United States Patent [19]

Swanson

[11] **3,880,419**

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[54] **APPARATUS FOR FEEDING PRINTED SHEETS**

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[73] Assignee: **R. R. Donnelley & Sons Company,** Chicago, Ill.

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[52] **U.S. Cl.** **271/3.1;** 271/6; 271/35; 271/164; 271/200; 271/203

[51] **Int. Cl.** **B65h 3/04;** B65h 29/18

[58] **Field of Search** ..... 271/3–7, DIG. 7, 271/35, 164, 165, 134, 199–201, 203, DIG. 6, 171, 3.1

[56] **References Cited**

UNITED STATES PATENTS

1,087,121	2/1914	Ielfield	271/35 X
1,278,438	9/1918	Conradi	271/165 X
2,192,265	3/1940	Kallander	271/35 X
2,378,306	6/1945	Leonhart	271/166 X
3,126,199	3/1964	Rosoff	271/35 X
3,176,981	4/1965	Vandeman	271/57
3,522,943	8/1970	Swanson	271/DIG. 7
3,690,650	9/1972	Maier, Jr. et al.	271/DIG. 7
3,705,719	12/1972	Polit et al.	271/DIG. 7

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Attorney, Agent, or Firm—Wegner, Stellman, McCord, Wiles & Wood

[57] **ABSTRACT**

Apparatus for feeding printed sheet material, such as signatures consisting of two or more pages (one or more sheets) or cards, from a large reserve stack to a small stack in a supply hopper of a collator. The apparatus includes a feeder frame which has a horizontal conveyor section that overlies the rear portion of the collator frame with its front end defining the rear of the hopper and a depending drive section that requires very little space to the rear of the collator. The apparatus has improved means for retaining the sheet material in the reserve stack and for forming and feeding the shingled stream.

27 Claims, 8 Drawing Figures

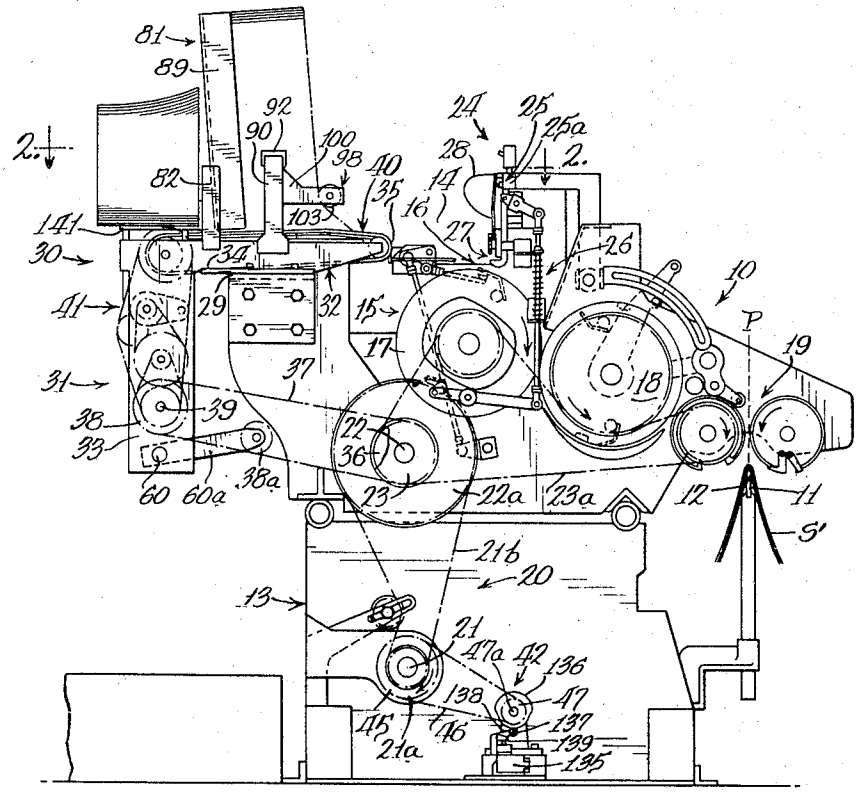
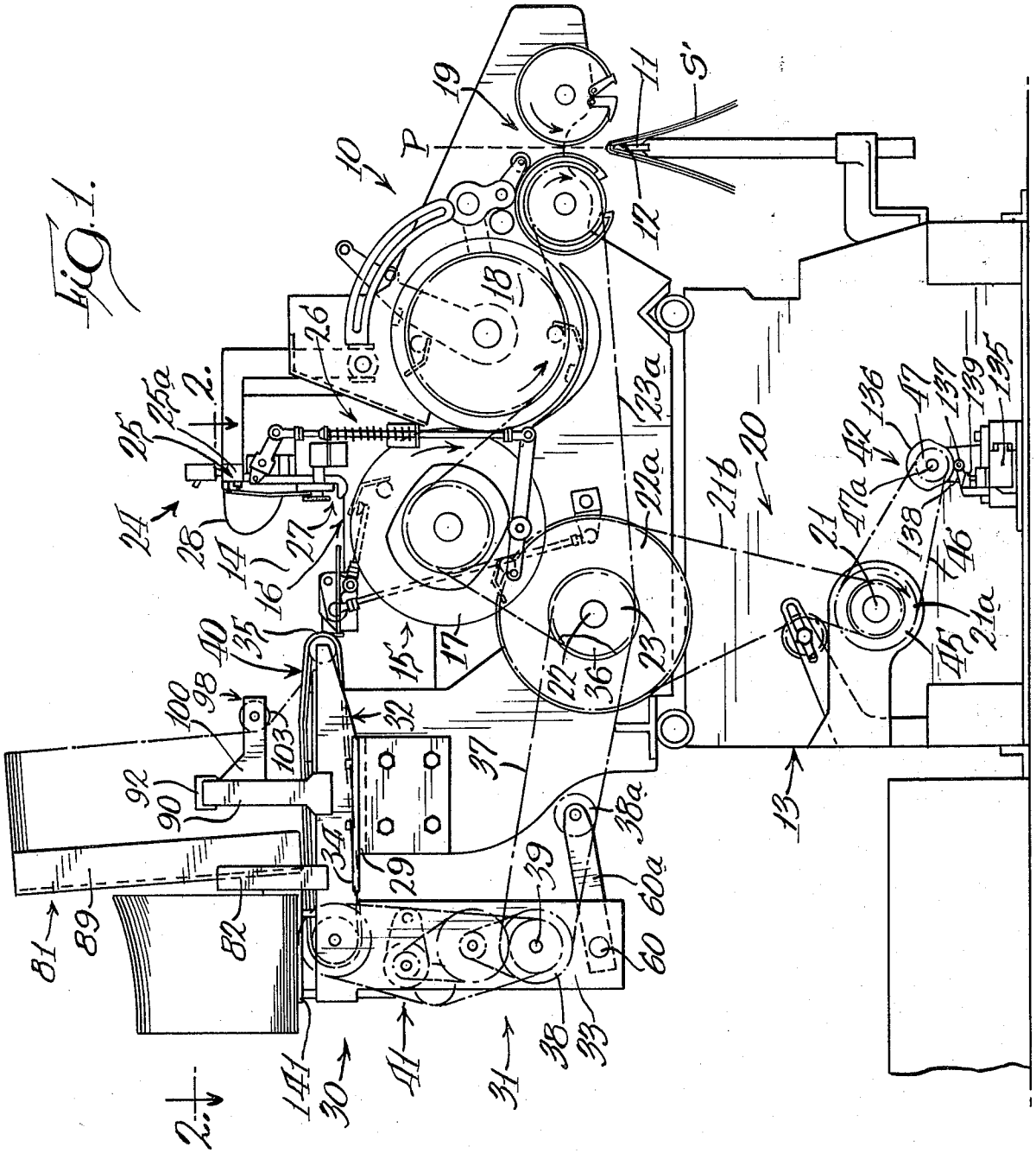


FIG. 1.


10
P
19
11
S'
12
18
26
25
25a
2
24
28
14
27
16
40
35
15'
17
100
98
103
92
90
32
37
34
29
39
38a
60a
60
81
89
82
141
30
11
31
38
33
2
23a
22a
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21a
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36
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13

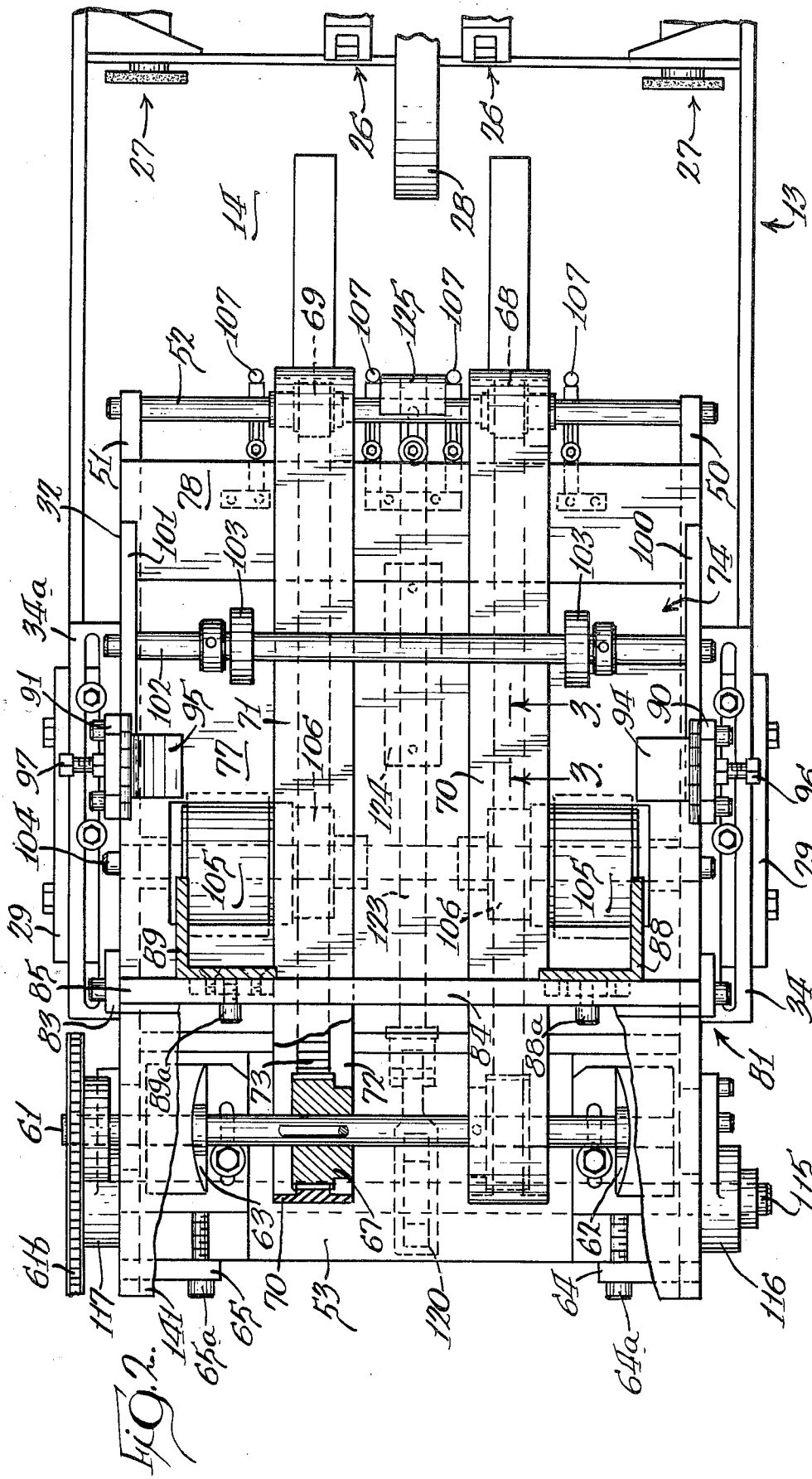


FIG. 2.

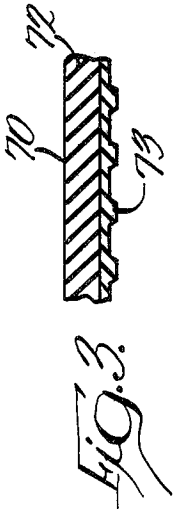
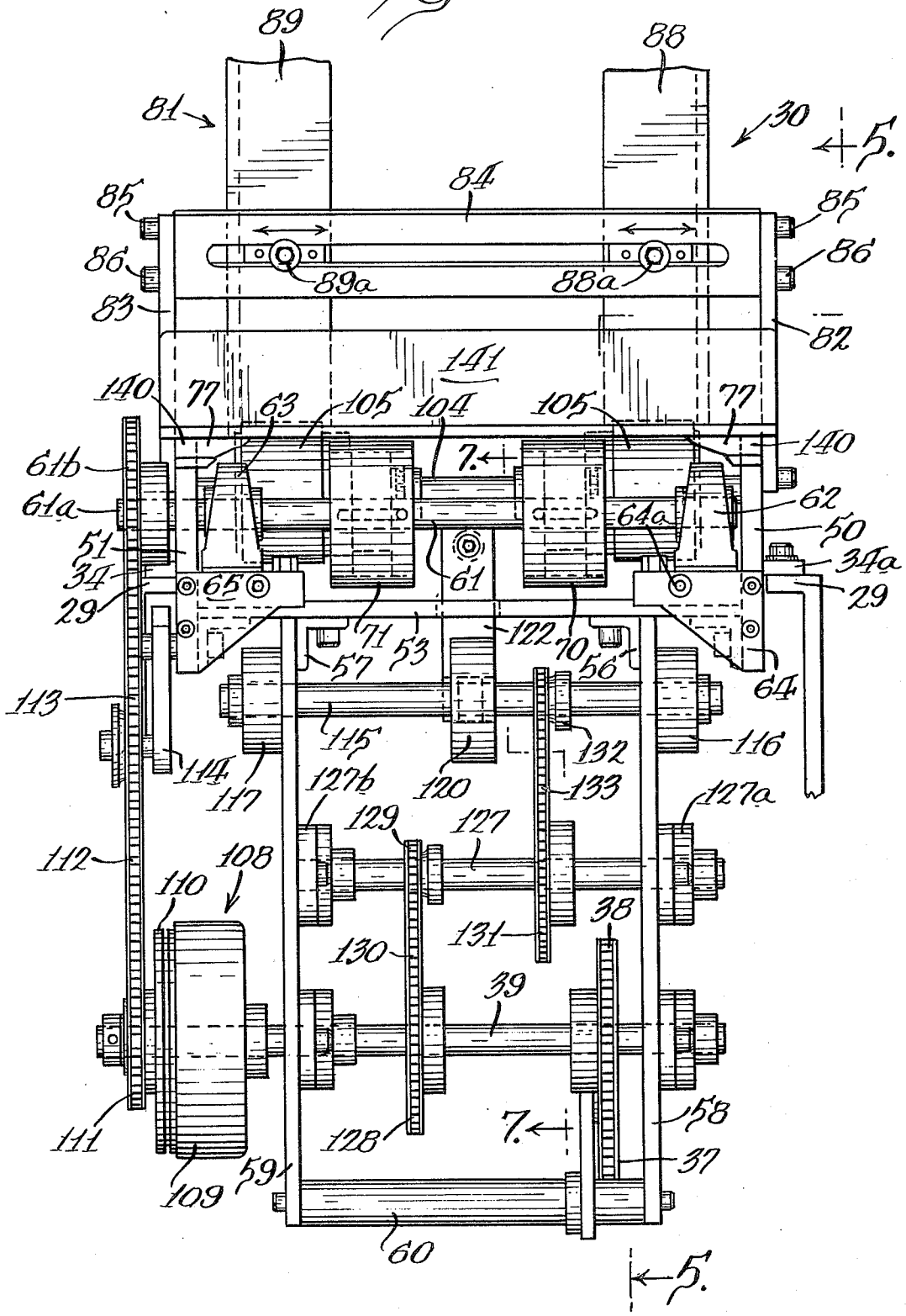


FIG. 3.

Fig. 4.


89
88
81
30
5.
84
85
86
83
89a
88a
82
141
140
77
63
105
104
105
7.
61b
61a
64a
62
50
51
34
34a
65
61
29
71
53
122
70
56
64
57
113
115
132
116
114
117
120
133
127b
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108
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38
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5.

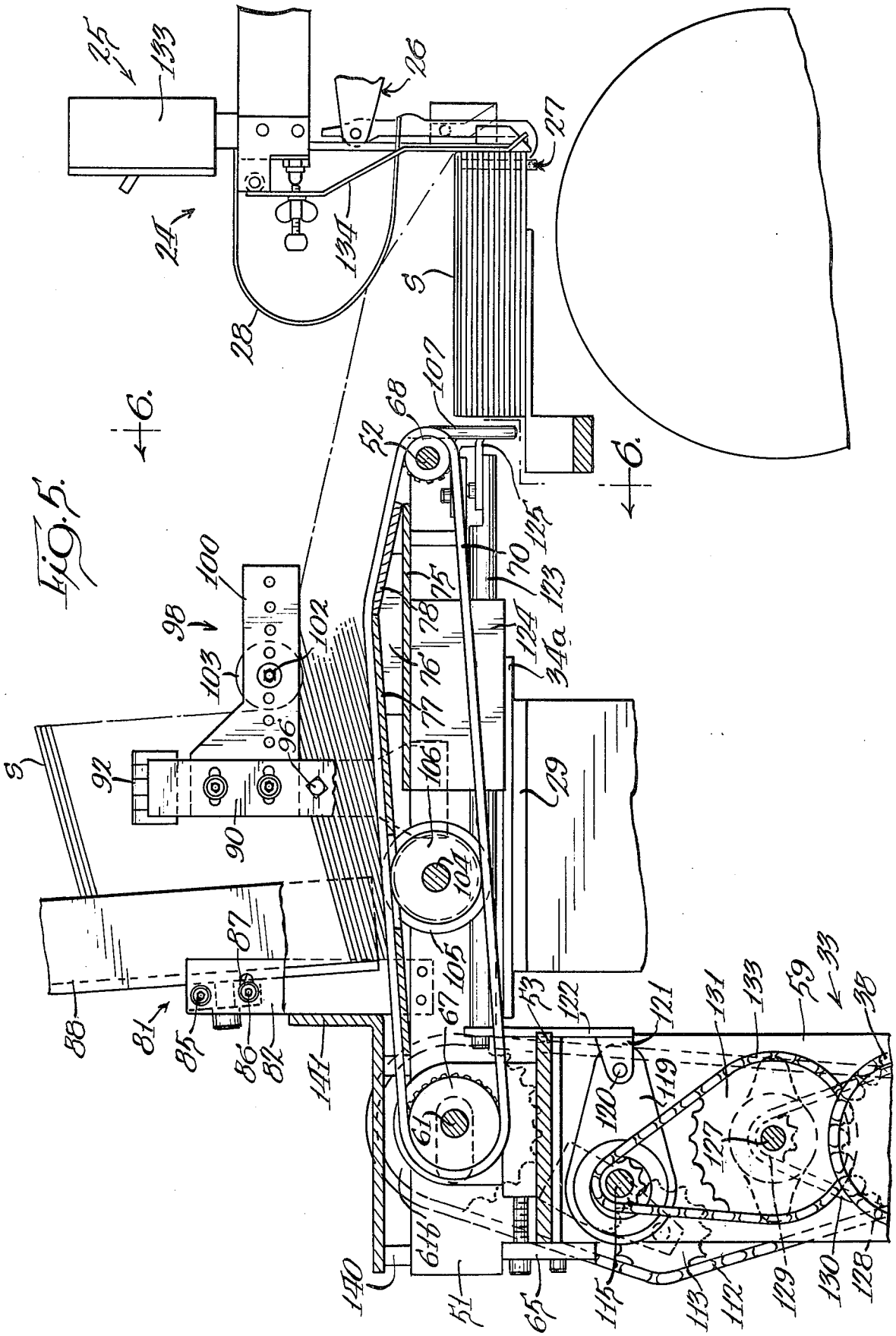
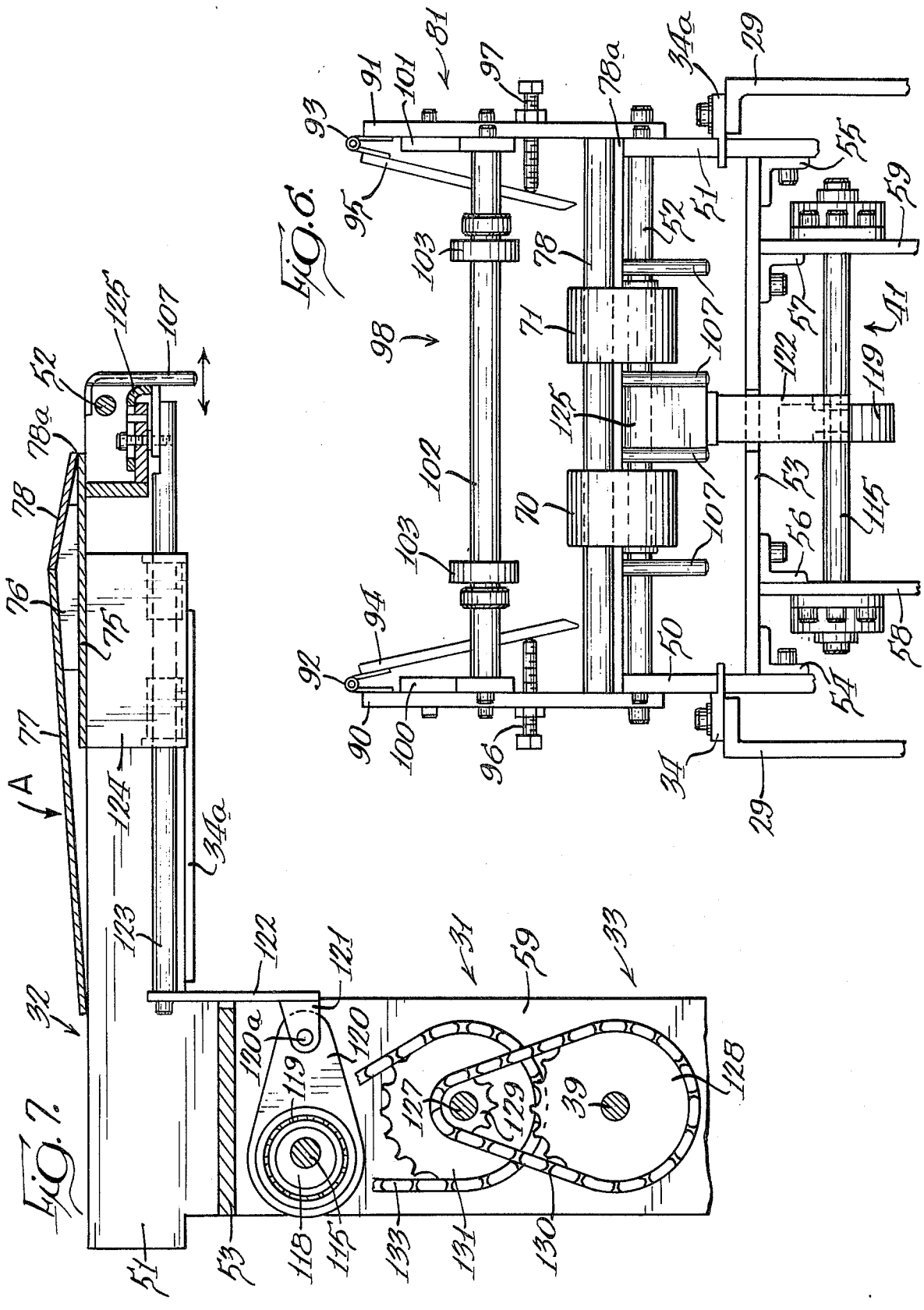

25
133
26
27
24
134
28
5
6.
6.
107
68
52
70
125
123
34a
122
75
78
76
77
102
100
98
103
96
92
90
106
104
29
87
88
81
85
86
82
111
105
67
53
121
131
133
59
33
36
120
119
127
61
49a
140
51
65
115
113
112
129
130
128

FIG. 5.


FIG. 6.
FIG. 7.
A
A

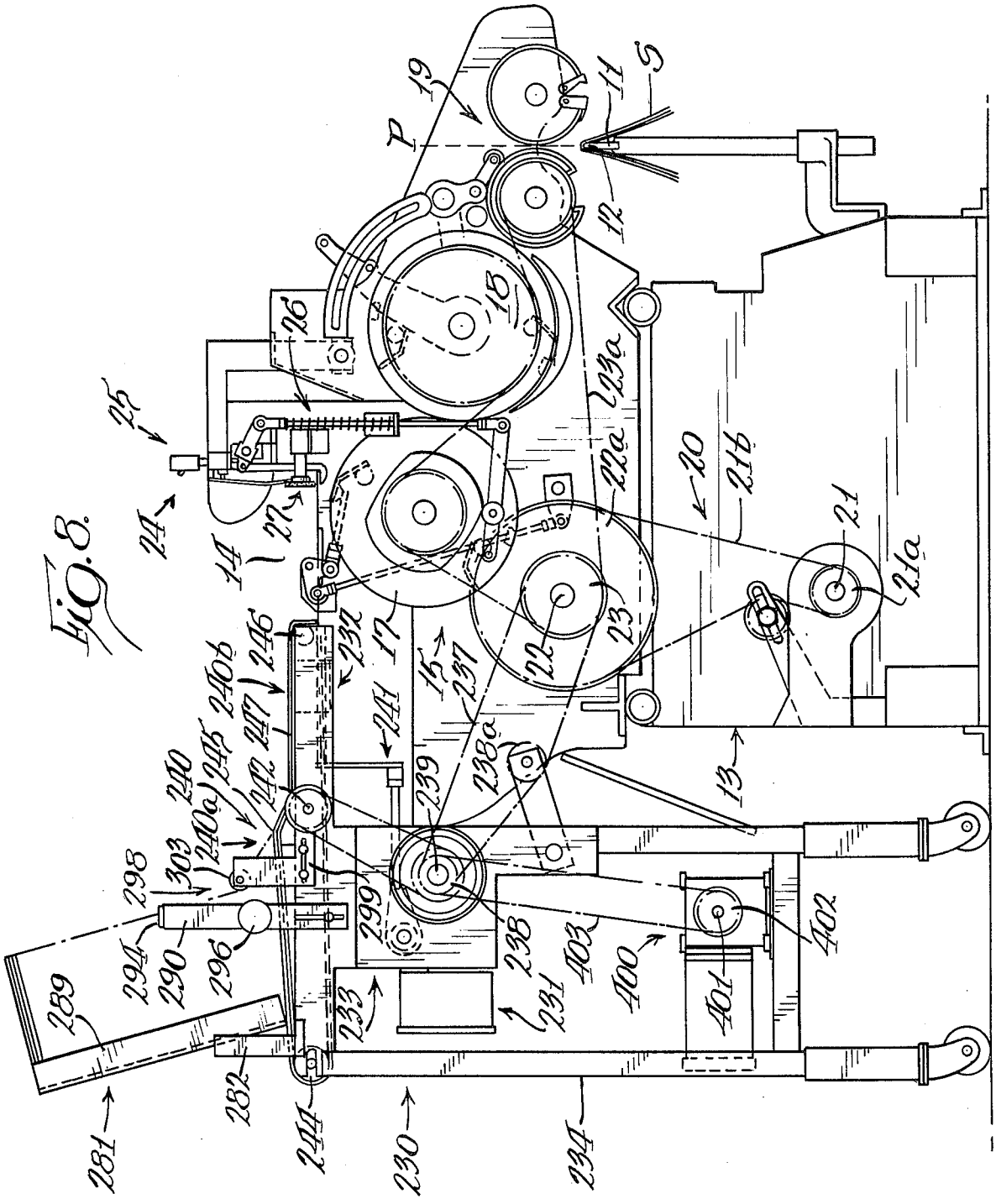

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240b
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240a
238a
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244
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281

Fig. 8.

APPARATUS FOR FEEDING PRINTED SHEETS

CROSS-REFERENCE TO RELATED APPLICATION

This application includes general drawings and a general description of a collator of the inserter type which is especially adapted to accommodate the present apparatus. The inserter is described in detail and claimed in applicant's copending application Ser. No. 370,522, filed June 15, 1973.

BACKGROUND OF THE INVENTION

The present apparatus constitutes an improvement upon the structure of Swanson U.S. Pat. No. 3,522,943, which is owned by applicant's assignee.

The apparatus of the above patent has effected a revolution in the handling of printed sheets such as signatures, whether they contain two pages or more, to maintain a supply of signatures in each box of a gathering machine. The apparatus of the patent is equally usable either with a flat gatherer of the type which feeds a patent binder or a side stitcher, or with the gatherers used in conjunction with saddle stitchers, which are commonly called inserters. However, the apparatus of the patent has certain limitations; and the present structure, while being much more compact than is that of the patent, provides superior handling and feeding of printed sheets to the collator, and greater versatility, than does the device of the patent.

SUMMARY OF THE INVENTION

The present invention comprises a number of related improvements to the apparatus of U.S. Pat. No. 3,522,943 which cooperate to provide improved feeding of printed sheets from the large reserve stack into the collator hopper. In addition, certain of the improvements increase the versatility of the apparatus by permitting it to handle and feed signatures of more different dimensions and thicknesses than can be handled by the device of the patent, and which also permit it to handle cards that could not be fed by the device of the patent; and the present apparatus is extremely compact.

Improvements in the hopper structure for confining the large reserve stack of printed sheets function in cooperation with improvements in the means for feeding such sheets from the bottom of the reserve stack to permit more efficient handling of a variety of different types of material than is possible with the prior art apparatus, and in addition a more uniform shingled stream is formed for transfer to the collator supply box.

The conveyor drive control for the shingled stream is improved to provide a steady flow of signatures to the collator hopper.

The term "sheet material" is used herein as a generic term to include single printed sheets, also sometimes called two-page signatures, printed and folded sheets forming multi-print signatures, cards, or any other material that may need to be fed into a machine which is used to collate such material for binding.

THE DRAWINGS

FIG. 1 is a schematic side elevational view of an inserter with the present sheet feeder mounted thereon;

FIG. 2 is a plan view, with parts in section and parts broken away, of the sheet feeder which also shows elements of the inserter sheet control;

FIG. 3 is a fragmentary section on a large scale, taken as indicated along the line 3—3 of FIG. 2, illustrating the structure of the laminar conveyor belts;

FIG. 4 is a fragmentary rear elevation view of sheet feeder;

FIG. 5 is a fragmentary sectional view of the sheet feeder taken substantially as indicated along the line 5—5 of FIG. 4;

FIG. 6 is a fragmentary front elevational view of the sheet feeder;

FIG. 7 is a fragmentary sectional view taken substantially as indicated along the line 7—7 of FIG. 4 to illustrate the jogger and jogger drive; and

FIG. 8 is as view similar to FIG. 1 of a modified sheet feeder structure.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings in detail, and referring first to FIG. 1, a collator has a series of printed sheet, or signature, supply and transfer boxes only one of which, indicated generally at 10, is illustrated in the drawings. The collator illustrated in the drawings is of the type which is commonly termed an inserter, and it has a conveyor chain 11 that extends along in front of the collator boxes 10 and is provided with spaced signature carriers 12 onto which opened signatures S are delivered from the boxes as the conveyor chain passes in front of them. In operation, each of the carriers 12 has an opened signature fed onto it from each of the boxes 10 so as to recive all the signatures required for a book, the book cover is fed onto the collated signatures at the last box, and the complete book passes to a saddle stitcher where it is bound by staples driven through the superimposed folded margins of the signatures which form the spine of the book.

The signature box 10 consists generally of a frame, indicated generally at 13, and surmounting frame 13 towards its front is a printed sheet hopper 14. Printed sheet delivery means, indicated generally at 15, includes a set of suction grippers 16, a pickup drum 17, a transfer drum 18 which is forward of the pickup drum, and a pair of opener rollers, indicated generally at 19, which are forward of the transfer drum 18 and flank the vertical median plane P of the carriers 12. Machine drive means, indicated generally at 20, includes a drive shaft 21 which extends through all the boxes 10 of the collator and is provided with drive sprockets 21*a*. A shaft 22 carriers a sprocket 22*a* which is driven from the sprocket 21a by a chain 21*b*. A sheet transfer drive sprocket operates through a chain 23*a* to drive the sheet transfer means 15.

The printed sheet hopper 14 is adapted to contain a small stack of printed sheets or signatures S: and operatively associated with the hopper 14 is stack control means, indicated generally at 24, which includes stack height sensing means, indicated generally at 25, a stack lifter mechanism, indicated generally at 26, rotary corner brush means, indicated generally at 27, and a printed sheet front guide 28.

The inserter is particularly adapted for use with a signature feed apparatus, indicated generally at 30, by reason of the orientation of the signature hopper 14, and also by reason of the stock control means 24. Further, in order that the signature feed apparatus 30 may be mounted on the rear upper portion of the inserter 10, the machine frame 13 has parallel members with horizontal webs 29 on which the signature feed appara-

tus **30** rests so that it may be moved fore and after on the inserter.

The signature feed apparatus **30** consists generally of a frame, indicated generally at **31**, which is generally of an inverted L shape and includes a horizontal conveyor section **32** and a vertical drive section **33** which depends from the rear of the conveyor frame section **32**. The conveyor frame section **32** has horizontal supporting plates **34** at its two sides which rest upon the horizontal webs **29** of the machine frame **13**, and the front end **35** of the conveyor frame section **32** defines the rear of the hopper **14**. As illustrated in FIG. **1**, the signature feed apparatus **30** is in its most rearward position with its front end **35** approximately **10** inches from the front **14***a* (best seen in FIGS. **2** and **5**) of the hopper **14** to accommodate a maximum 9½ inch signature. By moving the feeder forward until the drive frame section **33** is substantially abutting the rear of the machine frame **13** the length of the hopper can be reduced to function properly with a minimum signature, or printed sheet, of 3⅝ inches which is the size of many cards used as book inserts in saddle stitched books.

Further to accommodate the feed apparatus **30**, the shaft **22** is provided with a sprocket **36** which is mounted alongside the sprocket **23** and is of the same size; and a drive chain **37** makes a driving connection between the sprocket **36** and an input sprocket **38** which is keyed to an input shaft **39** journalled near the bottom of the feed apparatus drive frame section **33**. the sprocket **38** drives a conveyor mechanism, indicated generally at **40**, and a jogger mechanism, indicated generally at **41**.

Further cooperating with the feed apparatus **30** and with the stack height sensing means **25** is a pulsating switch means, indicated generally at **42**, which is driven from a sprocket **45** on the main machine drive shaft **21** through a chain **46** and a sprocket **47**.

THE FEEDER STRUCTURE

Referring now particularly to FIGS. **2** and **4** to **7**, the frame **31** of the sheet feeder apparatus **30** is seen to include conveyor section side plates **50** and **51**, the front ends of which are connected by a spacer rod **52** and at the rear ends of which is a cross member **53** which is seen in FIG. **6** to be connected to the side frame members **50** and **51** by angle brackets **54** and **55**, respectively. The member **34** (FIG. **1**) is seen in FIG. **6** to be welded into the side frame member **50**, and a corresponding member **34***a* is welded into the side frame member **51**, and said members **34** and **34***a* are slotted brackets by means of which the feeder **30** is secured to the machine frame plate **39** by cap screws which extend through the slotted brackets to secure the feeder **30** in any desired adjusted position with reference to the hopper **14**.

As seen in FIGS. **4** and **6**, the cross plate **53** and a pair of angle brackets **56** and **57** provide mountings for the drive frame section **33** which includes side plates **58** and **59** the lower ends of which are connected by a spacer rod **60**.

The conveyor means **40** which is mounted in the conveyor frame section **32** is best seen in FIGS. **2**, **4** and **5** to include a drive shaft **61** journaled in bearing blocks **62** and **63** which are adjustably mounted on the frame cross plate **53**. Gussets **64** and **65** on the conveyor frame side plates **50** and **51**, respectively, are threaded to receive adjusting screws **64***a* and **65***a* for the bearing blocks **62** and **63**, respectively. An end **61***a* of the conveyor drive shaft **61** extends through the side plate **51** to receive a drive sprocket **61**b, and on the shaft **61** are keyed fluted conveyor drive pulleys **66** and **67**. Journalled on the front spacer rod **52** in alignment with the fluted pulleys **66** and **67** are smaller fluted idler pulleys **68** and **69**; and over the aligned sets of conveyor pulleys are trained endless conveyor belts **70** and **71**. Proper tensioning of the belts is achieved by longitudinal adjustment of the bearing blocks **62** and **63** on their respective mounting brackets **64** and **65**.

The conveyor belts **70** and **71** are best seen in FIG. **3** to be of laminar construction including relatively wide commercial available outer belt members **72**, known as Rufftop Neoprene belts, which are laminated to wire or nylon cord reinforced toothed timing belts **73** so as to have a positive drive between the fluted drive pulleys **66** and **67** and the conveyor belts **70** and **71**.

Belt supporting and guiding means for the upper, or conveying runs of the belts **70** and **71** is provided by a conveyor floor indicated generally at **74**, which includes a mounting plate **75** surmounting the forward portions of the conveyor frame side plates **50** and **51**, a pair of mounting blocks such as the mounting block **76** seen in FIGS. **5** and **7**, a rearward floor plate **77**, and a forward floor plate **78**. The rear end of the rearward floor plate **77** rests on the side plates **50** and **51** near the conveyor drive pulleys **66** and **67** and is inclined upwardly to a forward mounting on top of the mounting blocks **76**; and the forward floor plate **78** is inclined downwardly toward the front of the conveyor from an apex where it abuts the front of the floor plate **77** to a forward margin **78***a* which is at the front of the mounting plate **75** just behind the idler pulleys **68** and **69**. Thus, the belts are guided upwardly from the drive pulleys **66** and **67** to the front of the rear floor plate **77**, and are then guided downwardly for a short distance to the front idler pulleys **68** and **69**.

As best seen in FIGS. **2**, **4** and **5**, printed sheet guide means, indicated generally at **81**, is operatively associated with the rear portion of the conveyor means to confine a large reserve stack of printed sheets which rests directly on the conveying runs of the belts **70** and **71** near the front of the rear conveyor floor plate **77**, which thus provides a reserve stack holding area A (FIG. **7**). The guide means **81** includes upright supporting posts **82** and **83**, the lower end portions of which are secured to the conveyor frame side plates **50** and **51**, respectively. A slotted cross plate **84** is secured between the upper end portions of the posts **82** and **83**, and as best seen in FIG. **5** the cross member **84** is angularly adjustable with respect to the posts about pivot screws **85**, with screws **86** being slidable in slots such as the slot **87** in the post **82**. A pair of generally upright angle members **88** and **89** which confine the reserve stack at the rear are secured to the slotted cross member **84** by means of cap screws **88***a* and **89***a* (FIG. **4**) so that the distance between said angle members may be adjusted to accommodate printed sheets which are of varying lengths from head to foot. Likewise, the angles of the angle members **88** and **89** with respect to the rear conveyor floor plate **77** may be adjusted by tilting the slotted member **84** with respect to the supporting posts **82** and **83**.

Also providing a part of the sheet guide means **81** is a pair of upright posts **90** and **91** which are mounted on

the conveyor side plates **50** and **51**, respectively, forward of the posts **82** and **82**. Surmounting the posts **90** and **91** are hinges **92** and **93**, respectively, and sheet engaging members in the form of plates **94** and **95** are connected by their upper ends to the hinges **92** and **93**, respectively. The plates **94** and **95** may caused to project greater or lesser distances into the space between the posts **90** and **91** by means of transverse adjusting screws **96** and **97** which are threaded in holes in the posts **90** and **91**, respectively, and have their inner ends bearing upon the plates **94** and **95**, respectively. The plates contact the lateral margins of printed sheets in the reserve stack to partially support those sheets and ease the load on the conveyors **70** and **71** is continuously moving the sheets off the bottom of the large reserve stack to form a shingled stream which is conveyed into the collator hopper **14**.

Also mounted on the posts **90** and **91** is metering roller means, indicated generally at **98**, which includes a pair of longiudinally extending mounting brackets **100** and **101** which carry shaft brackets **100***a* and **101**a that have vertical slots for adjustable mounting of a cross rod **102**. The brackets may be mounted in any of several aligned pairs of holes in said arms; so that metering rolls **103** journalled on the cross rod may be adjusted fore-and-aft and vertically. The rollers **103** define the front margin of the reserve stack of printed sheets and confine said reserve stack at the front, as well as serving to control the depth of the shingled stream which is formed by the lowermost signatures in the reserve stack as they are moved forwardly away from the guiding anagle members **88** and **89**.

As best seen in FIGS. **2** and **5**, approximately at the forward extremities of the angle members **88** and **89**, so as to be beneath the printed sheets in the large reserve stack, is a cross rod **104** which has its two ends mounted in the conveyor sides plates **50** and **51**; and journalled on the cross rod **104** is a pair of rollers **105** which are best seen in FIG. **3** to be immediately adjacent the outer margins of the belts **70** and **71**. The rollers **105** have their outer surfaces formed of Rufftop Neoprene; and as best seen in FIG. **5** each of the rollers **105** includes an integrally connected drive pulley portion **106** which is engaged by the timer belt portion **73** of the belts **70** and **71**. The uppermost portions of the rollers **105** project through openings in the rearward conveyor floor plate **77**, so that the total surface area in contact with the lowermost sheet in the large reserve stack occupies a substantial proportion of the total head to foot length of the sheets although the belts **70** and **71**, themselves, occupy only a minor fraction of that length.

The conveyor and conveyor frame structure are completed by a set of four depending bars **107** which is mounted at the front of the conveyor frame forward of the spacer rod **52** to define the rear of the hopper **14**.

Referring now particularaly to FIGS. **4** and **5**, the drive means for the conveyor **40** includes the input sprocket **38** on the shaft **39** which is journalled in the lower end portion of the frame drive section sides plates **58** and **59**, and the input chain **37** which is trained around the input sprocket **38** and the sprocket **36** on the shaft **22** (FIG. **1**). A tensioning sprocket **38***a* for the chain **37** is carried on a spring loader arm **60***a* which is mounted upon the lower cross rod **60** of the drive section frame **33**. thus the input shaft **39** is constantly driven from the collator macahine drive shaft **21**.

In order that the conveyor **40** may be driven intermittently, a solenoid clutch, indicated generally at **108** (FIG. **4**), has an input portion **109** keyed on the shaft **39**, and has an output disc **110** journalled on the shaft **39**. Pinned to the solenoid clutch output disc **110** is a sprocket **111**, and a drive chain **112** is trained over the sprocket **111** and the conveyor drive sprocket **61***b*. A chain tensioning sprocket **113** for the chain **112** is mounted on a pivotally adjustable arm **114**.

As previously mentioned in the general description, the sheet feeding apparatus **30** also includes jogger means **41**, and that means and the drive for it will now be described in detail with particular reference to FIGS. **4** and **7**. A jogger shaft **115** is journalled in bearings **116** and **117** which are mounted on the drive section side plates **58** and **59**, and a jogger drive disc **118** which is eccentrically secured to the jogger shaft **115** is journalled in a bearing set **119** of a follower **120** the front end of which carries a pivot pin **120***a* for a yoke **121** of a jogger arm **122**. Thus, rotation of the jogger shaft **115** causes the follower **120** to move in an orbital path, and produces short stroke motion of the jogger member **122**.

The jogger mechanism also includes a push rod **123** which is connected to the upper end of the jogger arm **122**, and which is slidable in a bushing **124** that is mounted beneath the rearward conveyor floor plate **77** so that the push rod is confined to linear movement. At the front of the jogger push rod **123**, between the conveyor belts **70** and **71**, is a jogger plate **125** which abuts the rear of the stack of sheets S in the hopper **14**.

The jogger drive is through a counter shaft **127** which is journalled in bearing assemblies **127***a* and **127***b* that are mounted upon the drive frame side plates **58** and **59**, respectively. A sprocket **128** is keyed on the input shaft **39**, a sprocket **129** is keyed on the counter shaft **127**, and a drive chain **130** is trained around said two sprockets to drive the counter shaft **127**. The counter shaft, in turn, carries a sprocket **131** with which a sprocket **132** on the jogger shaft **115** is aligned, and a drive chain **133** encircles the sprockets **131** and **132** to drive the eccentric shaft **115** from the counter shaft **127**. As can be seen from the different sizes of the sprockets **128**, **129**, **131** and **132**, the jogger shaft **115** is driven at a much higher rate of speed than the input shaft **39**. The drive for the conveyor means **40**, on the other hand, causes the conveyor drive shaft **61** to be driven considerably more slowly than is the input shaft **39**.

The drive for the conveyor means **40** through the solenoid clutch **108** is controlled by the stack height sensing means **25** in the collator supply hopper **14**, and by the pulsing switch means **42**. The stack height sensing means **25** includes a plunger type limit switch **133** (FIG. **5**) which is in the energizing circuit for the solenoid clutch **108**, so that the clutch can only be energized to drive the conveyor means **40** when the switch **133** is closed, and that occurs only when a pile height sensing finger **134** senses that the top of the small stack of sheets in the hopper **14** is between predetermined limits. As seen in FIG. **1**, a plunger type limit switch **135** of the pulsating switch means **42** is wired in series with the switch **133** in the energizing circuit for the solenoid clutch **108**, so that the latter may be energized only when both switches are closed. A constantly pul-

sing current in the energizing circuit is provided by the drive means afforded by the sprocket **45**, the drive chain **46**, and the sprocket **47**. Mounted on the shaft **47***a* which carries the sprocket **47** is a conjugate cam set **136**, and a cam follower roller **137** which bears on the cam set **136** is carried on a pivoted arm **138**, an actuating finger **139** of which bears upon the plunger of the switch **135**. Tension in the chain **44** is maintained by an adjustable tensioning sprocket **44***a* which is slidably mounted on an arm **44***b* on the main machine frame **13**.

As best seen in FIGS. 1 and **5**, in order that an operator may have a reserve supply of sheets immediately adjacent the sheet guidemeans **81**, a set of posts **140** which surmount the conveyor sections side plates **50** and **51** carry a sheet supporting tray **141** on which an extra stack of sheets is placed as seen in FIG. **1**. The sheets in the extra stack as illustrated in FIG. 1 consists of multiple page signatures which are folded along their forward margins, which accounts for the elevated condition of the leading end of the extra stack.

The versatility of the present apparatus results principally from the various adjustments which may be made in order to obtain optimum handling of printed material having a large number of variations in addition to differences in sheet dimension. A thin signature—i.e., one of two to four pages—obviously has totally different handling characteristics from a thick signature having, for example, 48 pages. Further, printed sheets handle totally differently depending on whether they are of 22 pound stock (typical telephone directly); or 60 pound stock (coated paper for coloring printed as used in periodicals of the highest quality); or something in between those two limits; or card stock which is **80** pounds. Finally, of course, the finish of the sheets—i.e., uncalendered, calendered, supercalendered or coated—affects the handling.

The number of pages in a signature has an effect upon the amount of air in a stack of given height, and thus upon the load that can be placed in the hopper **14** and in the reserve stack. Likewise, sheets which have been stored for an extended period of time usually are more compressed, and thus heavier than fresh stock of the same paper and in signatures of the same number of pages.

The pile height sensing means **25** associated with the hopper **14** may be raised and lowered to control the height of the stack in the hopper. Thinner signatures require a shallower stack.

Adjustment of the reserve stack supporting angle **88** and **89**, in conjunction with adjustment of the reserve stack sheets engaging plates **94** and **95**, also assists in proper feeding of sheets from beneath the reserve stack and, in conjunction with adjustment of the metering rollers **103**, controls shingle formation. Generally speaking, if the sheet material is dense—i.e., signatures having few pages, or of heavy paper, greater rearward tilting of the supporting angles **88** and **89** takes some weight off the forward position of the reserve stack, while inward adjustment of the sheet engaging plates causes them to afford to greater support for the reserve stack. The greatest problem in the reserve stack is "rollups"—i.e., displacement of the sheets of a signature along the fold line. Rollup is avoided by reducing weight at the front of the reserve stack, as previously described.

Vertical adjustment of the metering rollers **103** to form a thinner shingle is generally desirable in the handling of dense material.

Finally, uniformity of the shingled stream is more important in the handling of "hard to handle" material; and a higher pulse rate on the pulse switching means **42** tends to provide greater stream uniformity by affording a quick, jerking motion of the conveyor belts.

ALTERNATIVE FORM OF SHEET FEEDING APPARATUS

Referring now to FIG. **8**, the alternative form of sheet feeding apparatus, indicated generally at **230**, includes a frame structure, indicated generally at **231**, which has a conveyor section **232** and a drive section **233**. Both ends of the conveyor section overhand the drive section, so the frame is generally T-shaped. The feeder **230** is mounted upon a carriage **234** so that it may readily abe moved into position behind any box of a collator **10**. Since the collator with which the sheet feeder **230** is illustrated is not materially different from the collator illustrated in FIG. **1**, like parts are given the same reference numerals which are not repeated at this point.

The sheet feeder **230** is illustrated with alternative arrangements for providing power to its input shaft **239** which is journalled in the drive section frame **233**. In one form, an electric motor and gear box, indicated generally at **400**, is mounted on a platform at the bottom of the carriage **234**, and a gear box output shaft **401** is provided with a sprocket **402** from which a chain **403** drives the input shaft **239** through an input sprocket **238**. In the alternative arrangement, the drive is like that in the preferred form, with a drive chain **237** trained around a sprocket **36** on the shaft **22** and around the input sprocket **238**. In the latter arrangement, of course, the drive chain **237** must have a link that may be readily opened to disconnect it from the sprockets **36** and **238**.

The alternative form of sheet feeder also includes conveyor means, indicated generally at **240**, and jogger means, indicated generally at **241**.

The conveyor means **240** includes a drive shaft **242** which drives both a rearward conveyor, indicated generally at **240***a*, and a forward conveyor, indicated generally at **240***b*. Idler pulleys **244** at the rear of the rearward conveyor are aligned with one set of drive pulleys on the drive shaft **242** and carry rearward conveyor belts **245**; while forward idler pulleys **246** are aligned with a second set of drive pulleys on the drive shaft **242** to drive forward conveyor belts **247**.

Guide means **281** for a large reserve stack of sheets includes supporting posts **282** for a pair of sheet guiding angle members **289**; and a pair of supporting posts **290** for hinged guide plates **294** which are adjustable by means of hand scres **296**. Likewise, metering roller means, indicated generally at **298**, includes upright supporting posts **299** which are mounted for longitudinally adjustment on the sides of the conveyor frame section **232**, and metering rollers **303**.

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 feeding printed sheet material to a supply box of a collating machine which has a machine

frame, a printed sheet supply hopper which holds a small vertical stack of printed sheets surmounting said frame toward the front thereof, said hopper having a front plate, drive means on the machine frame, and means mounted in the machine frame and driven by said drive means for withdrawing sheets by their leading ends seriatim from the bottom of the stack at a predetermined rate and delivering them to a gathering chain which travels along the front of the machine frame, said apparatus comprising, in combination:

a feeder frame which includes a horizontal conveyor section and a structurally integral drive section depending from said conveyor section, said feeder frame being adapted to be positioned with the forward part of the conveyor section overhanging the machine frame and the drive section immediately to the rear of the machine frame, the front of the conveyor section defining the rear of the sheet supply hopper, and the feeder frame being bodily movable fore and aft with respect to the machine frame to vary the length of said sheet supply hopper for handling sheets of different sizes;

conveyor means in the feeder frame conveyor section, said conveyor means including a transverse driven shaft journalled in the conveyor section above the drive section, a plurality of drive pulleys on said driven shaft, a plurality of idler pulleys journalled in the conveyor section aligned with the drive pulleys to provide pulley sets, and endless belt trained over each pulley set to form a top conveying run and a return run, and belt supporting and guiding means beneath the belt conveying runs, said belt conveying runs being inclined upwardly from the rear of the conveyor section to provide a reserve stack holding area, and the forward portions of said conveying runs being inclined downwardly from the rear for a short distance;

an input shaft journalled in the lower portion of the feeder frame drive section parallel to the driven shaft;

drive transmission means in the drive section operatively connecting said input shaft to said driven shaft;

means for driving said input shaft;

printed sheet guide and confining means operatively associated with the reserve stack holding area to hold a large reserve stack of printed sheets which rests directly on the belt conveying runs close to the front of the upwardly inclined portion of said runs, said guide and confining means including rear guides toward the rear of said holding area and metering roller means at the front, said guide and confining means being adjustable laterally and longitudinally to confine printed sheets of different sizes;

means for adjusting the vertical position of the metering roller means to produce shingled streams of different depths;

means in the printed sheet supply hopper for sensing when the top of the small stack of printed sheets therein is between an upper level and a lower level;

and means controlled by said sensing means for causing driving of the conveyor driven shaft only when the height of said small stack is between said two predetermined levels, to draw printed sheets from beneath the reserve stack and feed them in a shingled stream to the supply hopper.

2. The apparatus of claim **1** in which the feeder frame is of an inverted L-shape, the driven shaft carrying the drive pulleys of the conveyor means is in the angle of the L, the idler pulleys are at the front of the conveyor section, the tops of the drive pulleys and of the idler pulleys are substantially in the same horizontal plane, and the belt supporting and guiding means has a first portion that is inclined upwardly from the drive pulleys to an apex at an intermediate point close to the front of the reserve stack and a second portion that is inclined downwardly from said apex to the idler pulleys.

3. The apparatus of claim **1** in which the belts are spaced apart, there are openings in the belt supporting and guiding means alongside the belts and beneath the reserve stack, and driven rollers with concentric high friction surfaces project through said openings to a height substantially coplanar with the top of the belt conveying runs so as to cooperate with the belts to support and feed sheets from said reserve stack.

4. The apparatus of claim **3** in which the rollers have laterally extending integral drive drums in driven contact with the undersides of the conveyor belts.

5. The apparatus of claim **1** in which the printed sheet guide means includes a transverse pivotal mounting to vary the angle of the reserve stack relative to the conveyor belts.

6. The apparatus of claim **1** which includes a jogger shaft in the feeder frame drive section, an eccentric on said jogger shaft, a jogger at the front of the conveyor frame to jog the stack of printed sheets in the supply hopper, said jogger being operatively connected to the eccentric, and a driving connection between the input shaft and the jogger shaft.

7. The apparatus of claim **6** in which jogger drive transmission means between the input shaft and the jogger shaft drives the jogger shaft continuously, and a solenoid clutch between the input shaft and the driven conveyor shaft is engaged and disengaged in response to operation of the sensing means.

8. The apparatus of claim **1** in which the sensing means includes an actuator and an electrical limit switch, the means controlled by the sensing means includes a solenoid clutch for selectively transmitting driving force to the driven shaft, and a constantly pulsating electrical switch is wired in series with said electrical limit switch, the solenoid clutch being engaged only when both of said switches are closed, the operating of said pulsating switching imparting a jerking movement to the conveyor.

9. The apparatus of claim **8** which includes eccentric cam means constantly driven by the drive means on the machine frame, and cam follower means for opening and closing the pulsating electrical switch.

10. The apparatus of claim **1** in which the feeder frame is generally T-shaped, the conveyor means includes a rear conveyor section to the rear of the driven shaft which inclines upwardly to the vicinity of said shaft and then downwardly, and a front conveyor section which extends from said shaft to the front of the feeder frame, and in which the printed sheet guide means confines the reserve stack on said rear conveyor section close behind the driven shaft.

11. The apparatus of claim **1** in which the printed sheet guide means includes inwardly extending, inclined, lateral sheet engaging members which contact the lateral margins of printed sheets in the reserve stack to partially support said stack and thereby relieve the

weight on the sheets in the bottom portion of said reserve stack.

12. The apparatus of claim **11** in which means are provided to adjust the sheet engaging members laterally to vary the amount of support that they give to the reserve stack.

13. The apparatus of claim **12** in which the sheet engaging members are plates hinged at their upper ends; and the adjusting means comprises transverse screws engaging the lower portions of said plates.

14. Apparatus for feeding printed sheet material to a gathering machine which has a machine frame, a printed sheet supply hopper which holds a small vertical stack of printed sheets surmounting said frame toward the front thereof, said hopper havinig a front plate, drive means on the machine frame and means mounted in the machine frame and driven by said drive means for withdrawing sheets seriatim from the bottom of the stack at a predetermined rate and delivering them to a gathering chain which travels along the front of the machine frame, said apparatus comprising, in combination:

a feeder frame of inverted L-shape which includes a short horizontal conveyor section and a structurally integral drive section which is short from front to rear depending from the rear of said conveyor section, said frame being adapted to be positioned with the conveyor section surmounting the machine frame and the drive section immediately to the rear of the machine frame;

upright members on the front of the conveyor section which provide rear confining means for the sheet supply hopper and the feeder frame being bodily movable fore and aft on the machine frame to vary the length of said hopper for handling sheets of different sizes;

conveyor means in the feed frame conveyor section, said conveyor means including a transverse driven shaft journalled at the rear of said conveyor section and at the top of the drive section, a plurality of drive pulleys on said driven shaft, a plurality of idler pulleys journalled at the front of the conveyor section aligned with the drive pulleys to provide pulley sets, an endless belt trained over each pulley set to form a top conveying run and a return run, and belt supporting and guiding means beneath the belt conveying runs, said belt conveying runs being inclined upwardly from the rear of the conveyor section to provide a reserve stacking holding area, and the forward portions of said conveying runs being inclined downwardly from the rear for a short distance;

an input shaft journalled in the lower portion of the feeder frame drive section parallel to and substantially in the same vertical plane as the driven shaft;

drive transmission means operatively connecting said input shaft to said driven shaft;

means for driving said input shaft;

adjustable printed sheet guide and confining means above the reserve stack holding area to hold a large reserve stack of printed sheets rests directly on the belt conveying runs close to the front of the upwardly inclined portion of said runs, said guide and confining means including rear guides toward the rear of said holding area and metering roller means at the front, said guide and confining means being adjustable laterally and longitudinally to confine printed sheets of different sizes;

means for adjusting the vertical position of the metering roller means to produce shingled streams of different depths;

means in the printed sheet supply hopper for sensing when the top of the small stack of printed sheets therein is between an upper level and a lower level;

means controlled by said sensing means for causing driving of the conveyor driven shaft only when the height of said small stack is between said two predetermined levels, to draw printed sheets from beneath the reserve stack and feed them in a shingled stream to the supply hopper.

15. The apparatus of claim **14** in which the tops of the drive pulleys and of the idler pulleys are substantially in the same horizontal plane, and the belt supporting and guiding means has a first portion that is inclined upwardly from the drive pulleys to an apex at an intermediate point close to the front of the reserve stack and a second portion that is inclined downwardly from said apex to the idler pulleys.

16. The apparatus of claim **15** in which the axis of the metering roller means in a vertical plane close behind the apex of the belt supporting and guiding means.

17. The apparatus of claim **16** in which the metering roller means is mounted for linear adjustment toward and away from the guide means.

18. The apparatus of claim **17** in which the metering roller means is mounted for vertical adjustment to vary the depth of the shingle.

19. The apparatus of claim **14** in whch the printed sheet guide means includes inwardly extending lateral sheet engaging members which contact the lateral margins of printed sheets in the reserve stack to partially support said stack and thereby relieve the weight on the sheets in the bottom portion of said reserve stack.

20. The apparatus of claim **19** in which means are provided to adjust the sheet engaging members laterally to vary the amount of support that they give to the reserve stack.

21. The apparatus of claim **14** in which the printed sheet guide means includes a transverse pivotal mounting to vary the angle of the reserve stack relative to the conveyor belts.

22. The apparatus of claim **14** which includes a jogger shaft in the feeder frame drive section, an eccentric on said jogger shaft, a jogger at the front of the conveyor frame to jog the stack of printed sheets in the supply hopper, said jogger being operatively connected to the eccentric, and a driving conection between the input shaft and the jogger shaft.

23. The apparatus of claim **22** in which jogger drive transmission means between the input shaft and the jogger shaft drives the jogger shaft continuously, and a solenoid clutch between the input shaft and the driven conveyor shaft is engaged and disengaged in response to operation of the sensing means.

24. The apparatus of claim **14** in which the belts are spaced apart, there are openings in the belt supporting and guiding means alongside the belts and beneath the reserve stack, and driven rollers with concentric high friction surfaces project through said openings to a height substantially coplanar with the top of the belt conveying runs so as to cooperate with the belts to support and feed sheets from said reserve stack.

25. The apparatus of claim 24 in which the belts and rollers are in contact with substantially more than one-half the head to foot length of the sheets in the reserve stack.

26. Apparatus for feeding printed sheet material to a supply box of a collating machine which has a machine frame, a printed sheet supply hopper which holds a small vertical stack of printed sheets surmounting said frame toward the front thereof, said hopper having a front plate, drive means on the machine frame, and means mounted in the machine frame and driven by said drive means for withdrawing sheets by their leading ends seriatim from the bottom of the stack at a predetermined rate and delivering them to a gathering chain which travels along the front of the machine frame, said apparatus comprising, in combination.

a feeder frame which includes a horizontal conveyor section and a drive section depending from said conveyor section, said feeder frame being adapted to be positioned with the forward part of the conveyor section overlying the machine frame and the drive section immediately to the rear of the machine frame, the front of the conveyor section defining the rear of the sheet supply hopper, and the feeder frame being bodily movable fore and aft with respect to the machine frame to vary the length of said sheet supply hopper for handling sheets of different sizes;

conveyor means in the feeder frame conveyor section, said conveyor means including a transverse driven shaft journalled in the conveyor section above the drive section, a plurality of laterally spaced drive pulleys on said driven shaft, a plurality of idler pulleys journalled in the conveyor section aligned with the drive pulleys to provide pulley sets, an endless belt trained over each pulley set to form a top conveying run and a return run having spaced apart belts, and belt supporting and guiding means beneath and conveying runs, there being openings in the belt supporting and guiding means alongside the belts;

driven rollers with concentric high friction surfaces which project through said openings to a height substantially coplanar with the top of the belt conveying runs;

an input shaft journalled in the lower portion of the feeder frame drive section parallel to the driven shaft;

drive transmission means in the drive section operatively connecting said input shaft to said driven shaft;

means for driving said input shaft to drive the endless belts and the rollers;

printed sheet guide means operatively associated with the rear portion of the conveyor means to confine a large reserve stack of printed sheets which rests directly on the belt conveying runs and the driven rollers, said guide means being adjustable to confine printed sheets of different sizes;

means in the printed sheet supply hopper for sensing when the top of the small stack of printed sheets therein is between an upper level and a lower level;

means controlled by said sensing means for causing driving of the conveyor driven shaft only when the height of said small stack is between said two predetermined levels, to draw sheets from beneath the reserve stack and feed them in a shingled stream to the supply hopper;

and adjustably mounted metering roller means for controlling the depth of said shingled stream as it moves from under th reserve stack.

27. The apparatus of claim 26 in which the rollers have laterally extending integral drive drums in driven contact with the undersides of the top conveying runs.

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