operated during said portion of the cycle of operation to retract the fingers 40ª, 40ª. Retraction of the fingers occurs for a period of time sufficient only for the leading edges of the covers of a lead book Lª to pass the same as the book is transported toward the discharge end of the channel 20ª. Thereafter, and as the flat 168ª passes the plunger 170ª, the solenoids are operated and the fingers are permitted to engage the book covers under spring pressure so as to enter the gap between said book and a succeeding book in the manner described.

Book Elevator Assembly

The elevator or elevator assembly 14 is adapted to receive books as they are discharged one at a time and at regular intervals from the book stop and feed device 16 or from the book stop and feed device 16ª. In the elevator assembly the books are lifted one at a time and at regular intervals to a book receiving device such as a presser unit at the loading station of the book forming and pressing machine shown. As best illustrated in FIGS. 7 and 8, the elevator or elevator assembly 14 includes a stationary book receiving table indicated generally at 174 and which includes a plurality of similar transverse members supported in longitudinally spaced relationship with each other. Said transverse members preferably take the form of horizontal transversely extending rollers 176, 176 and, as best shown in FIG. 8, each roller 176 is supported for free rotation about a shaft 178 disposed therewithin. Inner end portions of the shafts 178, 178 are fixedly secured to an inner book guide means comprising a plate 180 by means of suitable nuts 182, 182. The outer end portion of each shaft 178 carries a slotted nut 184 which holds the associated roller 176 axially on the shaft.

The inner guide means comprising the plate 180 extends vertically upwardly from the book receiving table 174 and may be secured, as by means of suitable screws 187, 187 to an adjacent frame portion 188 of the book forming and pressing machine. As will be seen, said guide means 180 indirectly supports a second guide means spaced transversely outwardly therefrom and indicated generally at 186. The outer guide means 186 extends upwardly from the book receiving table 174 and cooperates with the inner guide plate 180 to guide and support books as they are delivered to and elevated from the book receiving table 174. As best shown in FIG. 7, the inner guide plate 180 is provided with a notch 190 for receiving an end portion of the aforementioned base plate 24 of the book stop and feed device 16 or the base plate 24ª of the device 16ª. Thus, it will be seen that books may be discharged from either of the book stop and feed devices described onto the receiving table 174. As mentioned above, books are handled by the book stop and feed devices in edgewise attitudes with their binding edges facing downwardly and the books are so delivered to the receiving table 174 as is illustrated by a book B in FIG. 8. A book delivered to the receiving table 174 passes longitudinally over said table between the aforesaid glide means with the rollers 176, 176 turning freely therebeneath, and the book is stopped on said table at a selected longitudinal position by suitable stop means not shown.

As best shown in FIG. 7, the aforementioned outer book guide means 186 comprises a series of five similar vertically extending guide plates 192, 192, a vertically extending left-hand side plate 194 of greater width than the plates 192, 192, and a right-hand side plate 196 which is also of greater width than the plates 192, 192. All of the plates of the guide means 186 are equally spaced longitudinally with respect to each other and said plates are connected together at their lower end portions by means of a longitudinally extending tie bar 198. There are seven rollers 176, 176 provided in the embodiment of the invention shown and said rollers project outwardly respectively through suitable openings in the seven plates of the guide means 186. The spaces between said rollers and the spaces between the several plates of the guide means are vertically aligned respectively to define six similar channels 200, 200. Said channels 200, 200 extend vertically from a point substantially below the rollers 176, 176 to an upper end portion of the elevator 14.

The book guide means 186 is supported in the elevator 14 by attachment of its left and right-hand plates 194 and 196 respectively with inner end portions of horizontally adjustable left and right-hand rack members 202 and 204. Such attachment may be effected as by means of suitable screws 206, 206 as best shown in FIG. 8. The left and right-hand rack members 202 and 204 are supported for horizontal inward and outward sliding movement respectively by left and right-hand guide and support blocks 206 and 208 and said blocks are mounted respectively on left and right-hand side frame plates 210 and 212 as by means of suitable screws 214, 214. Left and right-hand pinions 216 and 218, drivingly engaged respectively with the rack members 202 and 204, are fixedly mounted on a horizontal shaft 220. The left-hand end portion of the shaft 220 is journaled in the left-hand guide and support block 206 and a right-hand end portion thereof is entered in a locking block 220 and journaled in the right-hand guide and support block 208. A small hand knob 222 fixedly mounted on a left-hand end portion of the shaft 220 facilitates manual rotation of the same for horizontal inward and outward adjustment of the rack members 202 and 204. Such adjustment may be accomplished to change the horizontal position of the inner guide means 186 whereby to accommodate books of varying thickness.

The above-mentioned left and right-hand side plates 210 and 212 form part of a stationary frame of the elevator 14. Said frame also includes upper and lower longitudinally extending tie bars 224 and 226 fixedly connected to and extending between said side plates 210 and 212. Similar left and right-hand upper support blocks 228 and 230 mounted respectively on the side plates 210 and 212 adjacent the upper end portions thereof receive outer end portions of left and right-hand upper support rods 232 and 234. Inner end portions of said support rods are slidably received in suitable apertures in the left and right-hand plates 194 and 196 of the outer guide means 186, and said inner end portions are fixedly connected with the inner guide plate 180 as by suitable nuts 236, 236 best shown in FIG. 8. Left and right-hand lower support blocks 238 and 240, mounted respectively on the side plates 210 and 212, receive outer end portions of left and right-hand lower support rods 241 and 242. Inner end portions of said lower support rods may be fixedly connected to the portion 188 of the machine frame as shown in FIG. 8.

The elevator or elevator assembly 14 also includes a book elevating table indicated generally at 244 and which is operable to lift books from the receiving table 174 one at a time and at regular intervals between the guide means 180 and 186 and to a book receiving device such as a presser unit. In accordance with the invention, the elevating table operates in such a manner that the book receiving table is free to receive a subsequent book after a first book, such as the book B, has been lifted by the elevating table and before said table returns to its lowermost position. In the preferred embodiment of the inven-

tion shown, the elevating table 244 comprises a body portion 246 which carries six horizontally inwardly projecting lifting fingers 248, 248. The fingers 248, 248 are equally spaced longitudinally and are adapted to be entered respectively in the six vertical channels 200, 200 when the elevating table 244 is moved to an inner horizontal position for an upward or book lifting stroke of the table. As will be seen, the table 244 may also be moved to an outer horizontal position wherein the fingers 248, 248 are retracted from the channels 200, 200. The table is moved to said outer position for return or downward strokes whereby to accommodate the delivery of a succeeding book to the receiving table 174 prior to the arrival of the elevating table at its lowermost position.

As shown, the body portion 246 of the book elevating table 244 is mounted for horizontal inward and outward sliding movement on a series of five longitudinally spaced horizontal support rods 250, 250. Said support rods 250, 250 are fixedly connected to and supported by an upper end portion of a table support and drive member 252 as best illustrated in FIG. 8. The member 252 forms part of a vertically reciprocal means for operating the elevating table 244 as will be seen. Two of the table support rods 250a, 250a have collars 254, 254 fixed thereon which serve as seats for springs 256, 256. Said springs 256, 256 serve to urge the elevating table 244 horizontally inwardly to an inner position wherein the body portion 246 of the table engages the drive member 252. In this inner horizontal position of the table, the fingers 248, 248 extend into the channels 200, 200 as stated. The location of the fingers 248, 248 in the channels 200, 200 is indicated in FIG. 8 wherein the fingers are shown in broken line form beneath a book C approaching a presser unit during a lifting stroke of the table.

Cam means are preferred for sliding the book elevating table 244 outwardly against the urging of the springs 256, 256 during downward or return strokes of the table. As shown, said cam means comprises a pair of similar cam rollers 258, 258 mounted on opposite sides of the table 244. The cam rollers 258, 258 cooperate respectively with an additional cam means mounted on the side plate 210 and an additional cam means mounted on the side plate 212. In FIG. 8, the cam means mounted on the side plate 210 is clearly shown and the following description thereof is equally applicable to the cam means on the opposite side plate 212, said two cam means being identical in all respects.

The cam means on the side plate 210 includes a cam plate 260 which has a downwardly and outwardly inclined upper surface 262 and a substantially vertical outer side surface 264. Said two surfaces 262 and 264 constitute cam surfaces which are engaged by the left-hand cam roller 258 during downward or return strokes of the elevating table 244. It will be obvious that said cam surfaces serve to guide the cam roller outwardly and downwardly during a beginning portion of a downward stroke of the table and substantially vertically downwardly during the remaining portion of the said downward stroke. Preferably, and as shown, a second cam plate 266 is mounted on the side plate 210 adjacent the upper end portion of the cam plate 260. Said cam plate 266 has a cam surface 268 which is spaced from but which conforms generally with the cam surface 266 and with an upper portion of the cam surface 264 so as to define a cam track 270. The cam track 270 confines the cam roller 258 during the initial or beginning portion of each downward stroke of the table 244 and insures that the cam roller 258 will closely follow the cam surfaces 262 and 264 at the point where said two surfaces join.

Means for engaging the cam roller 258 with the cam surface 262 and thus entering said roller in the cam track 270 as the elevating table 244 completes each book lifting stroke and starts a return stroke is also mounted on the plate 210. An identical means may be mounted on the side plate 212. As shown, said means comprises a gate member 272 slidable between upper and lower guides 274 and 276. The guides 274 and 276 are inclined so that the gate member 272 is slidable downwardly and outwardly and, in an opposite direction, upwardly and inwardly. Springs 278, 278 urge the gate member 274 downwardly and outwardly into a blocking position wherein it engages an upper end portion of the cam plate 260. A first cam surface 280 on the gate member extends linearly from the inclined surface 262 on said plate 260. A second cam surface 282 on the gate member 272 faces generally downwardly and is inclined upwardly and outwardly.

From the foregoing, it will be apparent that the left-hand cam roller 258 will engage the cam surface 282 on the gate member 272 shown as the elevating table 244 reaches the upper end portion of a book lifting stroke. Such engagement of the cam roller with the gate member 272 will cause the said member to be cammed aside in an upward and inward direction whereupon the cam roller can pass vertically upwardly. As the roller passes the gate member 272, the said member will be urged downwardly and outwardly to the blocking position shown by the springs 278, 278. Subsequent downward movement of the cam roller 258 will result in engagement of said roller with the cam surface 280 on the gate member 272 and said cam surface will guide the cam roller outwardly and downwardly onto the similarly inclined cam surface 262 for a return or downward stroke of the elevating table 244 in its second or outer horizontal position.

The path of movement of the cam rollers 258, 258 during book lifting and return strokes of the elevating table 244 should be apparent from the foregoing and is shown by small arrows in FIG. 8. The means for effecting the vertical components of this movement may take a variety of forms, but as shown the drive member 252 is connected with and is reciprocated vertically by power operating means of the book forming and pressing machine. A yokelike lower portion 284 of said member carries a pivot pin 286 which is loosely received in a suitable bore in an upper end portion of an adjusting link 288. As best shown in FIG. 1, the lower end portion of the adjusting link 288 is pivotally connected with an oscillable driving arm 290. The arm 290 is connected with and is oscillated by a shaft 292 connected with power operating means for the forming and pressing machine by a means not shown. The shaft 292 and the aforementioned cam shaft 158 for the book stop and feed device are rotated by said power operating means in suitably timed relation to provide for coordinated operation of the stop and feed device and the elevating table 244 of the elevator 14. That is, said two shafts are operated in timed relation so that the book stop and feed device discharges books to the receiving table 174 in succession and at regular intervals between lifting strokes of the elevating table 244. The books are lifted from said receiving table by the elevating table in succession and at regular intervals to a presser unit at the loading station in the book forming and pressing machine. As a result of the provisions which permit delivery of books to the receiving table 174 during return strokes of the elevating table 244, high speed operation of the elevator 14 is obtainable. Complementary high speed operation of the book stop and feed device is also obtainable and without danger of burning or marring of the book covers as is explained above.

The invention claimed is:

1. In a device adapted to receive books in succession from a continuous feed conveyor and to discharge the books one at a time and at regular intervals; the combination of means defining an elongated channel having a discharge end and an inlet end for successively receiving books in longitudinal alignment from a continuous feed conveyor, stop means movable into said channel to engage a lead book therein and hold the same in a feed

position against the urging of the books therebehind, an endless conveyor belt having one pass disposed longitudinally in said channel adjacent said feed position but out of feeding engagement with a book thereat, a drive pulley operatively engaged with said conveyor belt adjacent said inlet end of said channel and providing for movement of said one pass thereof toward the discharge end of said channel, a support pulley operatively engaged with said conveyor belt adjacent the discharge end of said channel and movable transversely to swing said one pass angularly into feeding engagement with a lead book at said feed position and to transport the book toward the discharge end of the channel, and operating means for moving said stop means and said belt support pulley alternately whereby to first hold and then discharge successive lead books from the channel.

2. The combination as set forth in claim 1 wherein said drive and support pulleys are arranged so that a front end portion of said one pass of the conveyor belt adjacent the discharge end of said channel is located so as to be in feeding engagement with an adjacent book when the portion of said one pass of the belt adjacent said feed position is out of feeding engagement with a book at said position.

3. In a device adapted to receive books in succession from a continuous feed conveyor and to discharge the books one at a time and at regular intervals, an elongated flat base plate fixedly supported in a horizontal plane adjacent the discharge end of a continuous feed conveyor, a first elongated flat side plate fixedly supported in a vertical plane adjacent one side edge portion of said base plate, a second elongated flat side plate extending adjacent an opposite side edge portion of said base plate and supported for horizontal swinging movement about a vertical axis adjacent the discharge end of said continuous conveyor, said three plates cooperatively defining an elongated channel having a discharge end and an inlet end for successively receiving books from the continuous feed conveyor in end abutting relationship, a pair of stop fingers movable transversely into said channel from opposite sides to engage a lead book therein and hold the same in a feed position against the urging of the books therebehind, a first endless conveyor belt having one pass disposed longitudinally in said channel adjacent said first elongated side plate and driven toward the discharge end of said channel, a second endless conveyor belt having one pass disposed longitudinally in said channel adjacent said second elongated side plate, a support pulley for said second conveyor belt mounted on an end portion of said second side plate adjacent the discharge end of said channel and movable with said plate end portion, a drive and support pulley for said second conveyor belt supported adjacent the opposite end portion of said second side plate and driving said belt so that said one pass thereof travels toward the discharge end of said channel at a rate substantially equal to the rate of movement of said one pass of said first conveyor belt, operating means for swinging said second side plate horizontally from a first position wherein said one pass of said second conveyor belt is located so as to be in feeding engagement with a book adjacent said discharge end of said channel but out of feeding engagement with a lead book at said feed position to a second position wherein the said one pass is swung inwardly in the channel into feeding engagement with a lead book at said feed position whereby to transport the same toward the discharge end of the channel, and means for actuating said stop fingers and said operating means for said second side plate alternately whereby to first hold and then discharge successive lead books from the channel.

4. In a device adapted to receive books in succession from a continuous feed conveyor and to discharge the books one at a time and at regular intervals; the combination of means defining an elongated channel having a discharge end and an inlet end for successively receiving

books in longitudinal alignment from a continuous feed conveyor, first stop means movable from a position outside said channel into the channel to engage a lead book therein and hold the same in a feed position against the urging of the books therebehind, feed means comprising a conveyor belt pass normally out of feeding engagement with a lead book at said feed position in said channel but swingable angularly about an axis adjacent said channel inlet end into feeding engagement with such a book to transport the same toward the discharge end of the channel at a rate in excess of the rate of movement of books into the channel, second stop means disposed rearwardly of said first stop means and movable from a position outside said channel into the channel between a lead book and a book therebehind to engage and hold the latter during discharge of the lead book from the channel, and means for operating said first and second stop means and said feed means in timed relation so that a book entering the channel from the continuous feed conveyor is arrested in succession by said second and said first stop means and is thereafter discharged from the channel by said feed means with the feed means at no time in feeding engagement with a book while it is being held by either of said stop means.

5. In a device adapted to receive books in succession from a continuous feed conveyor and to discharge the books one at a time and at regular intervals; the combination of means defining an elongated channel having a discharge end and an inlet end for successively receiving books in longitudinal alignment from a continuous feed conveyor, first stop means movable from a position outside said channel into the channel to engage a lead book therein and hold the same in a feed position against the urging of the books therebehind, an endless conveyor belt having one pass disposed longitudinally in said channel adjacent said feed position but out of feeding engagement with a book thereat, means supporting said conveyor belt and driving the same so that said one pass thereof travels toward the discharge end of said channel, said means being movable to swing said one pass of said conveyor belt angularly about an axis adjacent said channel inlet end into feeding engagement with a lead book at said feed position whereby to transport the book toward the discharge end of said channel at a rate in excess of the rate of movement of books into the channel, second stop means disposed rearwardly of said first stop means and movable at the urging of spring means from a position outside said channel into the channel between a lead book and a book therebehind to engage and hold the latter during discharge of the lead book from the channel, and means for moving said first and second stop means and said belt support and drive means in timed relation so that a book entering the channel from the continuous feed conveyor is arrested in succession by said second and said first stop means and is thereafter discharged from the channel by said conveyor belt with the said one pass of said belt at no time in feeding engagement with a book while it is being held by either of said stop means.

6. In a device adapted to receive books in succession from a continuous feed conveyor and to discharge the books one at a time and at regular intervals, an elongated flat base plate fixedly supported in a horizontal plane adjacent the discharge end of a continuous feed conveyor, a first elongated flat side plate fixedly supported in a vertical plane adjacent one side edge portion of said base plate, a second elongated flat side plate extending adjacent an opposite side edge portion of said base plate and supported for horizontal swinging movement about a vertical axis adjacent the discharge end of said continuous conveyor, said three plates cooperatively defining an elongated channel having a discharge end and an inlet end for successively receiving books from the continuous feed conveyor in end abutting relationship, a first pair of stop fingers movable from positions outside said channel transversely into said channel from opposite sides to engage

a lead book therein and hold the same in a feed position against the urging of the books therebehind, a first endless conveyor belt having one pass disposed longitudinally in said channel adjacent said first elongated side plate and driven toward the discharge end of said channel at a rate in excess of the rate of movement of books into the channel, a second endless conveyor belt having one pass disposed longitudinally in said channel adjacent said second elongated side plate, a support pulley for said second conveyor belt mounted on an end portion of said second side plate adjacent the discharge end of said channel and movable with said plate end portion, a drive and support pulley for said second conveyor belt supported adjacent the opposite end portion of said second side plate and driving said belt so that said one pass thereof travels toward the discharge end of said channel at a rate substantially equal to the rate of movement of said one pass of said first conveyor belt, operating means for swinging said second side plate horizontally from a first position wherein said one pass of said second conveyor belt is located so as to be in feeding engagement with a book adjacent said discharge end of said channel but out of feeding engagement with a lead book at said feed position to a second position wherein the said one pass is swung inwardly in the channel so as to be in feeding engagement with a lead book at said feed position whereby to transport the same toward the discharge end of the channel, a second pair of stop fingers disposed rearwardly of said first pair of stop fingers and movable at the urging of spring means from positions outside said channel transversely into said channel from opposite sides and between a lead book and a book therebehind to engage and hold the latter during discharge of the lead book from the channel, and means for actuating said first and second pairs of stop fingers and said operating means for said second side plate in timed relation so that a book entering the channel from the continuous feed conveyor is arrested in succession by said second and said first pairs of stop fingers and is thereafter discharged from the channel by said conveyor belts with said belts at no time in feeding engagement with a book while it is being held by either of said pairs of stop fingers.

7. In a device adapted to receive books in succession from a continuous feed conveyor and to discharge the books one at a time and at regular intervals; the combination of means defining an elongated channel having a discharge end and an inlet end for successively receiving books in longitudinal alignment from a continuous feed conveyor, movable stop means spring biased into said channel to engage a lead book therein and hold the same in a feed position against the urging of the books therebehind, feed means comprising a conveyor belt pass normally out of feeding engagement with a lead book at said feed position in said channel but swingable angularly about an axis adjacent said channel inlet end into feeding engagement with such a book to transport the same toward the discharge end of said channel at a rate in excess of the rate of movement of books into the channel, and operating means for said stop means and feed means adapted to move said stop means out of said channel and to move said feed means for discharge of a lead book at said feed position from the channel, said operating means serving also to permit said stop means to be spring biased back into said channel during discharge of a lead book whereby to stop a book therebehind at said feed position.

8. In a device adapted to receive books in succession from a continuous feed conveyor and to discharge the books one at a time and at regular intervals, an elongated flat base plate fixedly supported in a horizontal plane adjacent the discharge end of a continuous feed conveyor, a first elongated flat side plate fixedly supported in a vertical plane adjacent one side edge portion of said base plate, a second elongated flat side plate extending adjacent an opposite side edge portion of said base plate and supported for horizontal swinging movement about a vertical axis adjacent the discharge end of said continuous conveyor, said three plates cooperatively defining an elongated channel having a discharge end and an inlet end for successively receiving books from the continuous feed conveyor in end abutting relationship, a pair of movable stop fingers spring biased transversely into said channel from opposite sides to engage a lead book therein and hold the same in a feed position against the urging of books therebehind, a first endless conveyor belt having one pass disposed longitudinally in said channel adjacent said first elongated side plate and driven toward the discharge end of said channel at a rate in excess of the rate of movement of books into the channel, a second endless conveyor belt having one pass disposed longitudinally in said channel adjacent said second elongated side plate, a support pulley for said second conveyor belt mounted on an end portion of said second side plate adjacent the discharge end of said channel and movable with said plate end portion, a drive and support pulley for said second conveyor belt supported adjacent the opposite end portion of said second side plate and driving said belt so that said one pass thereof travels toward the discharge end of said channel at a rate substantially equal to the rate of movement of said one pass of said first conveyor belt, operating means for swinging said second side plate horizontally from a first position wherein said one pass of said second conveyor belt is located so as to be in feeding engagement with a book adjacent said discharge end of said channel but out of feeding engagement with a lead book at said feed position to a second position wherein the said one pass is swung inwardly in the channel so as to be in feeding engagement with a lead book at said feed position whereby to transport the same toward the discharge end of the channel, and operating means for said stop fingers and said operating means for said second side plate adapted to move said stop fingers out of said channel and to cause said side plate to swing inwardly for discharge of a lead book at said feed position from the channel, said operating means serving also to permit said stop fingers to be spring biased back into said channel during discharge of a lead book from the channel whereby to stop a book therebehind at said feed position.

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