

[54] APPARATUS FOR DISPOSING THIN SHEET MATERIAL IN A SHINGLED STREAM

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[58] Field of Search 271/12, 13, 3.1, 100, 101, 271/106, 221, 222, 187, 80, 82, DIG. 2, 225, 256, 186

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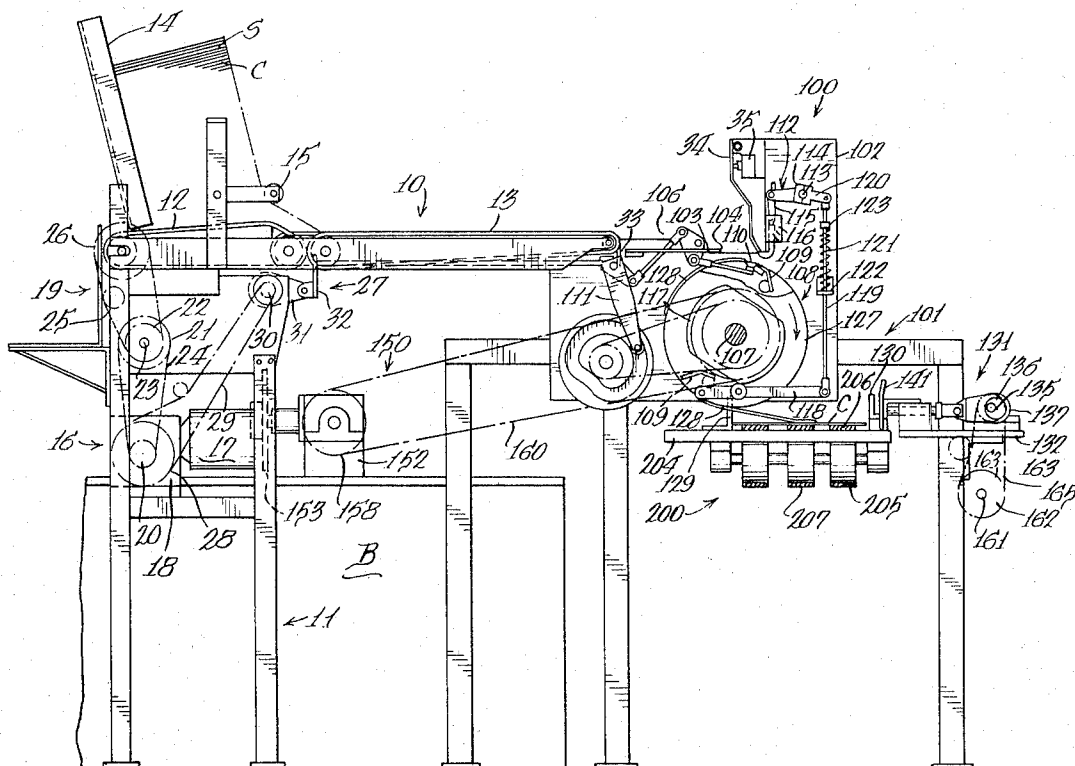
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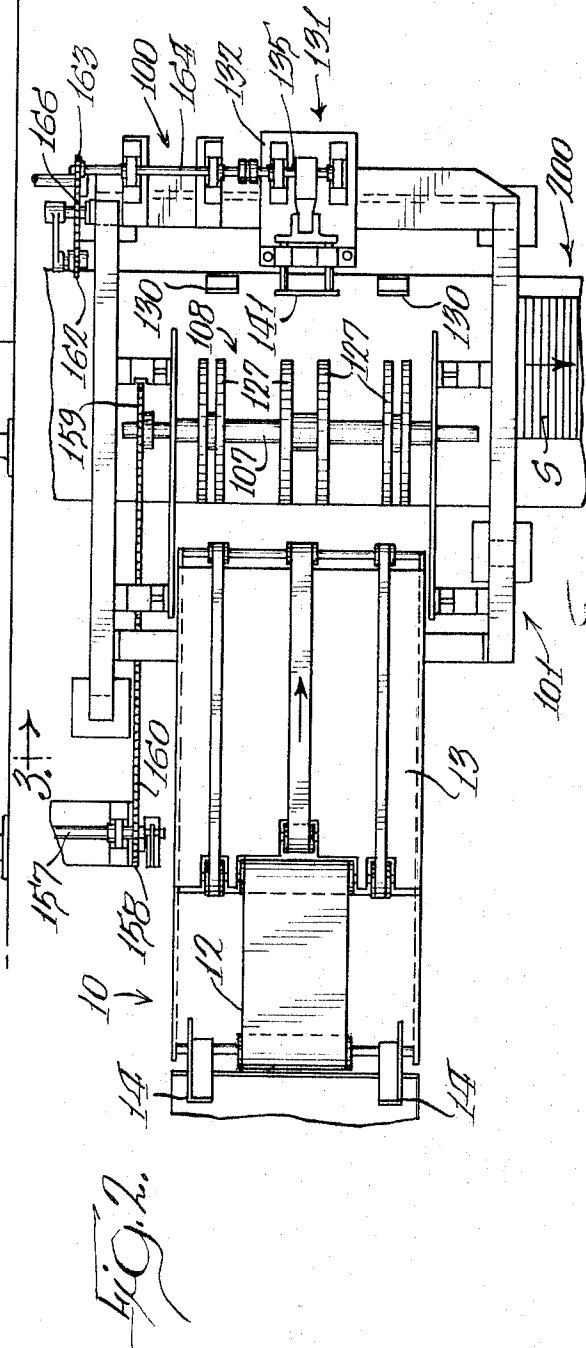
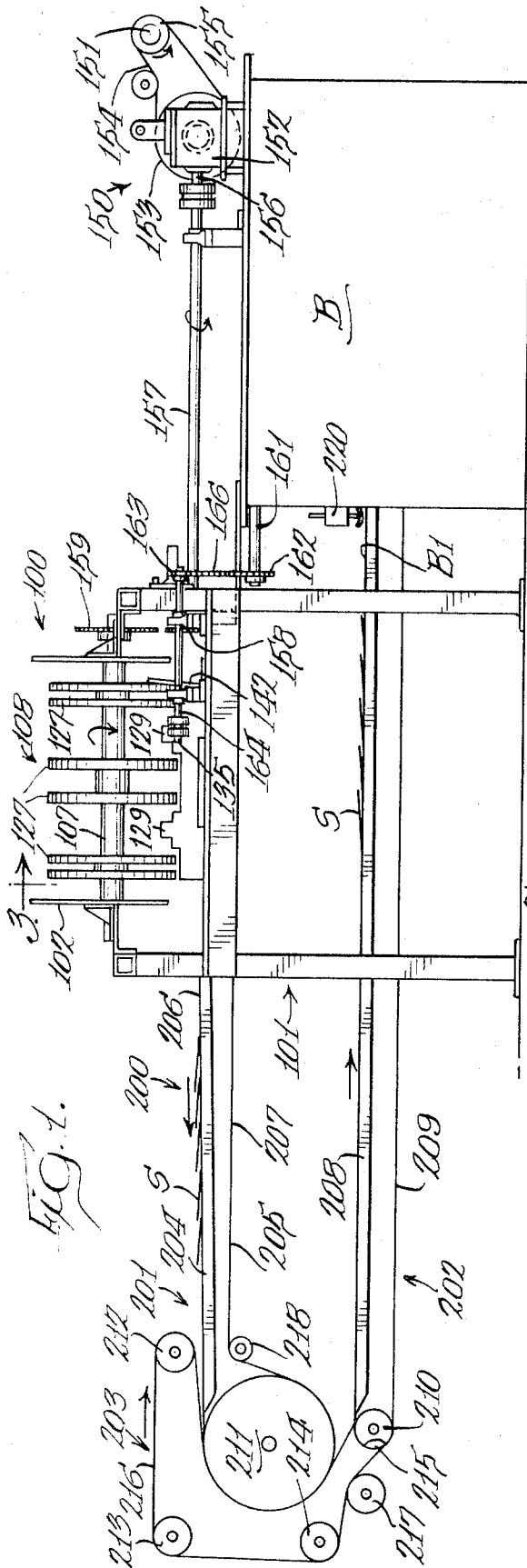
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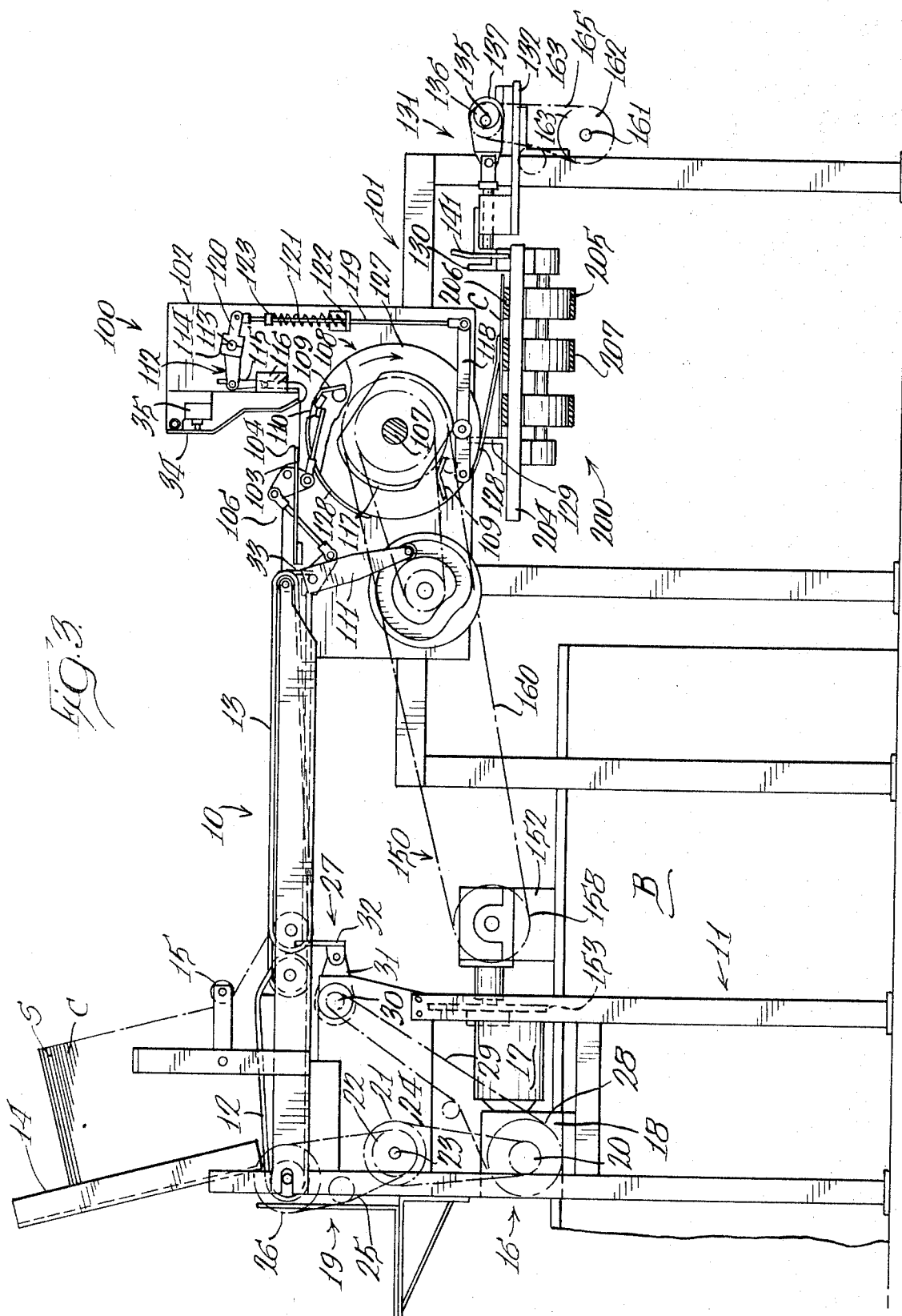
ABSTRACT

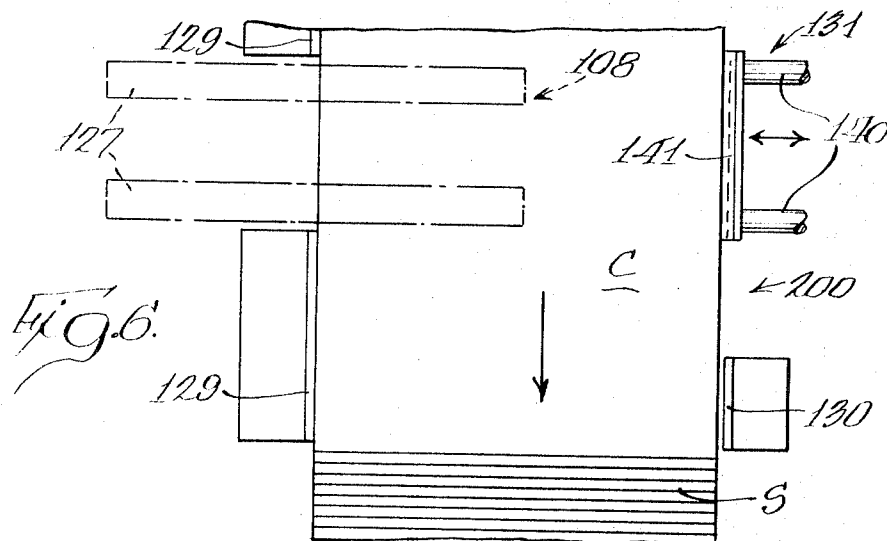
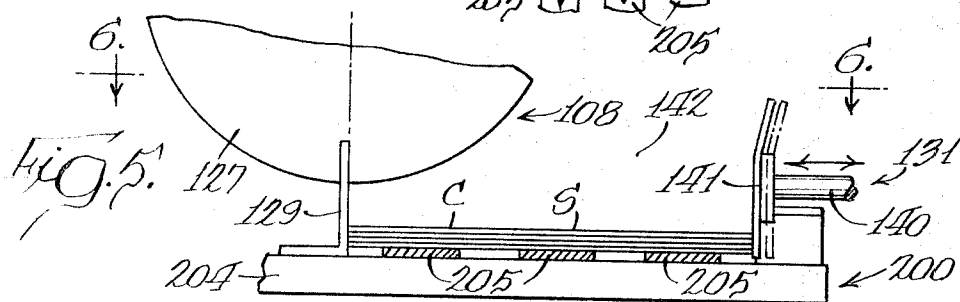
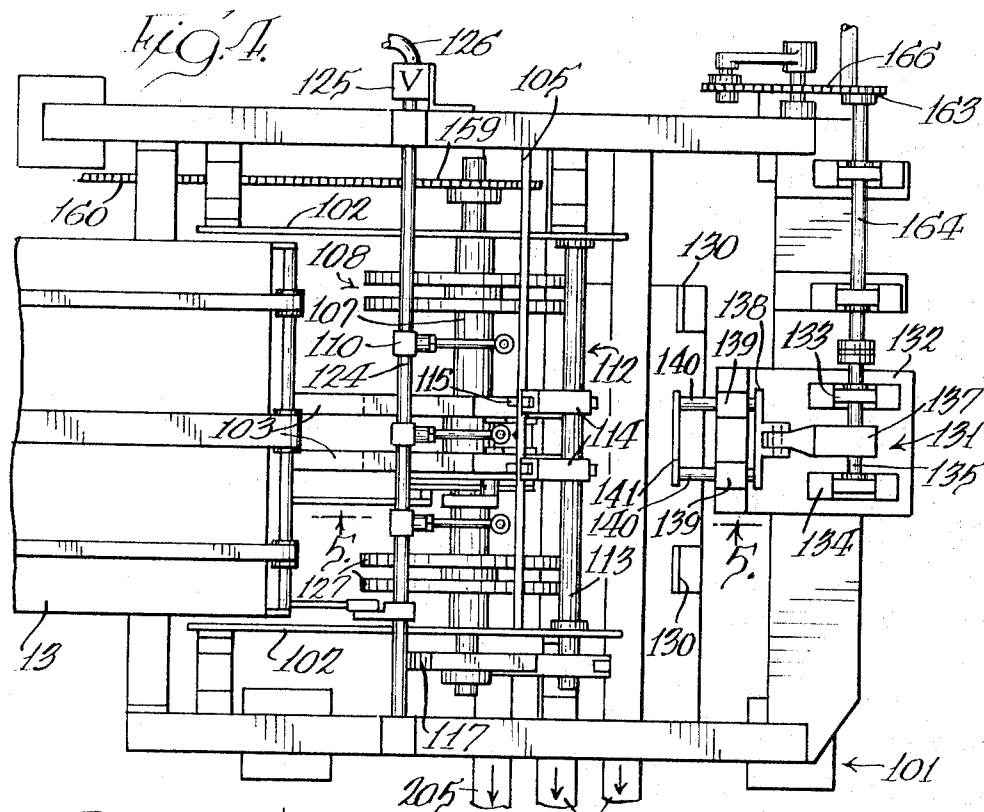
Apparatus for handling articles of sheet material which separates sheets that are delivered to a hopper with some sheets clinging to one another, and delivers the sheets individually onto a slowly moving conveyor to form a shingled stream. The apparatus is particularly adapted to delivering covers to the cover feed of a book binding machine of the perfect type.

7 Claims, 6 Drawing Figures









APPARATUS FOR DISPOSING THIN SHEET MATERIAL IN A SHINGLED STREAM

BACKGROUND OF THE INVENTION

Perfect binders are used in the binding of such books as telephone directories, mail order catalogs, and periodicals which are not saddle stitched. The signatures for each book are clamped, the backbones are trimmed, and adhesive is applied to bind the leaves of the book together. Thereafter, a cover is fed beneath the backbone of the book, registered with the backbone, and folded around it with a backbone area adhering to the adhesive coated rear edges of the leaves.

Perfect binders now available on the American market have belt type conveyors which carry a shingled stream of covers to a cover feeder where a shallow pile of covers is permitted to develop and a cover feeder which operates in timed relationship with the movement of the book clamps past the feeder successively pushes the top cover of the small pile into a carrier pocket which moves it into contact with the backbone of the book to which it is to be adhered. Heretofore, the conveyor which takes the belts to the cover feeder has always been manually loaded by a worker who picks a batch of covers from a supply, manipulates them to help overcome any tendency that they have to adhere to one another, lays them on the conveyor, and manually forms them into a shingled stream.

The manual formation of a shingled cover stream has been a problem area for many years in the use of perfect binders. It is difficult to assure that no covers are stuck together in the shingle, and it is also difficult to build a shingle that is sufficiently uniform in the overlap of the covers in the shingle as to assure proper feeding of the leading end of the shingle into the cover feeder. The problems have been increased by a trend toward the use of thinner stock for covers of periodicals, and also a trend toward the printing of covers on web fed presses, rather than sheet fed presses.

It is obvious that thinner cover stock is harder to handle, both from the point of view of avoiding "doubles" and from the point of view of making a uniform shingle. Even more aggravating, however, is the effect of printing covers on a web fed press. The printed web is cut into cover lengths, and the individual covers then go through an accumulator which gathers a group of three covers and discharges them simultaneously for further handling. Accumulators are used because the press operates at about three times the speed of the next piece of equipment.

The accumulator utilizes a drum with pins which penetrate the leading edge of each cover as it reaches the drum, and the cover is carried around the drum for two full revolutions during which a second cover and a third cover are picked up by the pins and the three covers are then simultaneously discharged from the accumulator. The pin holes of the three accumulated covers stick together, and it is quite difficult to assure that the three accumulated covers are broken apart so that they may feed individually at the binder.

SUMMARY OF THE INVENTION

The principal object of the present invention is to provide a feeder which forms a very uniform shingled stream on a belt conveyor, such as the cover conveyor of a perfect binder.

Another object of the invention is to provide such a device which utilizes relatively simple components that are already familiar to persons working in the book-binding field.

In accordance with the present invention, batches of covers are placed in a hopper of an apparatus which functions essentially like the apparatus of applicant's patent 3,522,943. That apparatus feeds the covers from the hopper into a small pile in a supply hopper from which the bottom covers are fed successively by suction gripper means which transfer the covers seriatim to a transfer drum which deposits them one at a time on a slowly moving belt conveyor that moves parallel to the axis of the drum shaft.

The rate of rotation of the drum and the speed of the belt conveyor are so related that successive covers are deposited on the belt a precise, predetermined distance behind one another. That distance is a small fraction of the width of the cover. The shingled stream for a cover feeder appropriately has a $\frac{1}{8}$ inch "pitch"—i.e., the distance between the forward edges of successive covers is one-eighth inch.

The mechanism for separating the covers and delivering them to the transfer drum operates with such precision that it substantially eliminates all double feed of covers.

In addition to forming a precisely shingled stream, the apparatus also assures that the sides of the sheets in the stream are aligned. This is also important to proper handling of covers by the cover feed of a perfect binder.

It is apparent that while the apparatus of the present invention is disclosed as applied to a cover feeder for a perfect binder, it is equally applicable to any material handling operation which requires that sheets be positively separated and formed into a uniform shingled stream.

Since the covers travel on the conveyor at right angles to the direction in which they are fed, for clarity the terms "leading" and "trailing" edge refer to those edges which lead and trail during feeding to and by the transfer drum. The terms "forward" and "rearward" edge are applied to the edges which occupy those positions on the belt where, of course, the "leading" and "trailing" edges become the sides of the shingled stream.

THE DRAWINGS

FIG. 1 is a generally schematic end elevational view of apparatus embodying the invention, illustrated in conjunction with a perfect binder;

FIG. 2 is a fragmentary plan view of the apparatus;

FIG. 3 is a fragmentary, generally schematic section on an enlarged scale taken substantially as indicated along the line 3—3 of FIG. 1;

FIG. 4 is a plan view on an enlarged scale showing the same area covered by the right hand portion of FIG. 2, with the shingled stream removed to show the conveyor belt;

FIG. 5 is a fragmentary, generally schematic sectional view taken substantially as indicated along the line 5—5 of FIG. 4, with magazine covers forming a shingled stream in position on the conveyor belt; and

FIG. 6 is a fragmentary, generally schematic sectional view taken substantially as indicated along the line 6—6 of FIG. 5.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings in detail, and referring first to FIGS. 1 to 3, the apparatus is seen to include generally a cover, or sheet feeder, indicated generally at 10; a cover transfer apparatus, indicated generally at 100; and a belt conveyor system, indicated generally at 200, for feeding a shingled stream of covers to a perfect binder, indicated generally at B. The transfer means 100 is driven from the perfect binder drive by a drive means which is indicated generally at 150.

Supporting frame means for the apparatus includes a cover feeder supporting frame, indicated generally at 11; and a supporting frame, indicated generally at 101, for the transfer means 100 and part of the conveyor means 200. It is obvious from FIG. 1 that supporting framework for the outer end of the conveyor means 200 is also required, but not illustrated in the drawings.

The cover feeder 10 is described only generally, because a detailed description of a feeder of the same general type, and of its mode of operation, is found in U.S. Pat. No. 3,522,943. It is sufficient to state that, as seen in FIGS. 2 and 3, the cover feeder 10 includes a first belt conveyor 12, and a second belt conveyor 13 which receives a rather deep, roughly shingled stream of covers from a stack S of covers C which is supported on the belt 12 by hopper guide means 14. Cover stream control means 15 is adjustable to vary the depth of the shingle which is fed by the conveyor belts 13 to the transfer means 100.

The feeder of U.S. Pat. No. 3,522,943 was used with a signature gathering machine, and was driven from the gathering machine drive. In the present apparatus, the cover feeder 10 has its own independent drive means, indicated generally at 16, which includes a $\frac{1}{4}$ h.p., 1,750 r.p.m., single phase 60 cycle motor 17 provided with a worm gear reducer 18, and a chain drive system, indicated generally at 19.

Chain drive system 19 includes an output sprocket 20 on the gear reducer, sprockets 21 and 22 on an intermediate shaft 23, a drive chain 24 which is trained around the sprockets 20 and 21, and a drive chain 25 which is trained around the sprocket 22 and around a sprocket 26 which is part of the conveyor belt means 12.

Jogger means, indicated generally at 27, is driven from a second output sprocket 28 on the gear reducer 18 through a drive chain 29 and a sprocket 30. The jogger means 27 include eccentric means 31 and a guided pusher 32 which extends beneath the conveyor means 13 and terminates in jogger plates 33 at the discharge end of said conveyor means.

In accordance with the teachings of U.S. Pat. No. 3,522,943, sensing means 34 associated with the transfer means 100 controls the operation of the conveyors 12 and 13 in accordance with the height of a small pile of covers C which collects at the transfer means. Specifically, this is accomplished by placing a solenoid clutch (not shown) between the sprockets 21 and 22, so that the sprocket 22 is driven only when the solenoid clutch is engaged; and energization of the clutch is controlled by an electric switch 35 that is operatively associated with the sensing means 34.

The transfer means 100 is generally of the type heretofore employed in signature gathering machines, and the general arrangement is similar to that disclosed in Kleinberg U.S. Pat. No. 2,621,039. A transfer frame 102 is carried upon the supporting frame means 101, and carries a floor means 103 the leading edge 104 of which is spaced from a front wall 105 to define a hopper 106 which carries a small pile of covers C supported upon the floor means 103 with its leading end abutting the wall 105 and the leading end portion of the pile unsupported. Substantially in the vertical plane of the unsupported forward end portion of the pile is a shaft 107 which carries transfer drum means, indicated generally at 108. The drum means has cam operated grippers 109 which receive covers seriatim from suction gripper means 110 that are reciprocated by a cam mechanism 111.

Operating in conjunction with the suction gripper means 110 is a pile lifter means, indicated generally at 112, which is cam operated to support all of the pile of covers except the bottom cover, as the latter is drawn down by the suction gripper means 110 into the grippers 109 on the transfer drum 108. The pile lifter means includes a rock shaft 113 which is journaled in bearings on the sides of the transfer means frame 102, and a pair of lifter brackets 114 are fixedly connected to the rock shaft 113 and have bifurcated free ends in which pins pivotally support lifter hooks 115.

As best seen in FIG. 3, box cams 116 are mounted on the forward side of the hopper front wall 105 and have cam tracks in which cam rollers on the stack lifters 115 ride. Thus, the stack lifter hooks are constrained to follow the path determined by the cam track as the rock shaft 113 is rocked.

Rocking movement of the rock shaft is provided by a cam control which includes a cam disc 117 keyed to the shaft 107, a pivoted arm 118 carrying a follower roller which rides on the cam disc 117, and a connecting rod means 119 which is pivotally connected to the pivoted arm 118 and to a crank 120 which is mounted on the rock shaft. Spring means 121 surrounding the connecting rod means 119 bears upon a fixed spring abutment 122 and upon a spring collar 123 which is secured to the connecting rod 119 so as to constantly urge the linkage system in a direction which holds the follower roller against the cam disc 117.

The operation of the lifter hook means 112 is so coordinated with the operation of the suction gripper means 110 that as the suction gripper means swings downwardly toward the position of FIG. 3 to draw the leading edge portion of the bottom cover into the grippers 109, the pile lifter hooks 115 swing inwardly and upwardly to engage the leading edge portion of the rest of the covers in the pile and lift it so as to reduce the weight upon the bottom cover and thus assure that it will be drawn out of the pile.

In accordance with known practice in the art, at the center of the hopper forward wall 105 is a vertical blade which projects a very short distance into the hopper so that the leading edges of the covers in the pile bear against the blade and are slit by it. Engagement of the covers with the blade helps to separate the lowermost cover in the pile from the rest of the pile by retarding downward movement of the leading edge of the pile.

The suction gripper means 110 includes a pivoted suction tube 124 which is connected through a solenoid

valve 125 to a vacuum pipe 126 that is connected to a vacuum source (not shown). The solenoid valve 125 is controlled from the perfect binder B in a manner and for a purpose which will be described hereinafter.

The transfer drum 108 includes spaced carrier discs 127 on which the covers are supported as they are withdrawn from the hopper 106 for deposit upon the conveyor means 200; and in order to cause the covers to be firmly deposited upon the conveyor means 200 at least the two central discs 127 are provided with flaps 128 which may be made of heavy webbing such as pieces of conveyor belting. The flaps 128 have their leading ends secured to the discs 127 immediately behind the clamps 109, and the trailing ends of the flaps are free so that as each flap reaches the bottom of the cylinder of rotation of the drum means 108 its free trailing end swings away from the disc 127 as illustrated in FIG. 3 and slaps the cover C firmly upon the conveyor means 200.

Referring now particularly to FIGS. 1 to 3, the conveyor means 200 as arranged to cooperate in the formation of a shingled stream S of covers and the carrying of the stream to a perfect binder, includes a top conveyor means, indicated generally at 201; a bottom conveyor means, indicated generally at 202; and transfer conveyor means, indicated generally at 203. Conveyor means including the top conveyor 201, the bottom conveyor 202 and the transfer conveyor 203 are commercially available both with Dexter Perfect Binding Machines and with Sheridan Binding Machines.

The top conveyor 201 includes a carrier board 204 and belt conveyor means 205 which has an upper working run 206 which moves in the direction of the arrows in FIGS. 1, 4 and 6, and a return run 207.

The bottom conveyor 202 includes a supporting board 208 and a belt conveyor 209 which has an upper run on top of the board 208 and which is carried upon outer sheaves 210 and inner sheaves (not shown) which are within the frame of the perfect binder B.

The transfer conveyor 203 includes a turning drum 211 around which the conveyor 205 passes between its upper run 206 and its lower run 207; and also includes carrier sheaves 212, 213, 214, and 215, the last of which is on the same shaft with the sheaves 210; and conveyor belt means 216 is trained around the carrier sheaves and over the outer surface portion of the drum 211 so that a shingled stream S of covers is carried around the drum 211 between the upper conveyor belt 205 and the conveyor belt 216 of the transfer means. Adjustable tensioning sheaves 217 are also a part of the transfer conveyor mechanism 203; and adjustable tensioning sheaves 218 are a part of the top conveyor means 201.

Referring now particularly to FIGS. 3 to 6, the transfer means 100 includes certain components in addition to those heretofore described; and those components cooperate in stripping the covers from the transfer drum 108 and forming then into a precise shingled stream on the upper run 206 of the top conveyor belts 205. They include stops 129 which are mounted on the top conveyor board 204 directly below the transfer drum shaft 107; side guides 130 which are mounted on the side of the board 204 opposite the stops 129; and jogger means, indicated generally at 131.

As the leading end of a cover on the transfer cylinder 108 approaches the bottom of the cylinder of revolution of the drum, the grippers 109 which are holding it

are opened, and the leading edge of the cover abuts the stops 129. At the same time, the flap 128 which is beneath the released cover swings to the position illustrated in FIG. 3 to slap the cover into place on top of the shingled stream which is forming on the upper run 206 of the belt conveyor 205. The momentum of the cover as it strikes the stops 129 gives it a tendency to bounce back toward the guides 130.

In order that the shingled stream may have perfectly straight margins, the jogger means 131 jogs the signatures against the stops 129, and as seen in FIGS. 2 and 4 the jogger means is directly aligned with the central area of the transfer drum 108 so as to act against the central area of the trailing end of each cover. The jogger means 131 includes a mounting bracket 132 on which there are bearing blocks 133 and 134 for a jogger shaft 135. An eccentric 136 on the jogger shaft is embraced by a bearing collar 137, and pivotally secured to an extension on the bearing collar is a bracket 138. A pair of parallel guide bores 139 slidably mount jogger rods 140 on the ends of which is a jogger plate 141; and the jogger rods are operatively connected to the pivoted bracket 138. Thus, rotation of the jogger shaft 135 causes reciprocation of the jogger plate 141 in the direction of the stops 129, so the covers C are constantly bumped lightly against the stops 129 so that the sides of the shingled stream are always perfectly aligned.

The belt conveyor 205 is parallel to the transfer drum shaft 107, so the covers are deposited crosswise on the belt conveyor; and the speed of the conveyor in relationship to the rate of rotation of the transfer drum determines the pitch of the shingle. Thus, if the belt conveyor 205 moves one-fourth inch for each revolution of the transfer drum 108, the shingle will have a $\frac{1}{4}$ inch pitch as a cover is deposited on each half revolution of the drum. Depositing the covers crosswise on the conveyor belt affords great accuracy in the pitch of the shingle; and the jogger means causes the shingled stream to be precisely straight along its sides.

Further assurance that the pitch of the shingle will be precise is an inclined rearward end guide 142 which is mounted on the board 204 straddling the center belt of the conveyor 205 where the rearward end of a cover slides along it as the cover is deposited by the transfer drum 108. As best seen in FIG. 1, the member 142 is slightly inclined so that the rearward end of a cover slides along the inclined surface if the cover was not precisely centered with reference to the transfer drum 108.

The drive 150 for the transfer means 100 is seen in FIG. 1 to be taken off a shaft 151 which is a part of the drive for the perfect binder B. A right angle gear box 152 is mounted on the binder frame and has an input sprocket 153 which is driven by a chain 154 from an output sprocket 155 on the shaft 151. The gear box 152 has an output shaft 156 to which an elongated transmission shaft 157 is coupled; and the shaft 157 extends outwardly beyond the front of the binder B and has a sprocket 158 which is aligned with a sprocket 159 on the transfer drum shaft 107. A drive chain 160 is trained around the sprockets 158 and 159, so that the transfer drum 108 is driven from the shaft 151.

The jogger means 131 has its own drive which is independent of the drive for the transfer means, and the jogger drive comes off a shaft 161 which is also a regular, driven part of the binding machine B. A sprocket

162 on the shaft 161 is aligned with a sprocket 163 which is on an extension 164 coupled to the jogger shaft 135. A jogger drive chain 166 is trained around the sprocket 162 and the sprocket 163, so that the jogger is driven from the binding machine shaft 161.

Referring again to FIG. 1, the bottom conveyor means 202 carries the shingled stream of covers into a cover feeding station B1, which is a part of the perfect binder B. In the cover feed station is a detector switch 220 which is also a part of the perfect binder mechanism. The detector switch 220 in a perfect binder ordinarily has the sole function of controlling operation of the cover conveyor by controlling the energization of a solenoid clutch that is in the conveyor power train. The conveyor is driven to feed covers toward the binder only when the detector switch 220 is between established limits marking the maximum and minimum number of covers which should be present at the cover feed station at any given time.

In the present apparatus, the detector switch 220 is given an additional function. It also controls energization of the solenoid valve 125 for the suction feeder 110 of the transfer means 100. Thus, in the present apparatus the movement of covers from the hopper 106 to the transfer drum 108 is suspended whenever the conveyor means 200 is stopped by the operation of the detector switch 220. Vacuum to the suckers may be cut off simultaneously with stopping of the conveyor means 200, or there may be a slight delay between the stopping of the conveyor means and the cut off of suction to the suction feeder. In any event, the stopping and restarting of the conveyor and the disabling and enabling of the suction means is in timed relationship, and is under the control of the detector switch 220.

The foregoing detailed description is given for clearness of understanding only and no unnecessary limitations should be understood therefrom, as modifications will be obvious to those skilled in the art.

I claim:

1. Apparatus for removing identical rectangular sheets from a pile in a supply hopper and disposing them in a stream of precisely shingled, aligned, individual sheets, said apparatus comprising, in combination:

a sheet supply hopper which is adapted to accommodate a small pile of sheets, said hopper having a floor, and a front wall against which the leading end of the pile abuts, there being a space between the floor and the front wall so the leading end portion of the pile is unsupported;

a shaft which is beneath said hopper, parallel to said front wall, and substantially in the vertical plane of the unsupported forward end portion of the pile;

a transfer drum on said shaft, said drum being adapted to receive sheets seriatim from the bottom of said pile at the top of the cylinder of revolution of the drum and deposit them at the bottom of said cylinder of revolution;

means for driving said shaft to rotate the drum so its surface moves forwardly with respect to the hopper in the upper portion of said cylinder of revolution;

means for withdrawing sheets seriatim from the bot-

tom of the pile by moving their leading end portions downwardly into engagement with the drum;

sheet receiving endless belt conveyor means which has an upper run immediately beneath the drum, said conveyor means having a line of travel parallel to the drum shaft;

means for driving said conveyor means at a speed which is so related to the rate of rotation of the drum that the conveyor belts move a very small fraction of the length of a sheet for each half revolution of the drum, whereby successive sheets deposited on the upper run of the conveyor means trail one another by a distance equal to said very small fraction;

fixed stop means alongside the conveyor means and positioned to be abutted by the leading ends of the sheets as the sheets are deposited by the drum;

and jogger means for jogging the deposited sheets against the stop means, whereby said sheets are precisely aligned along the belt conveyor means.

2. The apparatus of claim 1 which includes means for retaining a large stack of sheets adjacent the supply hopper, means for sensing when the top of the pile of sheets in said hopper is between predetermined levels, and means controlled by said sensing means for moving sheets from said stack into said supply hopper to maintain the top of said pile between said levels.

3. The apparatus of claim 1 in which the drum is provided with oppositely disposed sets of movable gripper means which grip the leading end portions of sheets at the top of the drum's cylinder of revolution and release said leading end portions at the bottom of said cylinder of revolution.

4. The apparatus of claim 3 which includes flaps of flexible material each of which extends circumferentially of the drum and has an end secured to the drum surface immediately trailing one of the sets of gripper means, said flaps being otherwise unconnected to the drum.

5. The apparatus of claim 1 which includes flaps of flexible material each of which extends circumferentially of the drum and has a leading end secured to the drum surface, said flaps being otherwise unconnected to the drum and underlying all but the leading end portions of sheets received by the drum.

6. The apparatus of claim 1 in which the conveyor means carries the sheets to another apparatus which collects a small supply of sheets for further use, said other apparatus has sensing means for maintaining said small supply within predetermined upper and lower limits, and there are means controlled by said sensing means to suspend the deposit of sheets on the conveyor and the movement of the conveyor when said small supply reaches the upper of said predetermined limits and to recommence said deposit of sheets and said conveyor movement when said small supply reaches the lower of said limits.

7. The apparatus of claim 6 in which the means suspending and recommencing the deposit of sheets disables and enables the sheet withdrawing means.

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