Jan. 6, 1953 H. B. DIXON ET AL 2,624,571

COLLATOR SHEET EJECTING MEANS

Filed May 10, 1948 3 Sheets-Sheet 1

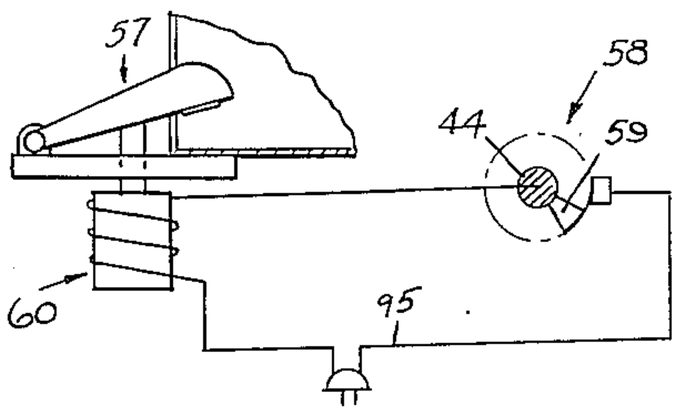

Fig 5

Fig 1

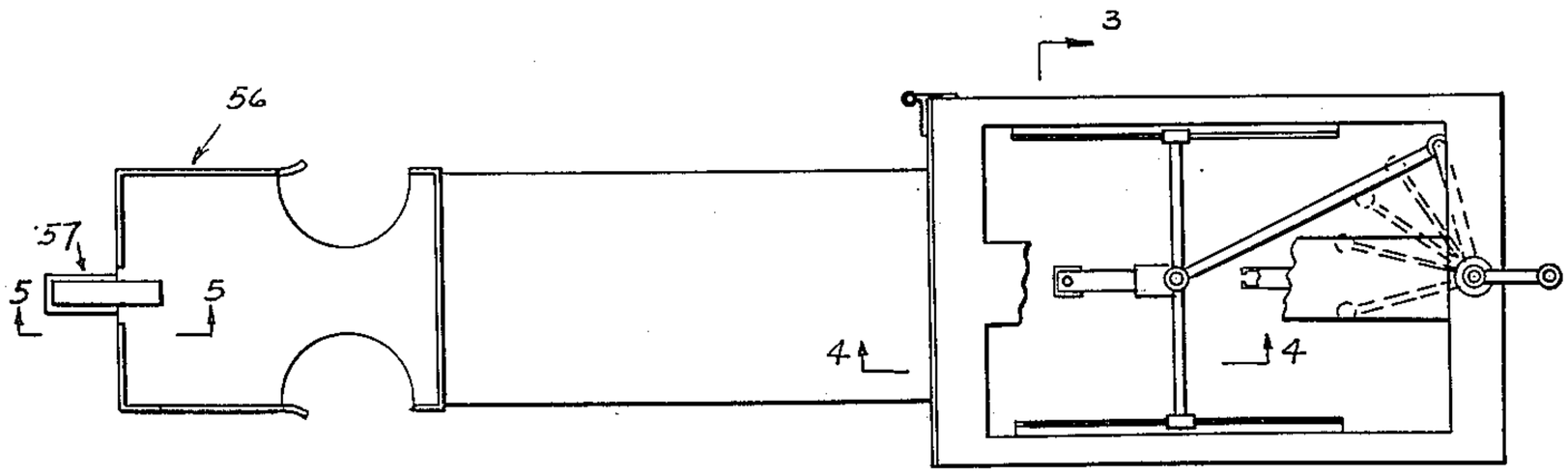

Fig 2

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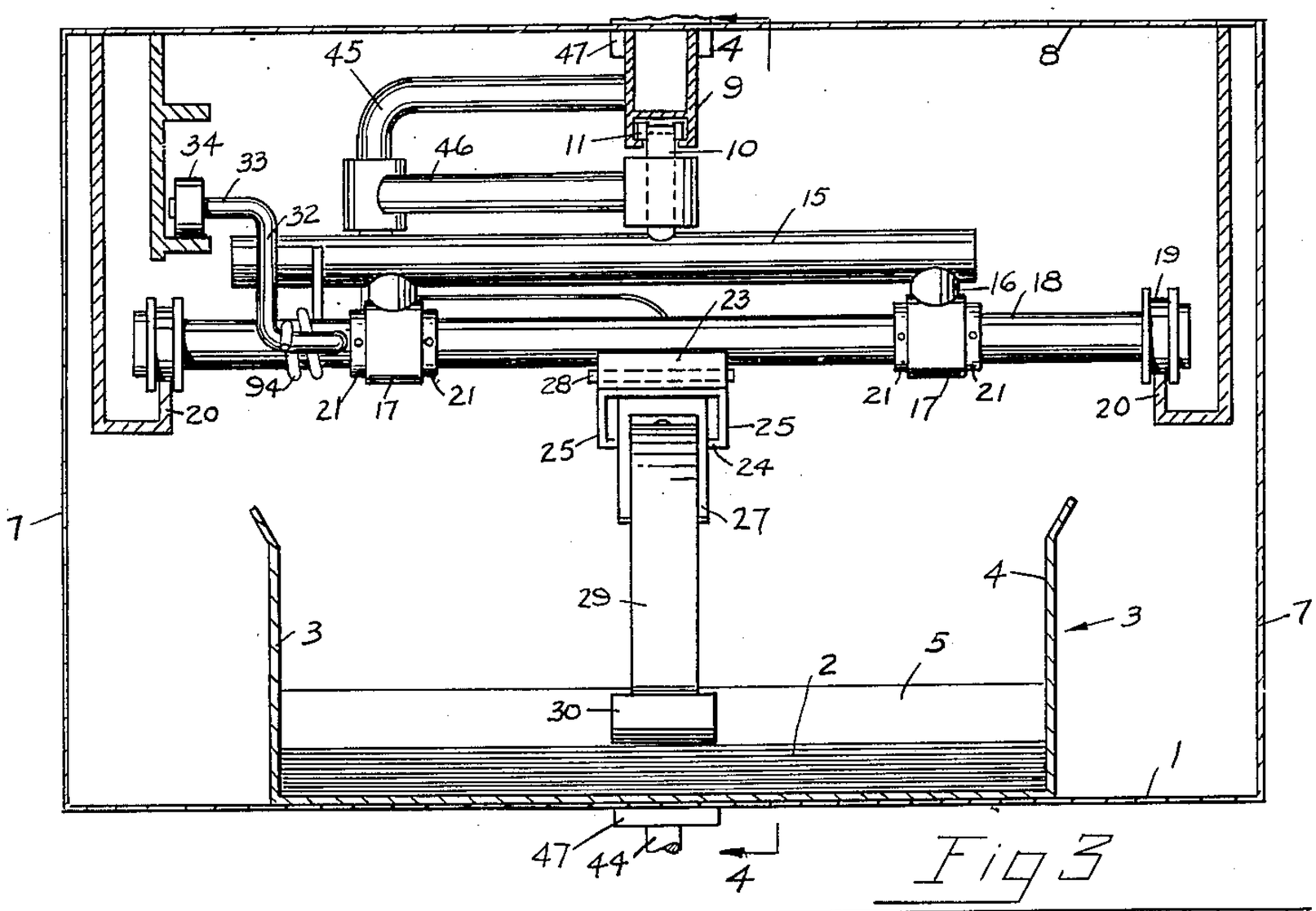

Fig 3

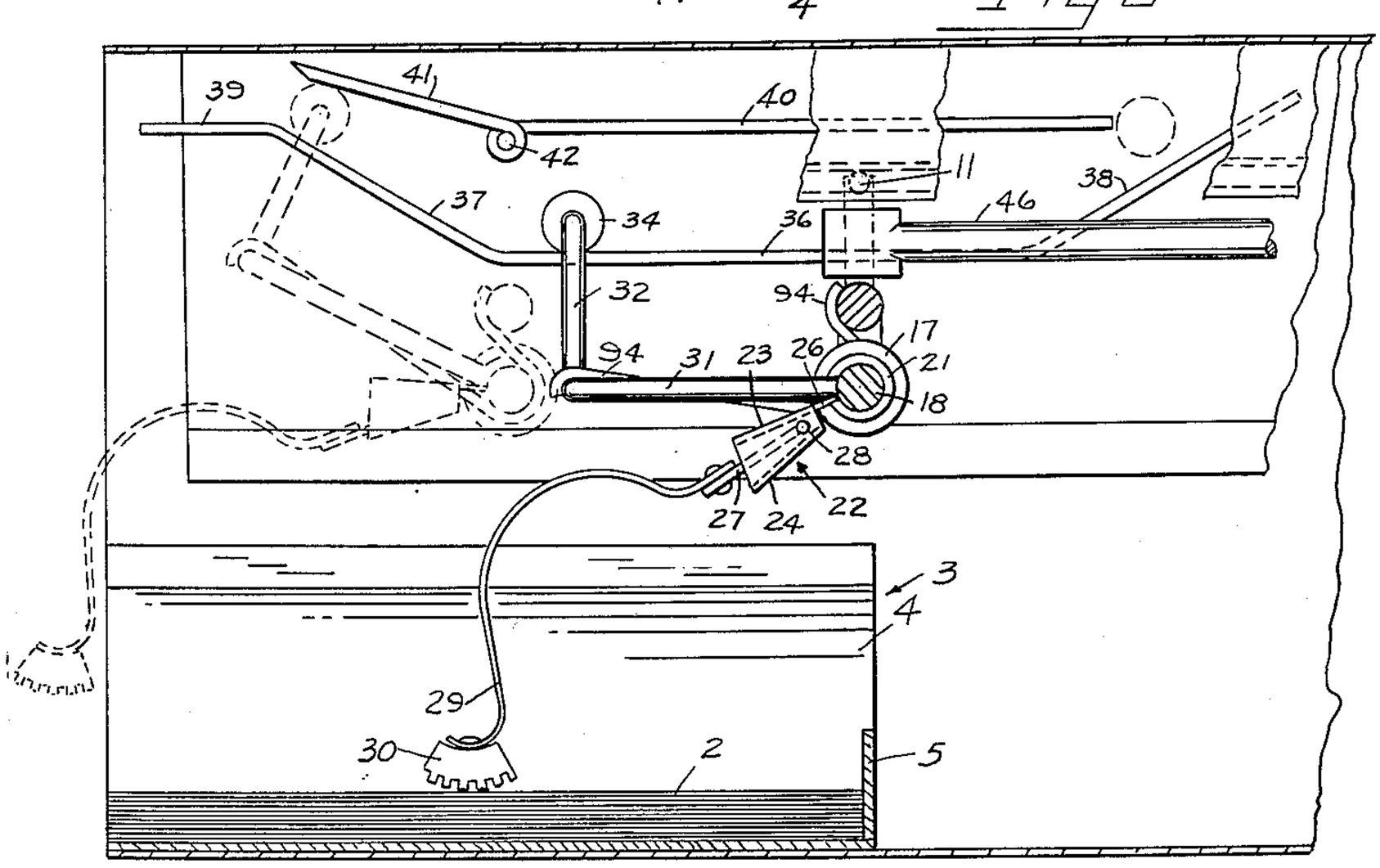

Fig 4

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Filed May 10, 1948 3 Sheets-Sheet 3

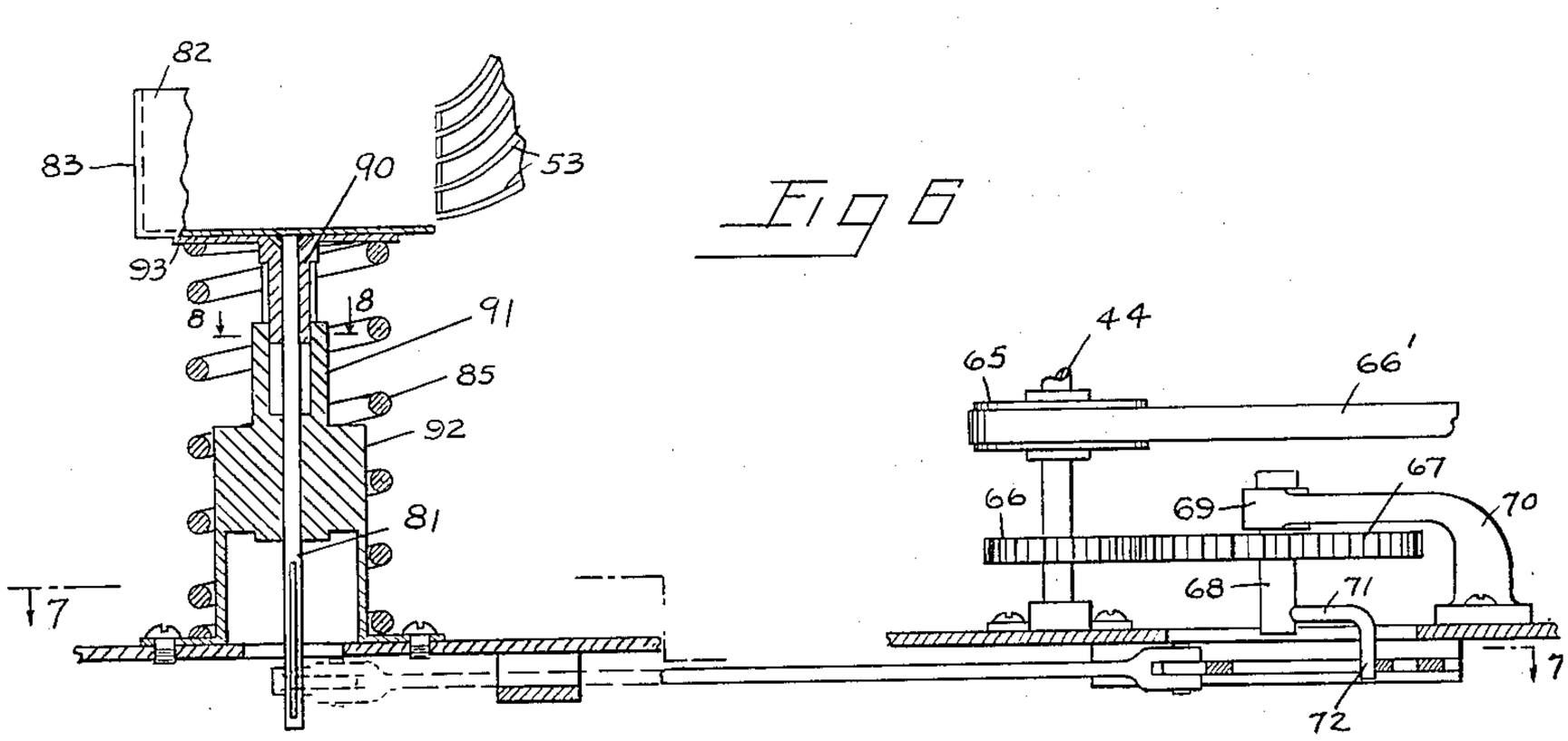

Fig 6

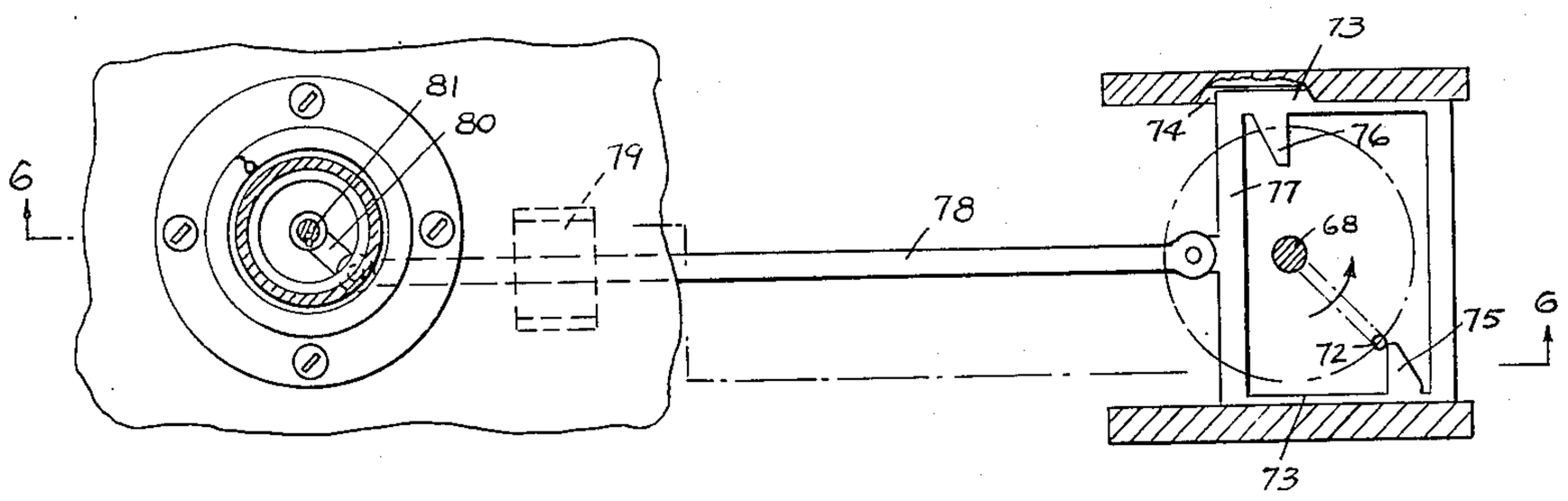

Fig 7

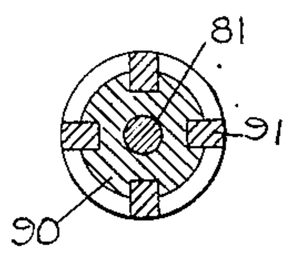

Fig 8

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UNITED STATES PATENT OFFICE

2,624,571

COLLATOR SHEET EJECTING MEANS

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Application May 10, 1948, Serial No. 26,006

5 Claims. (Cl. 270—58)

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This invention relates to collators and has for one of its objects the provision of a collator which will collate sheets more rapidly and efficiently than heretofore and which collator is adapted to be actuated automatically, if desired, without requiring the attention of an operator except for keeping a supply of sheets in the machine.

Another object of the invention is the provision of a collator that is adapted to quickly and completely eject the sheets to be collated from the separate stacks of different sheets and to collate or to gather said sheets in their proper order in sets.

A still further object of the invention is the provision of a collator that is adapted to collate sheets in successive sets in a pile without requiring the attention of the operator for removing each set as collated, and which sets are distinct from each other to facilitate binding.

A still further object of the invention is the provision of a collator that is more economical to make than heretofore and that is reliable and efficient.

An additional object of the invention is the provision of improved ejector means in a collator that is adapted to efficiently and quickly eject the uppermost sheets from a plurality of stacks in proper order and to collate the same.

Heretofore most collators require an operator to withdraw sheets from stacks. The machines are designed to partially remove the sheets and the operator than grasps them and pulls them from the stacks arranged in their desired order, or else the operator must manually hold the sheets as they are ejected. Some ejectors intermittently remove sheets in successive movements. Such devices are relatively slow and require the constant presence of an operator.

With the present invention, the sheets are fully ejected from their stacks in one stroke of the ejectors and automatically fall in order in a set.

Means is provided so that each set is shifted after ejection of the sheets to form the set, and subsequently ejected sets will be offset relative to the preceding set, thus enabling the sets to maintain their identify. In this manner the operator merely keeps sheets in the collator and the rest is automatic.

Also, by the present invention, the sheets can be stapled as collated and this stapling operation may be automatic with each set. The operator merely removes each stapled set and sees that a supply of sheets are in the collator.

The present invention further provides a simple

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structure whereby the respective sheets in the collator can be ejected at slightly different times in order to arrive at a predetermined point at the same time where the travel to said point is by gravity.

Other objects and advantages will appear in the specification and in the drawings.

In the drawings, Fig. 1 is a semi-diagrammatic side view of a collator, certain parts being broken away and in section.

Fig. 2 is a top plan view of the collator of Fig. 1.

Fig. 3 is an enlarged sectional view taken through one only of the sections of the collator that contains one stack of sheets, said section being taken along line 3—3 of Fig. 2, the sheets being indicated by parallel lines and not in section.

Fig. 4 is a fragmentary sectional view taken along line 4—4 of Fig. 3, the sheets being indicated by parallel lines instead of being shown in section.

Fig. 5 is a semi-diagrammatic view of a stapler that may be used, including an electrical circuit in which it may be positioned for automatic actuation thereof by actuation of part of the collator.

Fig. 6 is a fragmentary enlarged sectional view of the receiver that may be part of the collator, including means for actuating the same so as to cause each successive set of collated sheets to be shifted relative to the set that has been collated immediately prior thereto.

Fig. 7 is a sectional view taken along line 7—7 of Fig. 6.

Fig. 8 is an enlarged sectional view taken along line 8—8 of Fig. 6.

In detail, the collator comprises a plurality of superposed vertically spaced shelves 1 on each of which is adapted to be positioned a stack of sheets 2.

The sheets in each stack are the same but the sheets in each stack differ from those in the other stacks. In actual practice, assuming a five sheet booklet has been published, the top shelf in the collator of Fig. 1 will carry a stack of the first sheets, the next shelf will carry a stack of the second sheets, and so on to the fifth shelf which will carry a stack of the fifth sheets.

A holder generally designated 3 may be part of each shelf or supported thereon for holding each stack of sheets, which holder has opposed side walls 4 and an end wall 5 (Fig. 3). The spacing between side walls 3 should be such that the sheets 2 snugly fit between said side walls so that

the two oppoite side edges of each sheet have fricitional engagement with said side walls. This arrangement enables the top sheet in each stack to be ejected therefrom by sliding it off the remainder of the stack without effecting double feeding, which is the discharge of two sheets or more at a time instead of one.

The main shelves 1 are spaced from each other by opposed side frame walls 7 (Fig. 3) and which walls may connect adjacent pairs of shelves, although preferably a top wall 8 extends between the upper edges of said frame walls.

Centrally depending from each top wall 8 is a horizontally extending downwardly opening channel member 9. This member 9 extends longitudinally of the sheets 2 therebelow and preferably centrally over such sheets.

A vertical stub shaft 10 extends upwardly into said channel member through its open side and carries a roller 11 on its upper end within said member. The free edges of said channel member extend toward each other below said roller thus retaining the latter within said member.

The lower end of shaft 10 is rigidly secured to a horizontally extending bar 15 that is at right angles to the channel member 9 and that is spaced below said member a sufficient distance for pivotally connecting one end of a connecting rod to said shaft, as will later be explained.

The bar 15 has a pair of arms 16 depending therefrom, which arms have axially aligned sleeves 17 at their lower ends through which a shaft 18 rotatably extends in parallel relationship to bar 15.

This shaft 18 has wheels 19 at its opposite ends, which wheels have peripheral grooves for parallel tracks 20 that may be suspended from the top 8. In this manner the shaft 18 and bar 15 are supported for reciprocable movement over shelf 1 and the stack of paper 2 adapted to be supported on said shelf within holder 3. Also the shaft 18 is rotatable relative to the bar 15. Collars 21 secured to shaft 18 at opposite sides of one of the sleeves or bearings 17 prevent end motion of shaft 18.

Directly below the stub shaft 10 on shaft 18 is secured a hollow generally conical body 22 disposed with its smaller end adjacent shaft 18 and with its larger end directed forwardly and downwardly as best seen in Figs. 3, 4.

The top wall 23 and bottom wall 24 of this body 22 are flat and extend convergently toward the shaft 18 from the larger end of said body. The side walls 25 are parallel and vertical and connect the corresponding side edges of said top and bottom walls. An extension 26 of top wall 23 connects the body 22 rigidly with shaft 18.

A short strip 27 extends into the larger open end of the body 22 being horizontally pivoted at 28 to sides 25 centrally between the top and bottom walls 23, 24. The strip 27 projects from the larger open end of the body and is free to swing up and down within the limits of the top and bottom walls 23, 24.

Secured to the projecting end of said strip 27 is a bowed leaf spring 29 having its bowed or convexly curved side facing generally toward the open end of shelf 1 in direction away from the end wall 5 of the holder 3. This spring extends generally downwardly and toward said open end and carries a shoe or finger 30 of friction material, such as rubber, at its lower forward end, which finger may have a corrugated downwardly facing surface of generally convex contour in direction longitudinally of the sheets 2 with the uppermost of which said lower surface is adapted to engage.

Secured to the shaft 18 adjacent one of its ends is one end of a horizontally extending arm 31 that projects forwardly from said shaft, it being understood that the term forwardly is used with respect to the open side of the shelf which is the forward side of the same. This arm 31 then extends upwardly at 32 and laterally at 33 toward the side wall 7 adjacent thereto (Figs. 3, 4). On the outer end of the lateral extension 33 is a wheel 34.

Wheel 34 is adapted to roll on a horizontal guide track 36 that extends slantingly upwardly at its forward and rear ends as at 37, 38 respectively (Fig. 4). The horizontal track 36 is parallel with the tracks 20 and the inclined forward end 37 terminates in a horizontal extension 39.

Above the horizontal track 36 is a second horizontally extending track 40 that is at the same level as the horizontal forward extension 39. This track 40 terminates at its forward and rear ends a sufficient distance from the upper ends of the inclined portions 37, 38 to permit the wheel 34 to pass between the ends of said track 40 and said upper ends of inclined portions 37, 38.

Bridging the space between the forward end of track 40 and the upper end of the inclined portion 37 is a track section 41 that is horizontally pivoted to track 40 at 42, the end of the latter adjacent the inclined portion 37.

The entire assembly of elements 11 to 34, except for tracks 20, vertically forms travelling carriage that is supported on tracks 20 for reciprocation over each shelf 1. This carriage constitutes the sheet ejector mechanism. It will be seen that when the carriage is at the forward end of the shelf the wheel 34 will travel upwardly on the inclined track 37, thus rotating shaft 18 and causing the body 22 that carries the spring 29 and shoe or finger 30 to be elevated as indicated by dash lines shown in Fig. 4. The wheel 34 will lift the pivoted track section 41 which will fall behind the wheel as soon as the latter is on the horizontal track extension 39. Then when the carriage is moved rearwardly or in a reverse direction, the wheel 34 will roll over the section 41 and onto track 40 until it rolls off the rear end of the track and onto the downwardly inclined track section 38. During this rearward travel the actual sheet ejector, which is the shoe or finger 30, is elevated off the stack of sheets 2. Spring 94 holds wheel 34 against the tracks.

There is a similar ejector mechanism, including the ejector 30, over each of the shelves 1. These ejectors are simultaneously actuatable for reciprocation by means of a vertical crank shaft 44 having a crank 45 for each ejector.

Each crank 45 is connected with the stub shaft 10 on each ejector mechanism by a connecting rod 46.

The crank shaft 45 may be journalled for rotation in suitable bearings 47 carried by the shelves 1 and top walls 8, and upon rotation of said shaft by any suitable means, such as a hand crank 48 or by a motor, the ejector mechanisms over the shelves 1 will be reciprocated and upon each ejection stroke the ejectors 30 will engage the uppermost sheet of each stack on the forward movement of each ejector, and will completely eject such sheet from the stack. The throw of the cranks is sufficient to cause such ejection and an important feature in this is the fact that the ejectors 30 are elevated to clear

the uppermost sheets while they are moving in a forward direction in the ejection stroke.

It has also been found that the engagement between the ejectors and the uppermost sheets during the ejection stroke is highly desirable, rather than having the ejector engage the sheet and then move in said direction from a stationary start. The top sheets readily slip off the under sheets if the ejectors are moving in the ejection stroke when they engage the top sheets. During the return stroke of the ejectors, they are lifted clear of the stack.

It is also important to note that the ejectors 30 are gravity actuated to follow the level of the stack as the sheets are discharged. This is due to the pivotal connection between the ejector and the body 22 of each ejector mechanism. The degree of pivotal action under the influence of gravity is sufficient to enable a large number of sheets to be placed on each shelf and automatically ejected.

It has also been found that the particular arrangement of the bow spring arm 29 is important. A straight arm or one that is differently bowed does not give the desired results. With the structure herein described, there is a yieldability in the arm during the time the ejector is ejecting a sheet and particularly at the moment of the engagement between the ejector and the sheet during said ejection stroke.

The cranks 45 are preferably sections of the crank shaft being rigidly, but adjustably coupled together by any suitable conventional couplings 50 which may be secured to the adjacent ends of the crank sections by set screws or the like so that the cranks need not be necessarily aligned one above the other but may be offset relative to each other as indicated in the dash lines in Fig. 2.

The provision of the sectional crank shaft enables adding more cranks in the event of adding more shelves, or else sections may be as readily removed where less shelves are required. In other words, one user may never use more than three sheets, in booklets he may publish, in which instance he would only require three shelves and three cranks, whereas another may publish booklets containing ten sheets or more, in which case the number of shelves and cranks would correspond with the maximum number of sheets in the booklet. Of course, in most instances, the user may prefer two or more collating operations for a booklet of say ten or fifteen sheets, in which case he could use the five shelf collator for collating pages 1 to 5 and 5 to 10 and 10 to 15 in three operations, or else he could use a three shelf collator five times, if desired. In any event, whether three, five, ten or any number of shelves were used, the sectional shelf and crank arrangement would enable adding to or subtracting from the equipment already owned, as the case might be.

Extending from each shelf 1 is a chute 55, and said chutes extend to a receiver 56 where the chutes discharge the sheets thereon into said receiver in the order in which the sheets are in the collator. Inasmuch as the discharge ends of the chutes are substantially lower than the shelves, the sheets will move by gravity down the chutes and into the receiver. The lower shelf is much closer to the receiver than the upper shelf and while the chute from the upper shelf is steeper than the chute from the lower shelf, the sheet from the lower shelf reaches the receiver in a shorter time than the sheet from

the upper shelf, and the sheets from the intermediate shelves reach the receiver at slightly different times. This may be compensated for by adjusting the cranks relative to each other about the axis of the crank shaft as seen in Fig. 2.

While the cranks move simultaneously in the ejection stroke, the ejectors do not necessarily discharge the sheets at the same time. The times of discharge are regulated through adjustment of the cranks so that the sheets will be discharged into the receiver at substantially the same time whereby they will be in the proper order in the receiver.

The sides of the receiver shown in Figs. 1, 2 are vertically slotted to enable manual removal of the sets of sheets discharged into the receiver.

Where an operator is in attendance to remove the sets, an automatic stapler 57 may be used. This stapler has the usual upper and lower jaws pivotally connected for swinging together and for stapling together sheets between said jaws.

The stapler is positioned at the side of the receiver opposite the discharge ends of chutes 55 and the sheets that are discharged into said chute automatically enter the space between the jaws of the stapler. A rotary switch 58 having a contact 59 revolvable with shaft 44 will close the solenoid circuit 95 after a set of sheets has been deposited in receiver 56, thus actuating the solenoid 60 for actuating the stapler, thereby stapling the set of sheets.

Usually the arrangement shown in Figs. 6 to 8, or the equivalent thereof, is preferred inasmuch as no attendant is necessary, although the stapling operation is not performed in this form.

The crank shaft 44 may have a pulley 65 thereon connected by a belt 66' with any suitable source of power (not shown) such as the reduction gear box of a motor.

Secured on shaft 44 is a pinion 66, the teeth of which are in mesh with the teeth of a gear 67. The ratio between pinion 66 and gear 67 is preferably two to one, whereby two revolutions of pinion 66 will effect one revolution of gear 67.

The gear 67 is secured on a shaft 68 that in turn is journalled in a bearing 69 carried by a rigid frame 70. Said shaft is provided with a radially projecting arm 71 having a depending vertical pin 72 on its outer end.

This pin 72 is revolvable between the arms 73 of a yoke that is slidable in guides 74. On the opposed sides of arms 73 are projections 75, 76, one on each arm, and which projections are so positioned that the pin 72 in revolving in the direction of the arrow (Fig. 7) will engage the projection 75, thus moving the yoke to the right (as seen in Fig. 7) for a limited distance during a portion of one half the revolution of said pin and during the same portion of the other half of said revolution the pin will engage the projection 76, moving the yoke a predetermined distance in the opposite direction. Thus, during one revolution of the pinion 66 the yoke will be moved in one direction and during the next revolution of said pinion the yoke will be moved in the opposite direction. The degree of movement of the yoke will depend upon the length of the projections and the distance of pin 72 from the shaft 68.

The yoke arms 73 are connected at one of their ends by a cross head or bar 77 and a connecting rod 78 is pivotally connected at one end with said bar. This rod 78 is reciprocable in a bear-

ing 79 and the end opposite the yoke is connected to the outer end of a lever arm 80 that is secured at its other end to a vertical rotary shaft 81.

Shaft 81 carries a two sided receiver 82 at its upper end position so that sheets from the chutes 53 will drop onto the bottom of said receiver when one open side of the receiver is adjacent the discharge ends of the chutes. A quarter turn of the shaft 81 will position the other open side of the receiver adjacent said chutes.

One of the two closed sides 83 will stop the sheets discharged into the receiver when the receiver is in either one of the above two positions.

After one actuation of the ejectors 30 and after the sets of sheets have been discharged into the receiver, the rotation of shaft 44 will cause the yoke arms 73 to be moved in one direction for effecting a quarter turn of the shaft 81 and receiver 82. Then the next revolution of shaft 44 will cause a second set of sheets to be ejected into the receiver crosswise of the first set and the yoke arm will be moved in the opposite direction and the cycle will be repeated.

As the weight of the sets ejected into the receiver increases, the receiver will be automatically lowered by compressing spring 85. A splined connection between shaft 81 and lever 80 permits this lowering of the receiver.

As seen in Fig. 6, the shaft 81 is rotatable in an upper bearing 90 that is splined to an upward extension 91 on a lower bearing 92. This upper bearing has a radially outwardly projecting flange 93 on which the receiver is rotatable, the spring 85 being stationary and stationarily engaging the under side of said flange 93. Thus the flange 93 constitutes a support for the receiver as well as a thrust bearing.

In the use of a rotatable receiver connected in synchronism with the ejectors, the shelves may be loaded with sheets and the motor started, and no further attention need be given, except to keep sheets on the shelves. In most instances the shelves will carry the full run of sheets and the "play" between spring arms 29 and the members 22 enables each ejector 30 to follow each stack of sheets by gravity from the top to the bottom and the capacity of each shelf is upwards of a thousand sheets.

The detailed description and drawings are not intended to be restrictive of the invention to the precise details so shown and described, inasmuch as it is obvious that certain variations may be made without departure from the invention. Different mechanical movements can be employed to oscillate the receiver, and the latter may be lowered by positive mechanical means, if desired, although the form shown is preferable.

We claim:

1. A collator comprising a plurality of superposed shelves open at one of their corresponding ends, each shelf being adapted to support a stack of sheets thereon, an ejector over each shelf supported for reciprocation in a direction toward and away from said open end of each shelf, each of said ejectors being gravity actuated for downward movement into engagement with the uppermost sheet of each stack during each ejection stroke toward said open end, a mechanism including guide means for automatically elevating each ejector from each stack at the end of each ejection stroke and for holding each ejector elevated during the return stroke between each ejection stroke, means for releasing each ejector for downward movement by gravity into engagement with the uppermost sheet in each stack at the end of each said return stroke, each ejector including a bowed spring arm having a friction finger of relatively soft friction material at one end for engaging each sheet, and the opposite end being pivoted for downward swinging of said finger by gravity, said spring arm extending generally upwardly from said finger and bowed in direction of movement of the same during the ejection stroke, a horizontally reciprocable carriage for each spring arm to which said opposite end of each arm is pivoted and means for reciprocating each of said carriages in said direction toward and away from said open ends of said shelves.

2. A collator comprising a plurality of superposed shelves open at one of their corresponding ends, each shelf being adapted to support a stack of sheets thereon, a vertical crank shaft adjacent the ends of said shelves opposite their open ends, an ejector over each shelf supported for reciprocation toward and away from the open ends of said shelves, cranks on said shaft respectively connected with said ejectors for causing said reciprocation of the latter, the throw of each of said cranks being sufficient to effect complete ejection of the uppermost sheet of each stack by each ejector upon each revolution of said crank shaft, said cranks being relatively offset to effect successive ejection of said uppermost sheets during rotation of said shaft means pivotally supporting each ejector for downward swinging by gravity into engagement with the uppermost sheet of each stack during the ejection stroke thereof, and means for elevating each ejector clear of the stack therebelow during the return stroke of each ejector.

3. A collator comprising a plurality of superposed shelves open at one of their corresponding ends, each shelf being adapted to support a stack of sheets thereon, a vertical crank shaft adjacent the ends of said shelves opposite their open ends, an ejector over each shelf supported for reciprocation toward and away from the open ends of said shelves, cranks on said shaft respectively connected with said ejectors for causing said reciprocation of the latter, the throw of each of said cranks being sufficient to effect complete ejection of the uppermost sheet of each stack by each ejector upon each revolution of said crank shaft, means pivotally supporting each ejector for downward swinging by gravity into engagement with the uppermost sheet of each stack during the ejection stroke thereof, and means for elevating each ejector clear of the stack therebelow during the return stroke of each ejector, said shaft being in sections with a crank in each section, and means removably securing said sections together whereby said shaft and the number of cranks may be varied in length and number as may be desired.

4. A collator comprising a plurality of superposed shelves open at one of their corresponding ends, each shelf being adapted to support a stack of sheets thereon, a vertical crank shaft adjacent the ends of said shelves opposite their open ends, an ejector over each shelf supported for reciprocation toward and away from the open ends of said shelves, cranks on said shaft respectively connected with said ejectors for causing said reciprocation of the latter, the throw of each of said cranks being sufficient to effect complete ejection of the uppermost sheet of each stack by each ejector upon each revolution of said crank shaft, said cranks being relatively

offset to effect successive ejection of said uppermost sheets during rotation of said shaft means pivotally supporting each ejector for downward swinging by gravity into engagement with the uppermost sheet of each stack during the ejection stroke thereof, and means for elevating each ejector clear of the stack therebelow during the return stroke of each ejector, said last mentioned means including an upwardly movable arm connected with each ejector for swinging said ejector upwardly upon upward movement of said arm, and guide means rigid relative to each shelf engageable with each arm for causing said upward movement of the latter at a point immediately prior to the end of the ejection stroke of each ejector.

5. A collator comprising a plurality of superposed shelves open at one of their corresponding ends, each shelf being adapted to support a stack of sheets thereon, an ejector over each shelf supported for reciprocable movement toward and away from the open ends of said shelves, said ejector being movable into engagement with the upper sheet of the stack therebelow during the ejection stroke of said ejector toward said open ends, means for elevating said ejector during its return stroke, means connected with said ejectors for causing said reciprocable movement, said movement of said ejectors during said ejection stroke of each being sufficient to fully eject the sheet engaged thereby, a chute for each ejected sheet extending from the open side of each shelf to point for discharge of said sheets

from said chutes one above the other in the same order as their order on said shelves, a receiver at said point for receiving the sheets discharged from said chutes, said means for causing said reciprocable movement being a plurality of superposed cranks in axial alignment and a connecting rod connecting each crank with one of said ejectors, means for varying the positions of said cranks relative to each other for varying the time of ejection of the sheets from said shelves during each reciprocable movement of said ejectors.

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