United States Patent

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[54] SHEET FEEDING APPARATUS

8 Claims, 5 Drawing Figs.

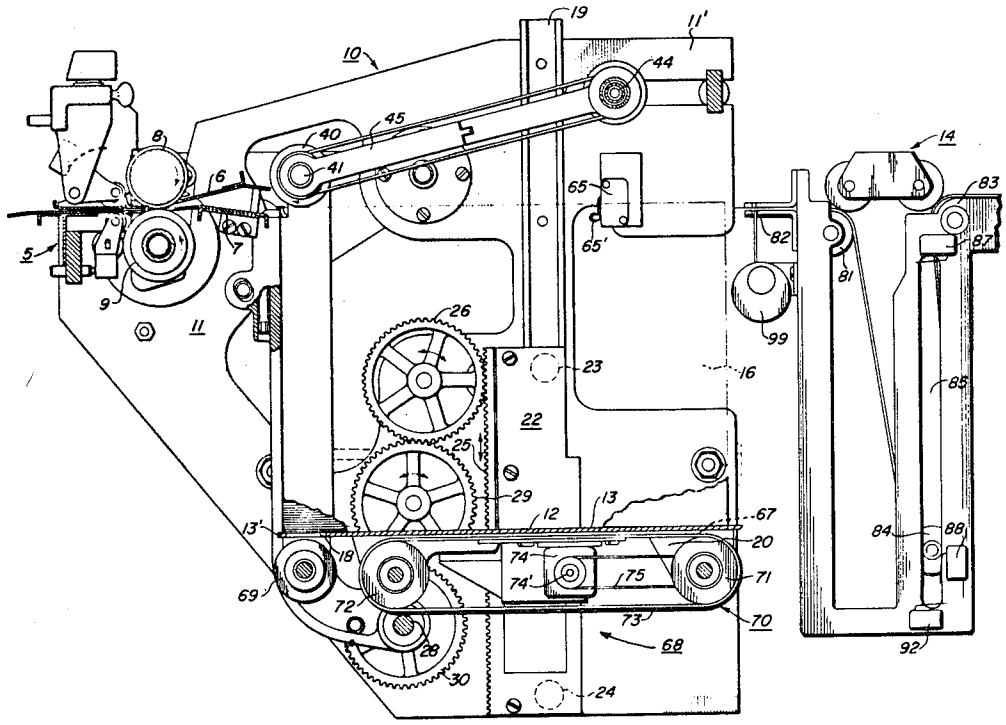
[52] **U.S. Cl.** **271/39,** 271/45
[51] **Int. Cl.** **B65h 3/06**
[50] **Field of Search** 271/39, 9, 28, 62, 45

[56] **References Cited**
UNITED STATES PATENTS

3,393,907 7/1968 Cain 271/39

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ABSTRACT: Sheet feeding apparatus incorporating a tray for storing precut sheets; first feeding means contactable with the topmost sheet of the precut sheet stock to feed precut sheets forward in seriatim; means to raise the tray to maintain the topmost sheet of the precut sheet stack in operative contact with the first feeding means as precut sheets are removed therefrom; second feeding means disposed under and jointly movable with the tray and cooperable with the base of the tray to form a passageway for feeding of ready cut sheets from a roll stock converter forward; and aperture means in the tray base enabling the first feeding means to drivingly contact the second feeding means when the tray is empty following raising of the tray to a maximum height.



Patented May 25, 1971 3,580,565

5 Sheets-Sheet 1

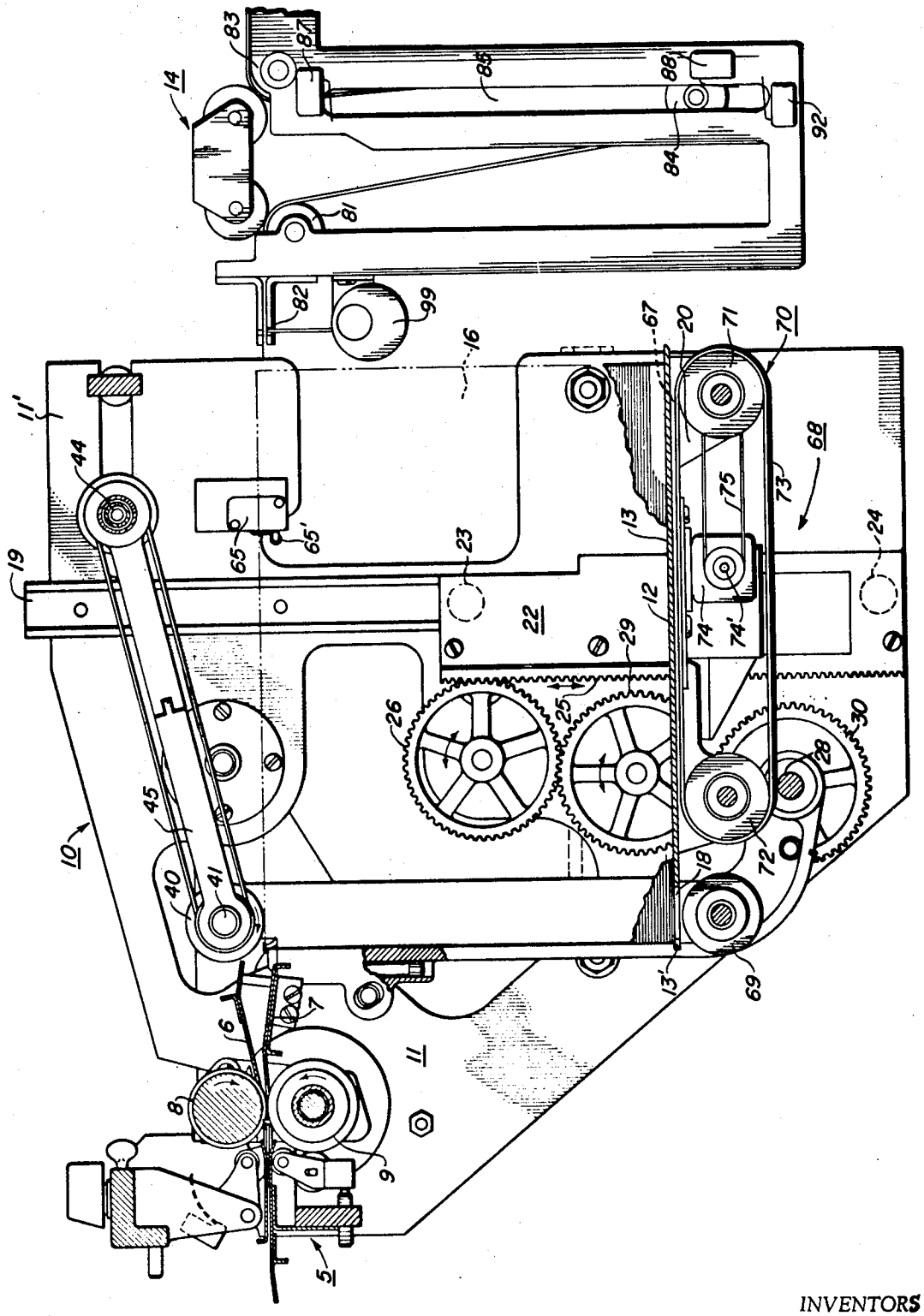


FIG. 1

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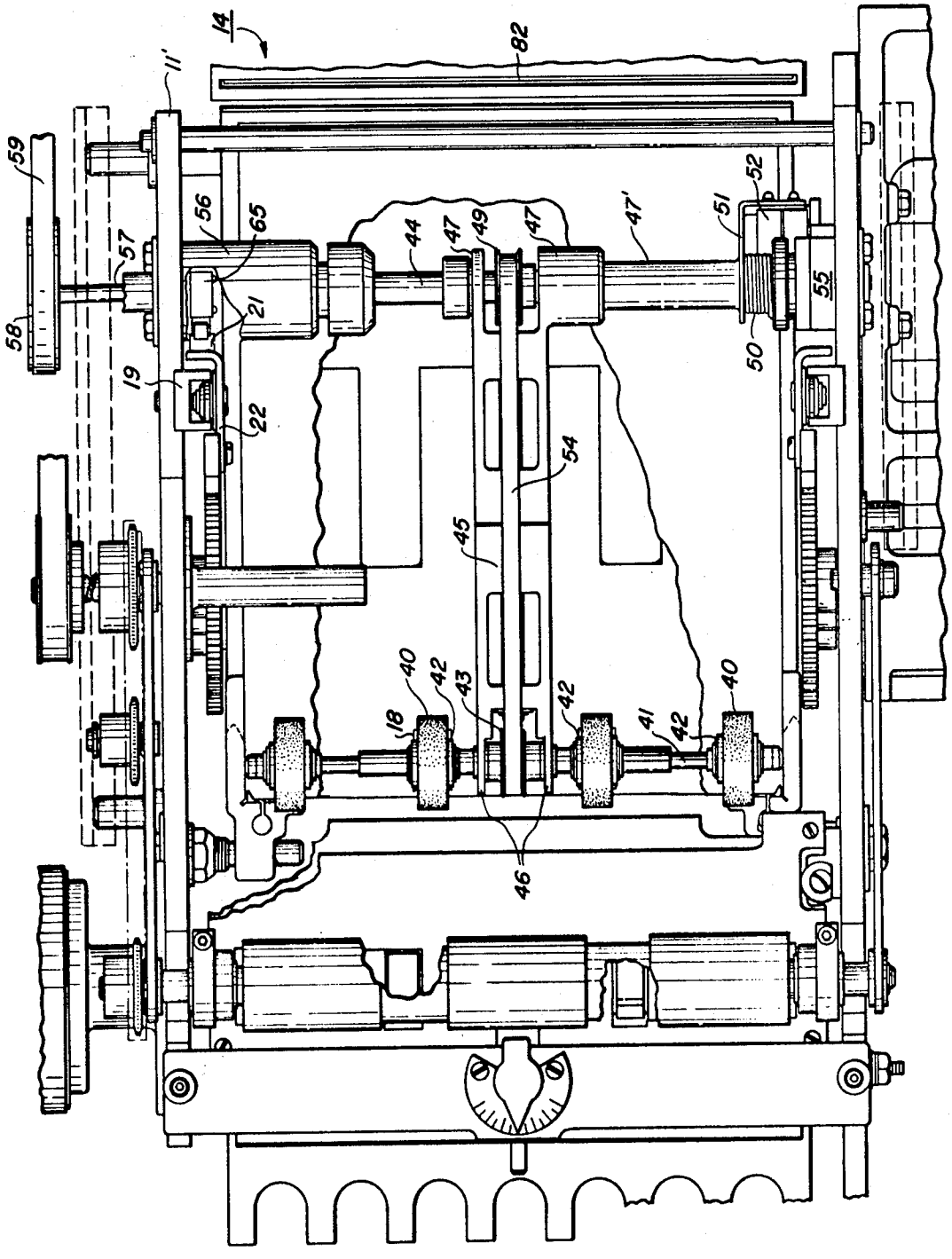

14
82
11'
59
56
65
57
44
47
49
47
47'
51
52
55
58
21
50
19
22
54
45
40
42
43
42
41
42
40
18
46

FIG. 2

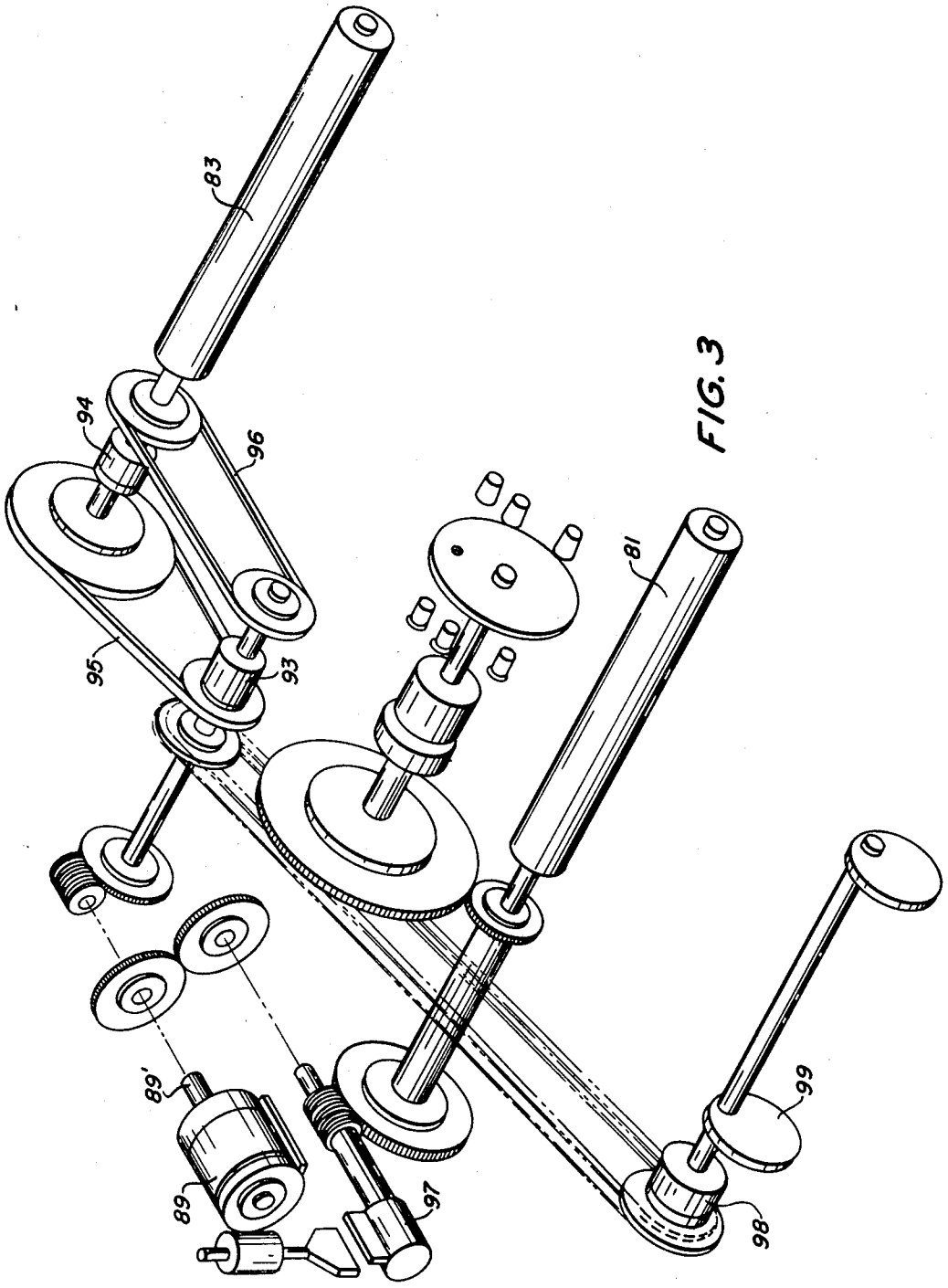


FIG. 3

5 Sheets-Sheet 4

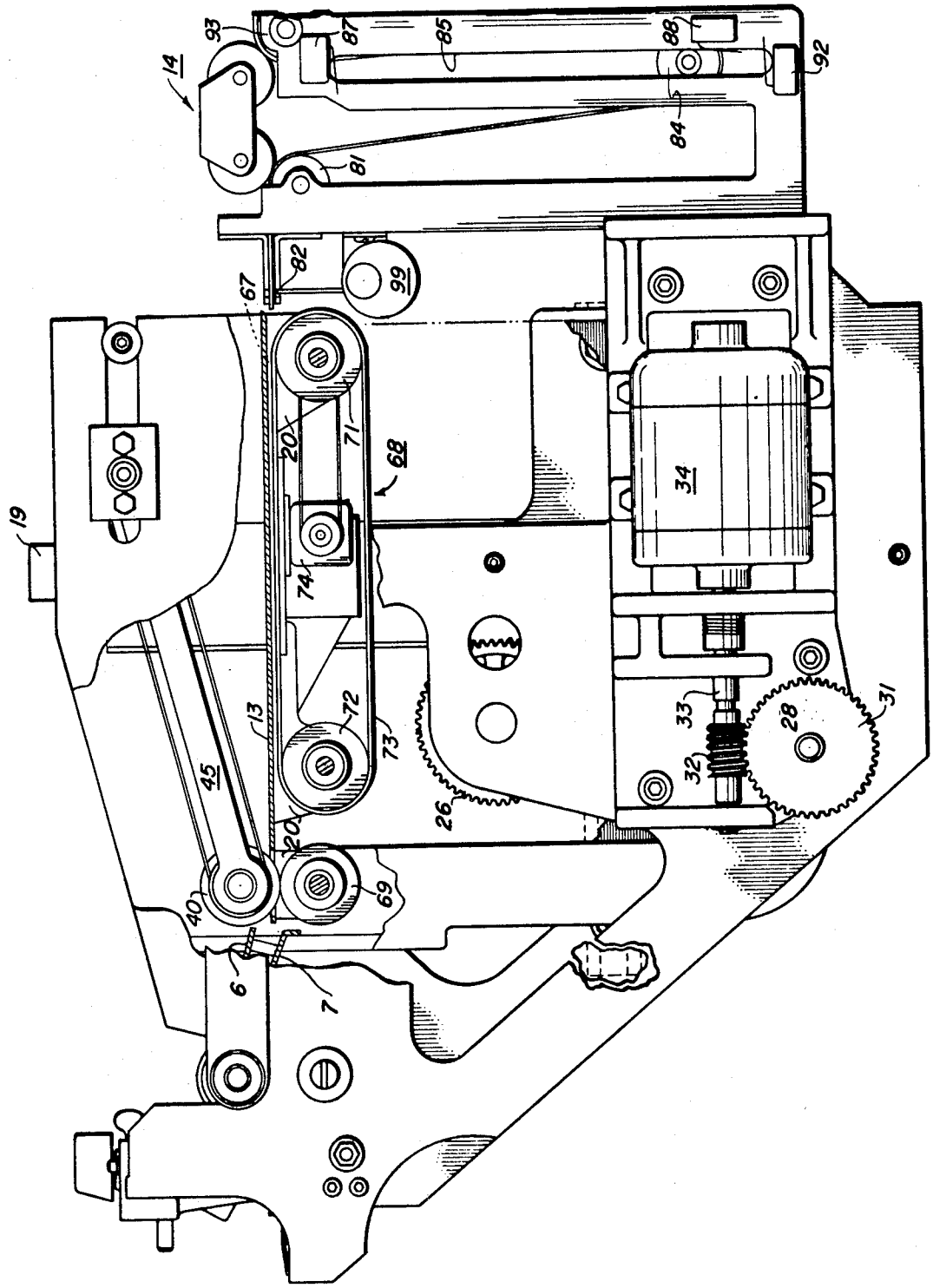
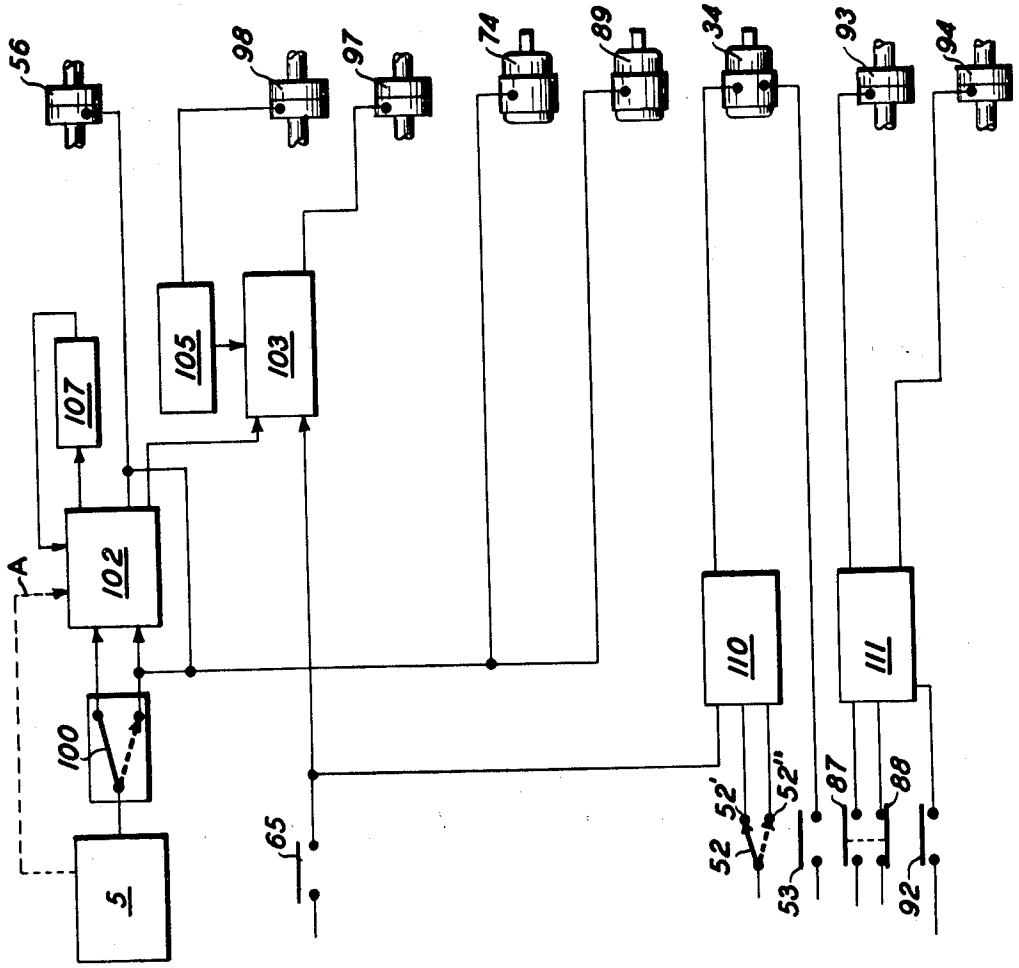


FIG. 4

FIG. 5


56
98
97
74
89
34
93
94
107
105
103
102
A
100
5
65
110
111
52
52'
52"
53
87
88
92

SHEET FEEDING APPARATUS

This invention relates to a sheet feeding apparatus, and more particularly to a sheet feeding apparatus for feeding both precut sheets and ready cut sheets.

In devices which require a supply of sheets for their operating cycle, for example reproduction or copying machines, there is normally provided either a precut sheet supply or a roll stock supply with sheets cut to size by a suitable stock cutter. A suitable transport means for carrying either the precut sheets or the ready cut sheets from the stock cutter to the user, for example, a reproduction machine is provided. As can be understood, individual advantages and disadvantages accrue with both arrangements. For example, a precut sheet system normally entails a lower initial cost than the ready cut sheet system which requires a stock cutter. However, the material cost is higher for precut sheets than for uncut stock. Additionally, the precut sheet system usually requires that various sized sheets be kept on hand to accommodate different demands as well as requiring that the device being served be stopped while the sheet size is changed. On the other hand, a ready cut sheet system avoids or greatly minimizes any storage problem while permitting the user to quickly change sheet size without any substantial interruption in the operating cycle of the device being served.

It is a principal object of the present invention to provide a new and improved sheet feeding apparatus.

It is a further object of the present invention to provide stock supply means adapted to provide both precut and ready cut sheets.

It is an object of the present invention to provide a sheet feeding apparatus incorporating both means to supply precut sheets and ready cut sheets including sheet transporting means, with control means for operating the sheet supply means to provide selective input of either precut or ready cut sheets to the user.

This invention relates to a sheet feeding apparatus comprising in combination, means adapted to support a supply of first sheets; first transport means engageable with the topmost one of the first sheets to feed the first sheets in seriatim from the apparatus; and second transport means adapted to receive a seriatim input of second sheets to said apparatus, the second transport means being operatively related with the first sheet support means and cooperable with the first sheet support means to feed the second sheets from the apparatus.

Other objects and advantages will be apparent from the ensuing description and drawings in which:

FIG. 1 is a side view partially in section showing the sheet feeding apparatus of the present invention in the precut sheet feeding mode;

FIG. 2 is a top plan view of the sheet feeding apparatus shown in FIG. 1;

FIG. 3 is an isometric view showing the drive mechanism for the sheet stock cutter;

FIG. 4 is a side view partially in section showing the sheet feeding apparatus of the present invention in the ready cut sheet feeding mode;

FIG. 5 is a schematic view of the control arrangement for the sheet feeding apparatus of the present invention.

Referring to the drawings, there is shown the sheet feeding apparatus, designated generally by the numeral **10**, of the present invention. As will appear, feeding apparatus **10** serves to supply precut sheet stock from tray **12**, or ready cut sheet stock from a roll stock converter or cutter **14**, to a suitable user. In the exemplary arrangement described, sheet feeding apparatus **10** supplies copy sheet or paper to a reproduction or copying machine, such as an electrostatic copier. Other uses and applications for feed apparatus **10** may be readily contemplated.

In the exemplary arrangement shown, the reproduction machine being served has suitable sheet receiving means which may comprise upper and lower guide members **6, 7** respectively through which sheets from feeding apparatus **10** enter. A pinch roll pair **8, 9** may be used to carry the sheets

forward into the reproduction machine. Pinch roll pair **8, 9** are driven by suitable means (not shown).

Sheet feeding apparatus **10** includes a suitable frame **11**, which in the exemplary arrangement shown consists of an appendage from the reproduction machine, having spaced outwardly projecting sides **11'**. Tracks **19** are suitably secured to the inside wall of each frame side **11'**. As will appear, tracks **19**, which are generally U-shaped in cross section, support the precut sheet tray **12** for vertical raising and lowering movement.

Referring particularly to FIGS. **1, 2** and **4** of the drawings, tray **12** of sheet feeding apparatus **10** includes a generally rectangular platelike base **13** having apertures **18** therethrough adjacent the sheet discharge end **13'** thereof. As will appear, apertures **18** enable feed rollers **40** to contact idler rollers **67** of ready cut sheet transport **68** whenever feeding apparatus **10** is operated in the ready cut sheet feeding mode.

Tray **12** has downwardly projecting sides **20**, which serve to support ready cut sheet transport **68** therebelow as will appear more fully hereafter. Upwardly projecting supports **22** on sides **20** of tray **12** adjacent the tray midpoint carry upper and lower guide rollers **23, 24**. Guide rollers **23, 24** are freely rotatable and ride in tracks **19** to support tray **12** for vertical raising and lowering movement. It is understood that the cooperation between the sides of the U-shaped tracks **19** and guide rollers **23, 24** restrain tray **12** against horizontal movement.

The forward edge of sides **20** has gear-teeth **25** thereon. Drive gears **26**, which are suitably journaled in frame sides **11'**, mesh with gear-teeth **25**. Intermediate gears **29** are suitably journaled on frame sides **11'**. A power shaft **28** is suitably journaled between frame sides **11'** and has gears **30** in meshing engagement with gears **29**. Shaft **28** carries a gear **31** which meshes with worm gear **32** on shaft **33** of reversible drive motor **34**. As is apparent, motor **34** rotates by means of gears **31, 32** the shaft **28**, which in turn drives gears **30, 29, 26** to raise or lower the tray **12** and the stack **16** of precut sheets thereon. Preferably motor **34** gears **25, 26, 29, 30** are chosen to provide incremental raising or lowering of tray **12**.

Feed rollers **40** serve to feed the topmost one of the precut sheets on tray **12** between guide members **6, 7** and into the nip of pinch roll pair **8, 9**. Feed rollers **40** are rotatably journaled on driven shaft **41**. Suitable overrunning or one-way clutches **42** are provided to drivingly couple rollers **40** with shaft **41** on rotation of shaft **41** in the sheet feeding direction (shown by the solid line arrow in FIG. **1**). Clutches **42** uncouple rollers **40** from shaft **41** whenever rollers **40** overrun or rotate faster than shaft **41**.

Shaft **41** is pivotally supported from a power shaft **44** by member **45**. Member **45** has spaced journal arms **46, 47** at the opposite ends thereof within which shafts **41, 44** respectively are supported. A driven pulley **43** is secured to the portion of shaft **41** between the arms **46** of member **45** while a driving pulley **49** is carried by shaft **44** between arms **47** of member **45**. Drive belt **54** connects pulley **43** with pulley **49**. Spring **50** biases member **45** in a counterclockwise direction to assure the requisite contact between feed rollers **40** and the topmost one of the precut sheets on tray **12**.

One arm **47'** of member **45** comprises a collarlike extension having a radially projecting leg **51** adapted to control tray lift switch **52**. As will appear, switch **52** cooperates with the feed roller support member **45** to maintain feed rollers **40** in continuous driving contact with the topmost one of the precut sheets on tray **12** as precut sheets are removed therefrom.

One end of shaft **44** is journaled on frame side **11'** by bearing **55**. The other end of shaft **44** is rotatably supported in the opposite side **11'** by means of clutch member **56**. Clutch member **56** includes input shaft **57** carrying drive pulley **58**. Pulley **58** is connected by belt **59** with a suitable source of power (not shown). Clutch **56**, which may be electromagnetic, serves when engaged to couple shaft **57** with power shaft **44** whereby feed rollers **40** are rotated in the sheet feeding direction shown by the solid line arrow in FIG. **1**.

During operation, the topmost sheet on tray 12 is frictionally advanced by rollers 40 between guide members 6, 7 and into the nip of pinch roller pair 8, 9. Roller pair 8, 9, which are preferably rotated faster than feed rollers 40, carry the sheet forward to the reproduction machine. The increased velocity imparted to the sheet by roller pair 8, 9 is accommodated by one-way clutches 42 which permit rollers 40 to overrun shaft 41. As will appear, clutch 56 is preferably disengaged following feed of each sheet into the nip of pinch roller pair 8, 9 thereby interrupting drive to shaft 41.

Suitable switch means (not shown) is preferably provided to limit downward movement of tray 12. To control upward movement of tray 12 and assure disposition of ready cut sheet transport 68 in a predetermined operating position between cutter 14 and guide members 6, 7, control switch 65 is provided. As will appear, switch 65, the operating arm 65' of which is disposed for engagement by projection 21 on one of the sides 20 of tray 12 following predetermined raising of tray 12, overrides lift control switch 52 to foreclose operation of motor 34 in a tray raising direction.

The ready cut sheet transport 68 includes feed rollers 69 arranged below apertures 18 in base 13 of tray 12 and opposite feed rollers 40, and a belt type conveyor 70 upstream thereof. Conveyor 70 has one or more endless belts 73 supported on drive and idler rollers 71, 72 respectively. Feed rollers 69, and rollers 71, 72 of conveyor 70 are suitably journaled in the depending sides 20 of tray 12 such that the peripheral surface of idler rollers 69 and the surface of conveyor belts 73 are spaced slightly below the lower surface of tray base 13. As will appear, transport 68 cooperates with the overlaying tray base 13 to form a passage 67 for conducting ready cut sheets from cutter 14 to the slotlike opening formed by guide members 6, 7. Motor 74, which may be supported from the underside of tray base 13, has output shaft 74' thereof drivingly connected to drive rollers 71 by means of belt 75.

Inasmuch as ready cut sheet transport 68 is supported from tray 12, transport 68 moves upwardly and downwardly with tray 12. Raising of tray 12 to the predetermined maximum height as determined by control switch 65 disposes the ready cut sheet passage 67 in operative alignment with the outlet of cutter 14 and the opening formed by guide members 6, 7. At the same time, feed rollers 40 contact, by means of apertures 18 in tray base 13, feed rollers 69 of transport 68 to form a pinch roll pair for feeding ready cut sheets forward from the conveyor 70 to guide members 6, 7. As will appear, clutch 56 is engaged to drive feed rollers 40 during the ready cut sheet operating mode of feeding apparatus 10.

Cutter 14 may comprise any suitable mechanism for cutting sheet stock from a roll (not shown) into individual sheets on demand such as disclosed in copending U.S. Pat. application Ser. No. 701,200 filed Jan. 29, 1968 in the name of Lyman H. Turner. The aforesaid stock cutter includes a metering roll 81 for advancing the desired length of sheet stock forward from the supply roll to a reciprocating knife 82. Cutter 14 is arranged such that the discharge therefrom is in operative alignment with the ready cut sheet passage 67 formed by tray base 13 and conveyor 70 whenever tray 12 is raised to the maximum height as determined by switch 65. Accordingly the feed of sheet stock forward by metering roll 81 brings the leading edge of the sheet stock into passage 67 and operative contact with conveyor 70.

Cutter 14 has a feed roll 83 to supply sheet stock from the supply roll to metering roll 81 in accordance with use as sensed by dancer roll 84. Dancer roll 84, which is between metering and feed rolls 81, 83 respectively, is freely movable in vertical tracks 85. The weight of dancer roll 84 on the stock provides requisite stock tensioning. At the same time the height of dancer roll 84 is representative of the length of stock between metering and feed rolls 81, 83 respectively.

Drive motor 89 for cutter 14 has shaft 89' thereof connected to feed roll 83 through clutch 93 and high speed belt and pulley drive means 95 or through clutch 94 and low speed belt and pulley drive means 96. Clutch 97 is provided to couple metering roll 81 with motor shaft 89' while clutch 98 serves to couple knife operating means 99 with motor shaft 89'.

High and low speed switches 87 and 88 respectively and stop switch 92, which are controlled by dancer roll 84, regulate operation of clutches 93, 94 respectively. As will appear, where the supply of stock to metering roll 81 is reduced, dancer roll 84 is raised, operating switch 87 to actuate clutch 93 and drive feed roll 83 at high speed. Where the supply of stock to metering roll 81 increases, dancer roll 84 descends, operating switch 88 to actuate clutch 94 and drive feed roll 83 at low speed. Where the length of stock between metering and feed rolls 81, 83 respectively becomes excessive, dancer roll 84 descends further, operating stop switch 92 whereby clutch 94 is uncoupled and feed roll 83 stopped.

Referring to FIG. 5 of the drawings, to facilitate description, numeral 5 is used to designate an exemplary reproduction machine while the demand or "print" signal thereof is designated by the letter A. Suitable selector means 100 is provided to enable feeding apparatus 10 to be operated in either the precut or ready cut sheet mode. A suitable controlling circuit 102 regulates operation of feed roll clutch 56 and of controlling circuit 103 in accordance with the setting of selector means 100 and the operational demands of reproduction machine 5. Controlling circuit 103 regulates operation of metering roll clutch 97 in accordance with control signal inputs from circuit 102, stock length selector control 105 and upper limit switch 65 as will appear more fully. Length selector control 105 additionally regulates operation of knife driving clutch 98. The selector means 100, when in the ready cut sheet mode, actuates transport drive motor 74, cutter drive motor 89, and feed roll clutch 56 directly.

A suitable timer 107 is provided, timer 107 serving to disengage clutch 56 following a preset interval. Suitable controlling circuits 110, 111 control operation of tray lift motor 34 in the tray raising direction in accordance with the condition of raise and limit switches 52, 65 respectively while circuit 111 controls operation of cutter feed roll high and low speed clutches 93, 94 respectively in accordance with the condition of high speed, low speed, and stop switches 87, 88, 92 respectively. Tray descend control switch 53 serves when actuated to reverse motor 34 and lower tray 12.

As described heretofore, the angular disposition of feed roll support member 45 controls tray raise switch 52 to provide automatic raising of tray 12 in accordance with a reduction in the height of precut sheet stack 16 to maintain feed rollers 40 in operative engagement with the topmost sheet of stack 16. Upper limit switch 65 determines the maximum height to which tray 12 may be raised. Additionally, switch 65 serves to condition the cutter control circuit 103 for operation.

For operation of sheet feeding apparatus 10 in the precut sheet mode, selector means 100 is disposed in the solid line position shown in FIG. 5 of the drawings to ready controlling circuit 102 for operation. On a demand signal A from reproduction machine 5, circuit 102 actuates clutch 56 to couple shaft 57 with power shaft 44 to rotate by means of pulleys 43, 49 and belt 54, feed rollers 40. At the same time, circuit 102 starts timer 107. Rollers 40, which rotate in the direction shown by the solid line arrow in FIG. 1, feed the topmost one of the precut sheets in tray 12 forward between guide members 6, 7 and into the nip of pinch roll pair 8, 9. Pinch roll pair 8, 9 which preferably rotate in a speed greater than that of rollers 40, transport the sheet forward with increased velocity, one-way clutches 42 permitting rollers 40 to overrun shaft 41 and prevent tearing or damage to the sheet.

Following an interval adequate for the sheet to pass into the nip of pinch rollers 8, 9, timer 107 triggers circuit 102 to disengage clutch 56 and terminate drive to feed rollers 40. It is understood that one-way clutches 42 permit the continued rotation of feed rollers 40 as the sheet is pulled therethrough by pinch roller pair 8, 9.

As the supply of precut sheets is reduced, the level of the precut sheet stack on tray 12 decreases turning support member 45 in a counterclockwise direction about the axis of

shaft 44. It is understood that spring 50 holds feed rollers 40 in operative contact with the topmost one of the sheets on tray 12. Following a predetermined decrease in the height of the precut sheet stack 16, leg 51 of member 45 actuates tray lift switch 52 closing contact 52' thereof and triggering circuit 110 to operate motor 34 and drive, by means of gears 26, 29, 30, 32, tray 12 upwardly. As tray 12 raises, feed roller support member 45 is pivoted in a clockwise direction about shaft 44 and following predetermined upward movement of tray 12, switch contact 52' is closed triggering circuit 110 to render motor 34 inoperative and stop tray 12.

When the supply of precut sheets on tray 12 is used up, support member 45 is in the lowermost position with feed rollers 40 thereof in driving contact with rollers 69 of transport 68 and switch contact 52' closed. Tray 12 is accordingly raised upwardly to where projection 21 of tray 12 actuates upper limit switch 65. Switch 65 triggers circuit 110 to stop motor 34 terminating further upward movement of tray 12 with the ready cut sheet passage 67 operatively disposed between cutter 14 and guide members 6, 7. Switch 65 additionally conditions control circuit 103 for operation and may actuate a suitable signal such as a light (not shown) indicating that the supply of precut sheets is exhausted.

Where continued operation in the precut sheet mode is desired, tray descend switch 53 is actuated by the operator, reversing motor 34 and lowering tray 12 to permit precut sheets to be loaded onto tray 12. Preferably, suitable switch means (not shown) are provided to limit downward movement of tray 12.

For ready cut sheets, selector means 100 is disposed in the dotted line position shown in FIG. 5 to operate transport motor 74 and cutter drive motor 89, and engage clutch 56. It is understood that length selector means 105 is set by the operator to provide the desired length of stock.

On a demand signal A, the input from circuit 102 triggers controlling circuit 103 which actuates clutch 97. Clutch 97 couples motor 89 with metering roll 81 which feeds sheet stock forward under knife 82 and into the ready cut sheet passage 67. Following feed of the selected length of stock to knife 82, a signal from length selector means 105 triggers circuit 103 to disengage clutch 97 stopping metering roll 81. At the same time, selector means 105 actuates clutch 98 to couple knife operating means 99 with motor 89. Knife 82 severs the stock, the severed stock being carried by sheet transport 70 into the nip of feed and idler rollers 40, 69 acting as a pinch roll pair.

Transport 70 and pinch roll pair 40, 69 transport the sheet of cut stock forward underneath base 13 of tray 12 and between guide members 6, 7. Pinch roll pair 8, 9 carry the cut sheet forward to the reproduction machine. The process is repeated in accordance with demand, it being understood that the length of stock provided may be varied through adjustment of length selector 105.

During operation of cutter 14, the length of stock between metering and feed rolls 81, 83 respectively may decrease raising dancer roll 84. Following a preset rise, dancer roll 84 actuates switch 87 triggering circuit 111 to actuate clutch 93 and couple stock feed roll 83 with motor 89 through high speed drive means 95. At the same time, clutch 94 is disengaged. As the length of stock between metering and feed rolls 81, 83 respectively increases, dancer roll 84 descends and following a preset descent, dancer roll 84 actuates switch 88 triggering circuit 111 to actuate clutch 94 and couple stock feed roll 83 with motor 89 through low speed drive means 96. At the same time, clutch 93 is disengaged. Where the length of stock between feed and metering rolls 81, 83 respectively reaches a preset maximum, dancer roll 84 actuates stop switch 92 to render circuit 111 inoperative whereby low speed clutch 94 is disengaged and feed roll 83 stopped.

While the invention has been described with reference to the structure disclosed herein, it is not confined to the details set forth; but is intended to cover such modifications, or changes as may come within the scope of the following claims.

We claim:

1. In a sheet feeding apparatus, the combination of means including a base section adapted to support a supply of first sheets,

first transport means engageable with the topmost one of said first sheets to feed said first sheets in seriatim from said apparatus; and

second transport means adapted to receive a seriatim input of second sheets to said apparatus, said second transport means being operatively related with said first sheet support means and cooperable with said first sheet support means to feed said second sheets through said apparatus;

said second transport means being spaced below said base section and cooperable therewith to form a passageway for said second sheets.

2. In a sheet feeding apparatus, the combination of

means including a base section adapted to support a supply of first sheets;

first transport means engageable with the topmost one of said first sheets to feed said first sheets in seriatim from said apparatus;

second transport means adapted to receive a seriatim input of second sheets to said apparatus, said second transport means being operatively related with said first sheet support means and cooperable with said first sheet support means to feed said second sheets through said apparatus, said second transport means being spaced below said base section and cooperable therewith to form a passageway for said second sheets;

and means for lifting said base section as said first sheets are fed from said first sheet supply whereby to maintain the topmost one of said first sheet supply in operative engagement with said first transport means.

3. The apparatus according to claim 2 in which said second transport means is movable with said base section, said first transport means being arranged to operatively engage said second transport means following feeding of the last one of said first sheets from said base section and lifting of said base section with said second transport means to a predetermined position whereby said second sheet passageway is substantially opposite said second sheet input, said first and second transport means cooperating to feed said second sheets through said apparatus.

4. The apparatus according to claim 3 in which said first transport means includes at least one driven feed roller, said second transport means including an idler roller opposite said first transport means feed roller, said base section including aperture means to enable said first transport means roller to drivingly contact said second transport means idler roller on lifting of said base section to said predetermined position; and control means to ready said first and second transport means for operation in response to lifting of said base section to said predetermined position.

5. In a sheet feeding apparatus, the combination of

means adapted to support a supply of first sheets, first transport means engageable with the topmost one of said first sheets to feed said first sheets in seriatim from said apparatus;

second transport means adapted to receive a seriatim input of second sheets to said apparatus, said second transport means being operatively related with said first sheet support means and cooperable with said first sheet support means to feed said second sheets through said apparatus;

means for driving said second transport means, and control means for readying said driving means for actuation on feed of the last one of said first sheets from said support means.

6. In a sheet feeding apparatus, the combination of

means adapted to support a supply of first sheets, first transport means engageable with the topmost one of said first sheets to feed said first sheets in seriatim from said apparatus;

second transport means adapted to receive a seriatim input of second sheets to said apparatus, said second transport means being operatively related with said first sheet sup-

port means and cooperable with said first sheet support means to feed said second sheets through said apparatus;

said first sheet support means including a tray adapted to hold a stack of said first sheets; said first transport means being disposed above said tray whereby to engage the topmost one of said first sheet stack and feed first sheets from said apparatus; and means for raising said tray in accordance with feed of sheets off said tray whereby to maintain said first sheets in operative engagement with said first transport means.

7. The apparatus according to claim 6 in which said second transport means is disposed underneath said tray and cooperable with the bottom of said tray to form a passageway for transporting said second sheets from said second sheet input through said apparatus.

8. The apparatus according to claim 7 in which said second transport means is movable jointly with said tray; said tray raising means being adapted when the supply of said first sheets is exhausted to raise said tray with said second transport means so as to operatively position said second sheet passageway substantially opposite said second sheet input; said tray bottom having aperture means enabling said first transport means to operatively contact said second transport means and feed said second sheets.