United States Patent

Thomas

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[54] COLLATOR

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[52] **U.S. Cl.** **270/58**, 271/86

[51] **Int. Cl.** **B65h 39/02**, B65h 31/36

[58] **Field of Search** 270/58–60, 45, 270/52

[56] **References Cited**

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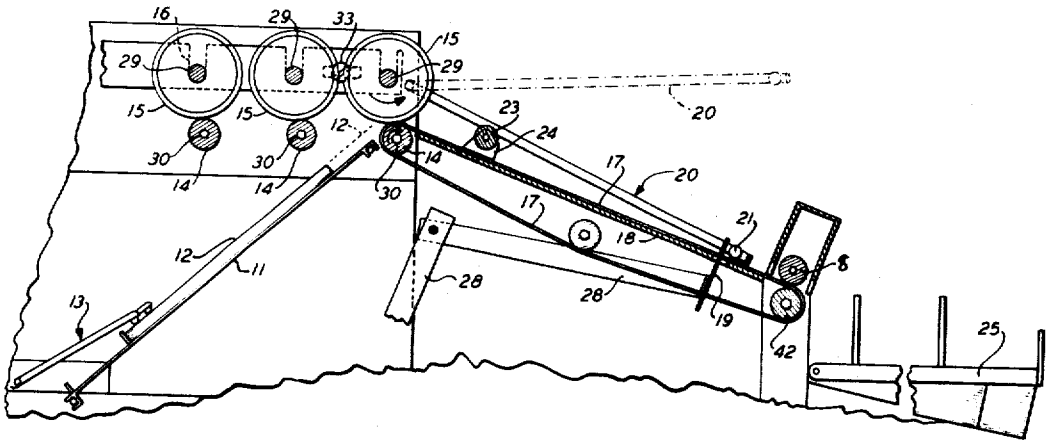
[57] **ABSTRACT**

A collator wherein an inertial roller projects successive sheets toward a gate, and the roller support intercepts sheets that may bounce back; idlers adjustable with respect to feed rollers; a paper deflector imparting a concave aspect to sheets moving onto a stacking table; and idlers larger than driven rollers in juxtaposition peripherally with adjacent idlers.

8 Claims, 6 Drawing Figures



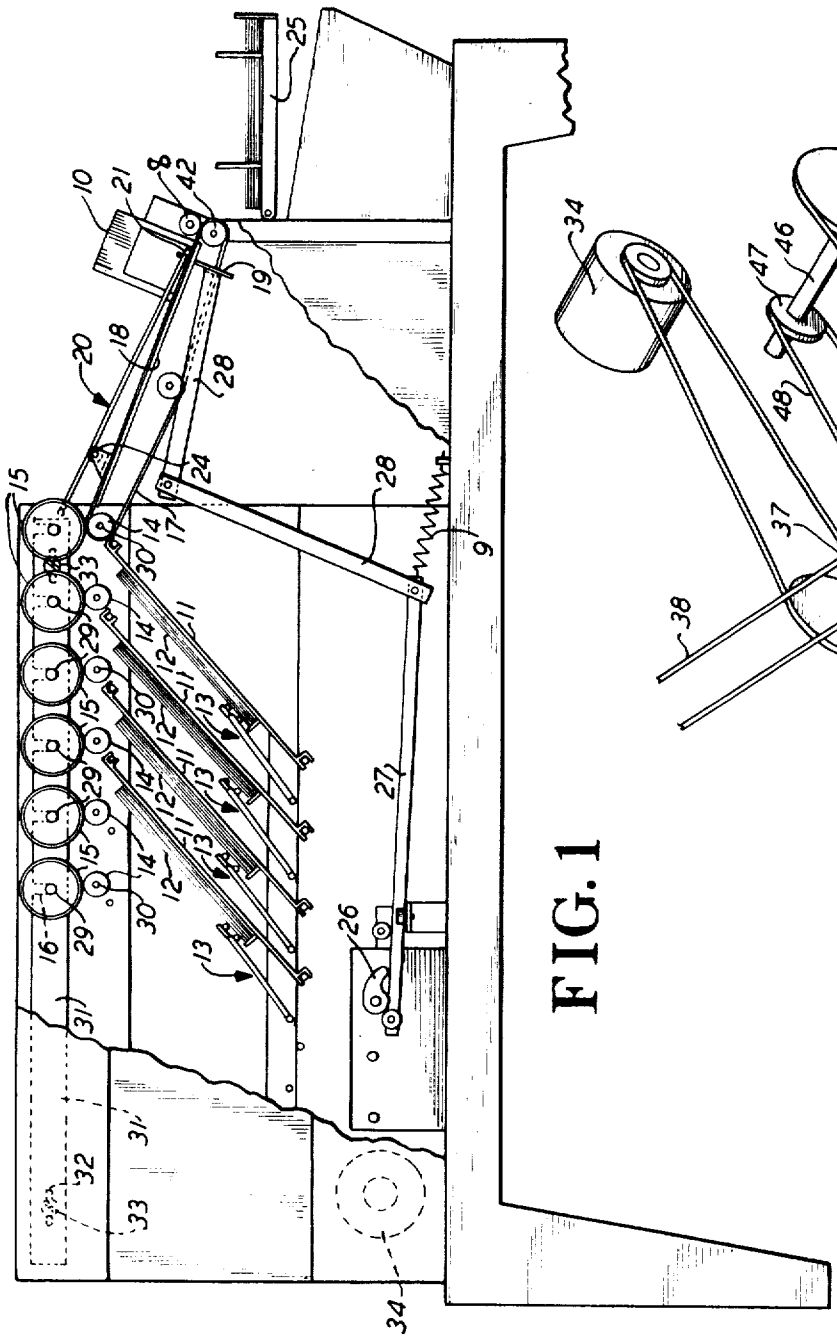


FIG. 1

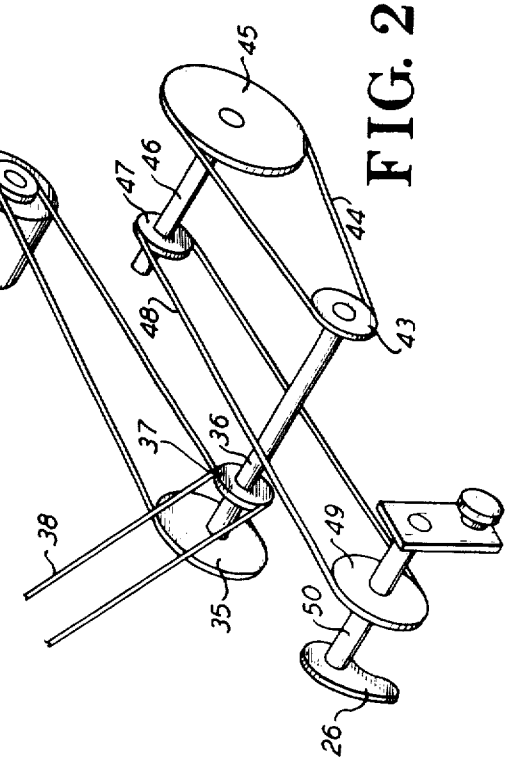


FIG. 2

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FIG. 3

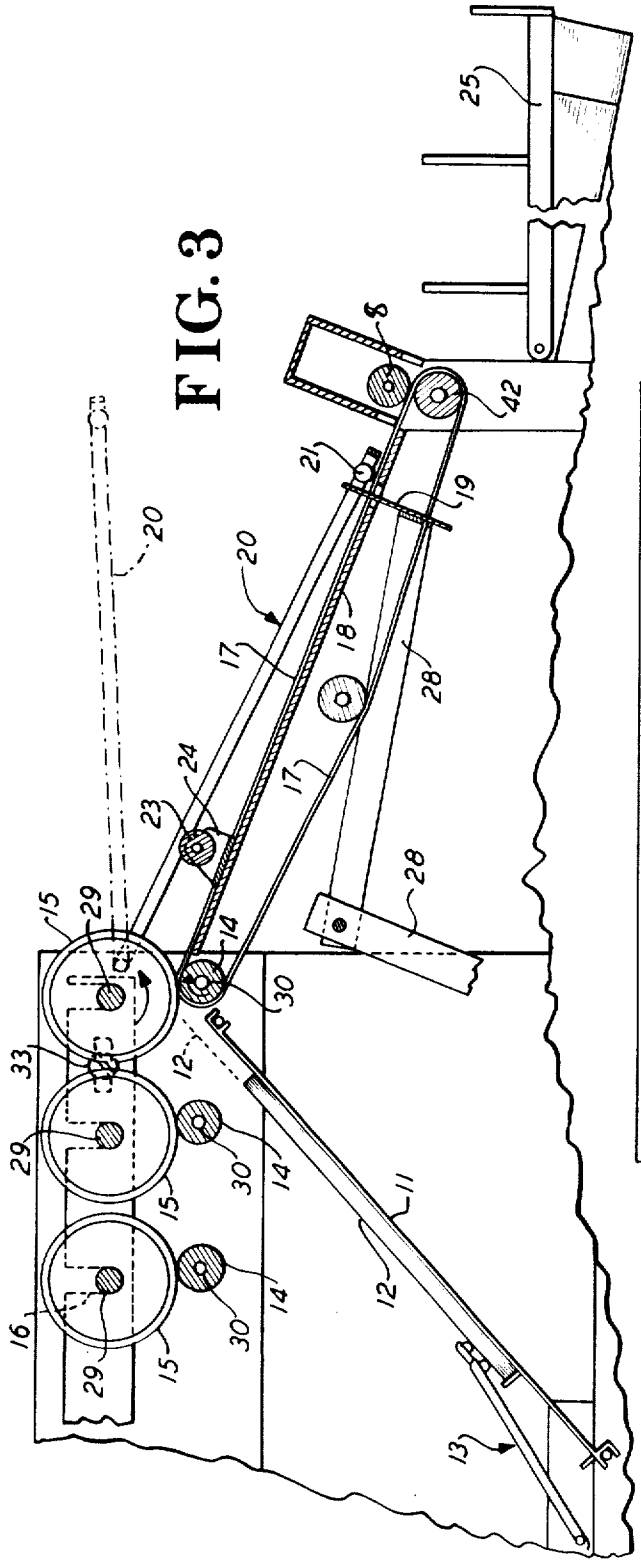
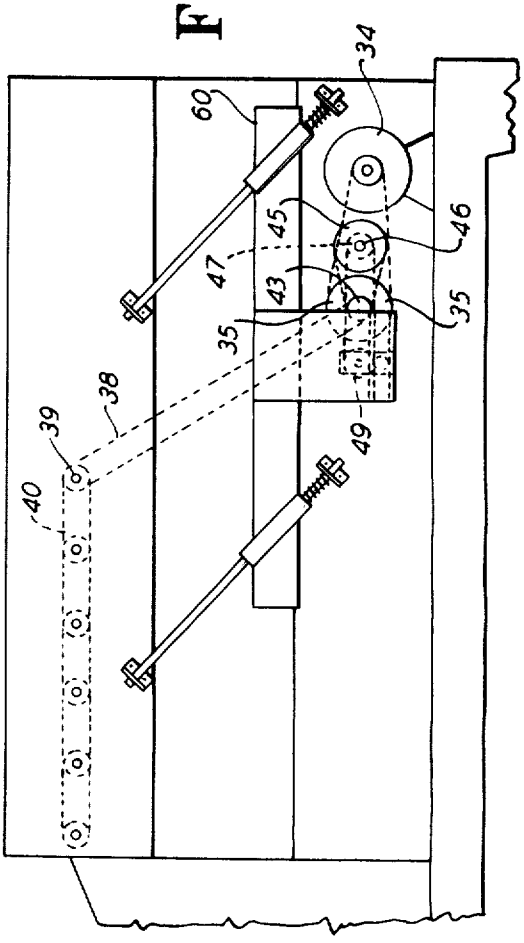


FIG. 6



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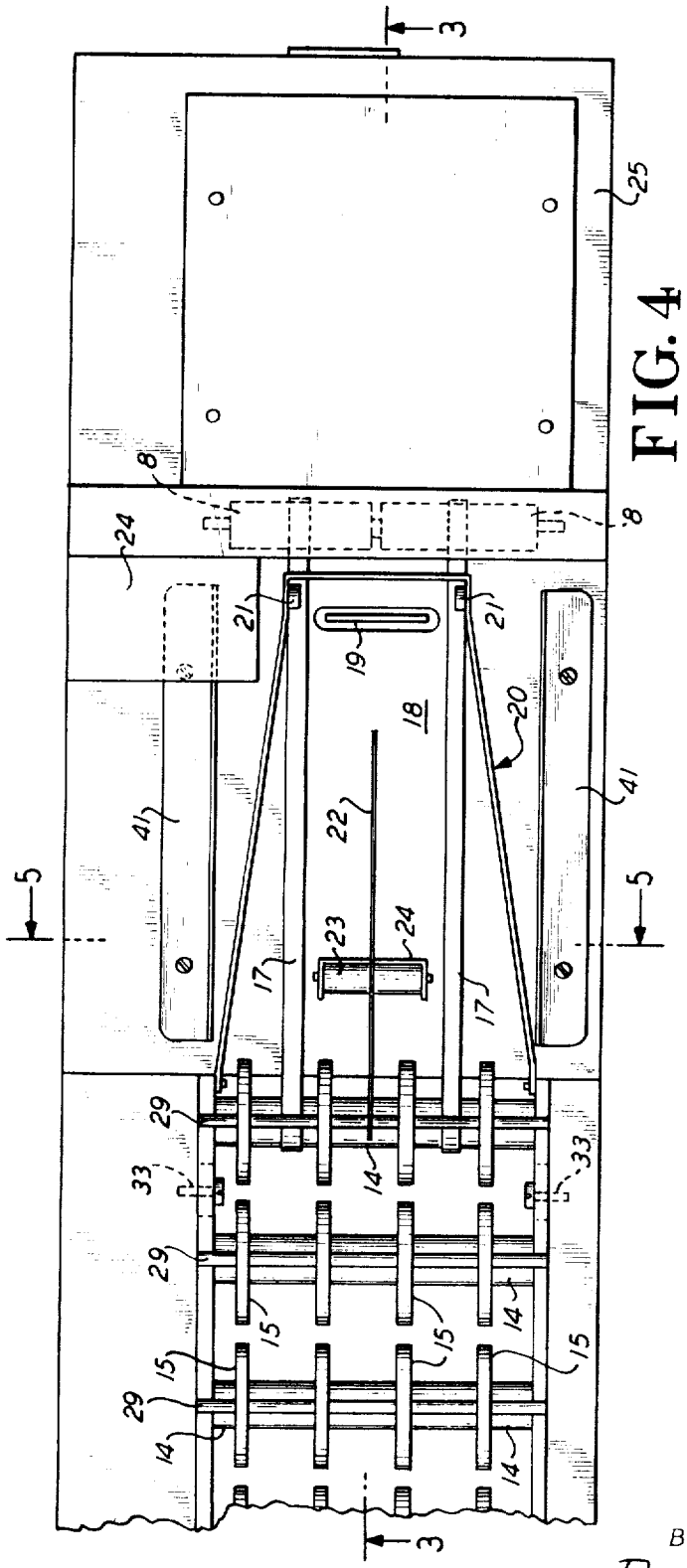

FIG. 4

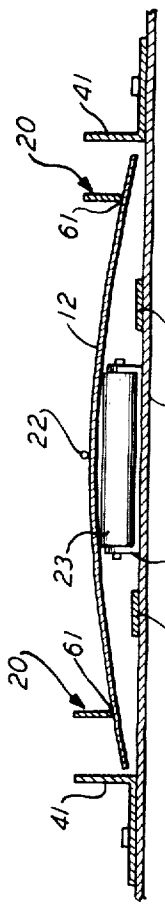

FIG. 5

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COLLATOR

BACKGROUND OF INVENTION

1. Field of Invention

This invention relates generally to collators and specifically to collators devised to insure completeness of collation, and exact registration of sheets in each collated set.

2. Prior Art

Collators are subject to producing incomplete sets, and failing to stack sheets of each collated set in exact registration. No adjustments are provided to accommodate stacks of sheets of varying heights, or different weights of paper, or different limpness, stiffness, or thickness of paper. The design of known collators is such that sheets often deviate from a preselected course, and are not included in a collated set, or are out of stacked registration.

SUMMARY

It has been found that a collator provided with idlers larger than driven rollers, paper deflectors or guides that impart an arch to the sheets, an inertial roller to speed the sheets toward a stop-gate, and an abutment to prevent bounce-back of sheets, will produce uniform stacks of collated sheets in exact registration with each other, and will not omit sheets from a collated group.

DRAWINGS

These objects and advantages as well as other objects and advantages may be attained by the device shown by way of illustration in the drawings in which:

FIG. 1 is a side elevational view of the collator;

FIG. 2 is a plan view showing the drives;

FIG. 3 is a partial side elevational view showing the discharge end of the collator;

FIG. 4 is a partial top plan view of the collator; and

FIG. 5 is a vertical sectional view taken on the line 5—5, in FIG. 4, looking in the direction of the arrows;

FIG. 6 is a partial side elevational view showing the opposite end of the collator;

PREFERRED EMBODIMENT

The collator provides a plurality of trays **11** directed obliquely upwardly, each tray holding a plurality of sheets **12**. In FIG. 1 only four trays are shown, but numerous others may be supplied. Ejection feet **13** (see U.S. Pat. No. 2,844,370 W.E.Thomas 7/22/58) move in each tray to expel the top sheet **12** of the stack of papers in each tray. The upper end of the top sheet **12** is projected over a driven, serrated-surface roller **14**. A rubber-surfaced idler **15**, seated in a slot **16**, bears upon the serrated roller **14**. The sheets **12** are seized in the nip of the roller **14** and idler **15** and are carried forward horizontally in sequence over successive serrated rollers **14** until they leave the last roller **14**. A pair of rubber belts **17** carry the sheets **12** from the last roller **14** downwardly into a collection tray **18** where they are stopped by a gate **19**. A pivotably mounted, gravitationally operated paper deflector **20** is positioned over the collection tray **18** and has a pair rollers **21** at the end thereof which ride on the belts **17**. Immediately preceded by the rollers **21**, is a gate **19**, which is intermittently raised to collect the sheets **12** as they leave the last driven roller **14** and ride on the belts **17** downwardly toward the gate **19**. A straight wire paper deflector **22**, also gravitationally operated, hangs over the collection tray **18** from an axle **29** of the last idler **15**. Since the sheets **12**, in moving into the collection tray **18**, hit the gate **19**, and may bounce back, and since at other times, there are some stragglers among the sheets **12**, so that the collated group of papers may not be in precise edge-to-edge registration with each other, a speed or jog-roller **23** is provided with a mounting **24** in spaced relation to the gate **19**. The sheets **12** will precisely fit the space between the mounting **24** of the jog-roller **23** and the gate **19**. As the first sheet **12** moves over the undriven speed or jog-roller **23**, it

causes the roller **23** to spin. Successive sheets **12** which encounter this jog-roller, **23** after the roller **23** has been cleared by the preceding sheet **12**, are urged forward by the speed roller **23** into contact with the gate **19** as the roller continues to be spun by each preceding sheet **12** that moves over the roller **23** in contact with it, thereby urging each successive sheet **12** into abutting relationship with the gate **19**. Since the sheets **12** also may display a tendency to bounce back from the gate **19**, the mounting **24** of the jog-roller **23**, having a generally perpendicular front edge acts as a barrier to prevent the successive sheets from bouncing back from the gate **19**.

Immediately adjacent to the gate at one side of the stack of papers is a stapler **10**, which is operated in timed relation to the arrival of a complete group of sheets **12**, to staple them together, whereupon the gate **19** is triggered and the collated stapled group of sheets **12** rides out on the belt **17** over the withdrawn gate **19** and is projected into a stacking tray **25**. The timing of the stapling machine **24** and of the gate **19** to staple and release a collated group of sheets **12** is accomplished by an adjustable cam **26** that triggers the discharge gate at timed intervals to permit a collated set of sheets **12** to be stapled and discharged. The cam engages an arm **27**, which is connected by two other arms **28,28** to the gate. A spring **9** restores the arms **28** to normal after each contact by the cam **26**. The stapler is operated by an electrical impulse immediately preceding the opening of the gate and it is controlled by an electroswitch engaged by the mechanism which opens the gate.

The superposed, gravitationally operated, rubber-surfaced rollers **15** change the direction of the motion of sheets **12** from obliquely upward to horizontal.

It is well known to drive sheets **12** forwardly in the nip of rollers which change the sheet's direction. It has been found that obliquely mounted dispenser trays **11**, when stacked heavily with sheets **12**, may cause a problem in that the sheets are not unerringly projected accurately into the nip of the drive roller **14** and the idler **15**. It has been found that if the idler roller **15** is made with a diameter which is approximately equal to or greater than the distance between the axles **29** of the successive driven rollers **14**, the moment of force which expresses the sheets **12** from between the idler **15** and the driven roller **14** will be sufficient to overcome the tendency of the sheets **12** to curl downwardly (either due perhaps to their own inherent limpness, or due to the force of gravity) and will tend to project the sheets linearly i.e., horizontally into the nip of the next succeeding driven roller **14** and idler **15**.

An adjustment is provided so that the axles **29** of the idlers **15** may be moved with respect to the axles **30** of the driven rollers **14**. Thus, the axles **29** of the idlers **15** may be moved from an initial position lying in the same vertical plane as the axles **30** of the driven rollers **14**, to other positions in respect to the axles **30** of the driven rollers **14**. This is accomplished by locating the slots **16** in a longitudinal bar **31** with slots **32**. Bolts **33** enable the adjustment of the bar to permit positioning of the slots **16** at various positions of offset with respect to the axles **30**. Depending upon the degree of offset linearly, the sheets **12** may be projected from the nip of the rollers linearly and horizontally in a direction above horizontal so that the sheets **12** unerringly encounter the successive large idler **15** and enter the nip between the idler and the driven roller **14** which succeeds the first pair of idlers **15** and driven rollers **14**. By this means the sheets **12** are never directed below the nip of succeeding rollers. The deflecting force of gravity is overcome, and the normal tendency of the sheet **12** to curl, forwardly around the driven roller **14** is overcome. If the idlers **15** were small and had a diameter substantially identical with the driven rollers **14**, control of linear movement of the discharged sheets **12** would be less accurate. With large idler rollers **15**, the direction of the discharged sheet may be controlled to compensate for (1) the inherent characteristics of the sheets **12**; (2) the speed of operation, (3) the direction of movement of the sheet being collated. Thus, in a collator, control of the direction of sheets **12** is provided. It is possible to

arrange the idler **15**, to overlap successive idler rollers **15** by offsetting each transverse set from each succeeding set (not shown). In addition to providing for linear discharge of sheets **12** into the nip of succeeding roller, the larger the idler **15** the more it is able to accommodate higher stacks of sheets in trays **11**. An upwardly projected sheet **12** might miss a small idler roller, and not be guided into the nip of the idler **15** and the driven roller **14**. With the large idler roller **15**, the upwardly projected sheets **12**, whether from a high stack or a low stack, will unerringly be directed against the large idler **15** and into the nip of the idler **15** and the driven roller **14**, at all times insuring collation in complete sets without missing or omitting any individual single sheet by reason of failure of a sheet **12** to enter the nip of the idler **15** and driven roller **14**. The use of large idler rollers **15** solves several problems of collation arising from the use of conventional pairs of small driven and small idler rollers having the same general diameter. In such former constructions, in order to insure the precise linear movement of sheets **12** being collated, it has been the practice to use paper deflectors to insure that the moving sheets **12** do not depart from a predetermined linear course. It also has been the practice to use conveyor belts to restrain the sheets from underneath from wandering from the predetermined desirable linear course. Both of these expedients become superfluous by virtue of the large idler roller. In addition, where belts are used, the sheets **12** are distorted in the areas where they are in contact with the belts so that a uniform straight leading edge of a sheet does not enter the nip of the rollers but rather a non-linear edge encounters one or the other of a driven or idler rollers. This results in the jamming of sheets, delayed delivery or marring of the paper. The idler rollers **15** of large sizes, as herein before set forth, avoid such mischances. The use of fixed governing belts or moving governing belts presents the same disadvantages, and the present large idler wheels **15** overcome the disadvantages of both of these types of conventional paper guides. It is known that fixed or moving deflector belts or fixed paper deflectors cause an abrupt or sharp change of direction of travel of a sheet. This coarse deflection of sheets causes numerous problems as already referred. An additional advantage of large idler wheels is that, when the leading edge of sheet encounters the periphery of a large idler **15**, it is gently deflected toward the nip of the idler **15** with the driven roller **14** and there is no abrupt deformation of the sheet to a new course immediately adjacent to the leading edge. A gentle deflection or diversion of the somewhat linear movement of the sheet **12** is accomplished, and it is guided toward the nip without any abrupt deflection, thereby again insuring smooth delivery of the sheet toward the collation tray **18** without marring or defacing the sheet. A still further advantage of large idlers **15** over moving or stationary deflecting belts, and stationary rigid deflectors, is that the idlers are mounted in slots **16** and may be easily lifted therefrom. Thus, in the case of a jamming for any reason, it is simple to lift the idler **16** out by the axles **29** from their mounting slots **16**, whereupon free and complete access to the trays **11** is permitted for the removal of jammed sheets or any other misadventure that may be encountered.

A motor **34** drives a first pulley **35** on a shaft **36**. A second pulley **37** operates a belt **38** to drive the first driven roller **39** and in turn drives another belt **40** which operates all of the driven rollers **14**. The axle of the last driven roller **14** (see FIG. **3**) also drives the belts or conveyor **17** in the collection tray **18**. Edge guides **41** to center the sheets **12** are provided adjacent to the belts **17**. These belts **17**, **17** are supported at the discharge end by a roller **42**. Idlers **8** bear on the roller **42**.

The axle **36** carries a third pulley **43** that drives a belt **44** connected to a fifth pulley **45** on the shaft **46**. A pulley **47** on that shaft, drives another belt **48** to operate another pulley **49** on the shaft **50**, on which the cam **26** is mounted. The ejection feet **13** are all pivotably mounted on a reciprocating bar **60**. The bar **60** is reciprocated by the motor **34**, whereby the ejection feet **13** ride up and down on the sheets **12**, to eject them from the trays **11**.

The pivotably mounted paper deflector **20** has a special relationship to the speed roller **23**, as shown in FIG. **5**. The bottom edges **61** of the arms of the deflector **20** are supported by the rollers **21** so that they (the edges **61**) extend below the plane defined by the top of the speed roller **23**. This causes the sheet **12** to be deflected arcuately downwardly (see FIG. **5**); in this manner, the middle of the sheet **12** is engaged by the speed roller **23** and projected toward the gate **19** while the marginal edges of the sheets are deflected toward the belts **17**, which they encounter as the leading edge of the sheets nears the gate **19**. The combination of the speed roller **23** and the belts **17** are thus caused by the paper deflector **20** to urge the sheets **12** into registration with each other in precisely stacked order against the gate **19**. Straggler sheets are avoided—precision stacking is insured.

I claim:

1. A collator comprising
- a. means for holding a plurality of sheets,
- b. means for ejecting a sheet from the means for holding,
- c. a plurality of driven rollers above each means for holding,
- d. a plurality of successive idlers in contact with the top of the driven rollers,
- e. the point of contact of the idlers and the driven rollers defining a tangential generally horizontal plane,
- f. the idlers having a diameter substantially larger than the diameter of the driven rollers,
- g. the idlers having a diameter to place them peripherally in juxtaposition to the next successive idler,
- h. a stacking table adjacent to the last of the driven rollers,
- i. a paper deflector above and converging on the stacking table,
- j. a pair of driven conveyor belts traversing the stacking table,
- k. rollers on the paper deflector engaged with the conveyor belts,
- l. a retractable gate near the outer end of the stacking table normally positioned to intercept sheets on the stacking table,
- m. a mounting for a speed roller at the inner end of the stacking table, in spaced relation to the retractable gate, positioned to intercept any sheet bouncing back from the gate,
- n. a speed roller mounted for free rotation on the mounting, positioned to be engaged and rotated by sheets moving onto the stacking table toward the gate,
- o. The paper deflector comprising a pair of arms spaced apart sufficiently to engage longitudinal edge portions of sheets moving onto the stacking table and to deflect the sheets over the speed roller,
- p. means to lower, and raise the gate to release a collated set of sheets to leave the stacking table on the conveyor belts.

2. The device according to claim **1** in which the means for holding a plurality of sheets comprises
- a. a plurality of trays directed generally upwardly toward the top of the driven rollers.

3. The device according to claim **1** in which the means for ejecting a sheet from the tray comprises
- a. an ejection foot,
- b. a means to reciprocate the ejection foot over the surface of the top sheet.

4. The device according to claim **1** and
- a. means to shift the idlers to vary their positions with respect to their points of contact with the driven rollers.

5. The device according to claim **1** in which the means to shift the idlers is
- a. a housing
- b. a pair of longitudinal bars
- c. means to attach the bars to the housing in a plurality of positions
- d. slots in the bars
- e. axles on which the idlers are mounted
- f. the axles positioned in the slots and in peripheral engagement with the driven rollers.

6. A collator comprising

a. a plurality of means for holding sheets,
b. means for simultaneously ejecting a sheet from each sheet holding means,
c. a driven feed roller above each tray defining a sheet conveyor,
d. an idler above and in gravitational contact with the top of each feed roller,
e. slotted bars on opposite sides of the idlers,
f. a shaft for each idler received at opposite ends in the slots of the bars,

g. means to hold the bars at any one of a plurality of positions thereby to alter the vertical allignment of the axles of the idlers with respect to the axles of the feed rollers.

7. A collator in accordance with claims 6 in which the feed rollers are provided with latitudinally serated surfaces, and the idler rollers are provided with a high friction periphery.

8. A collator in accordance with claim 7 in which the idlers each have a diameter greater than the driven roller, and are in peripheral juxtaposition with each adjacent successive idler.

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