

May 10, 1960

W. W. DAVIDSON

2,936,167

COLLATOR

Filed March 29, 1957

5 Sheets-Sheet 1

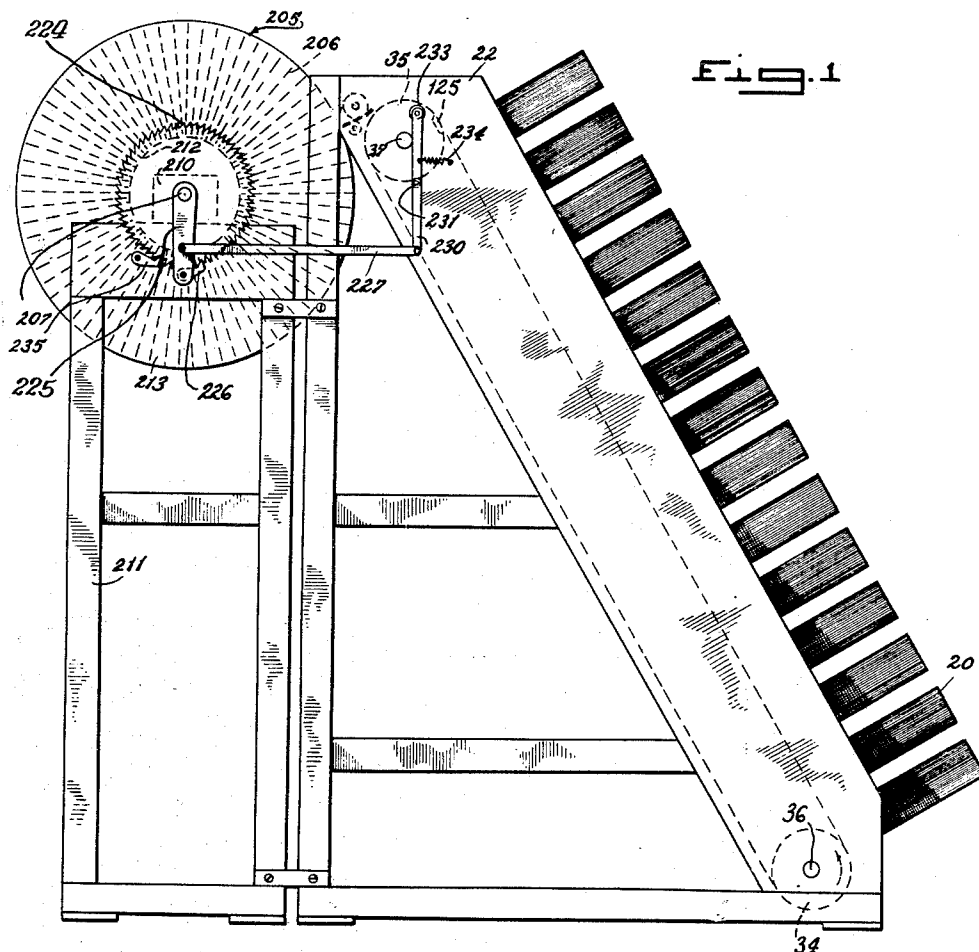


Fig. 1

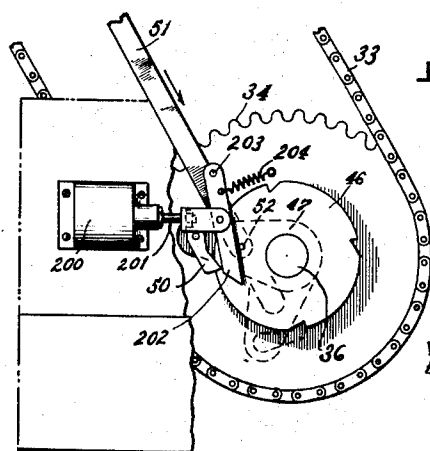


Fig. 3

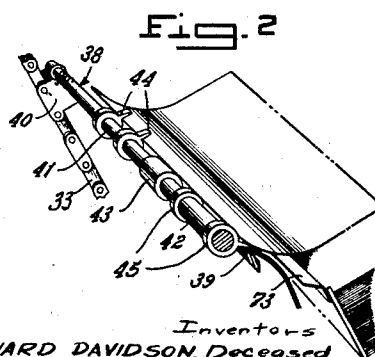


Fig. 2

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5 Sheets-Sheet 3

Fig. 6

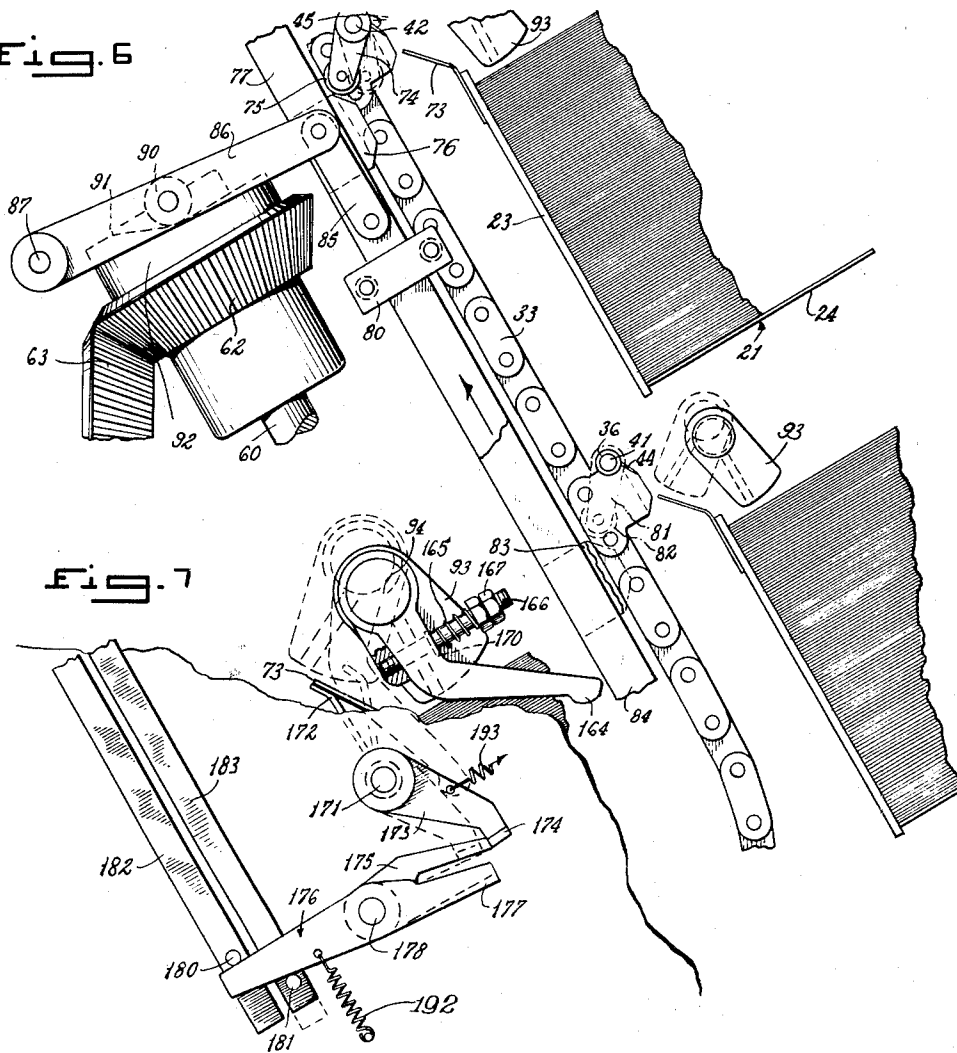


Fig. 7

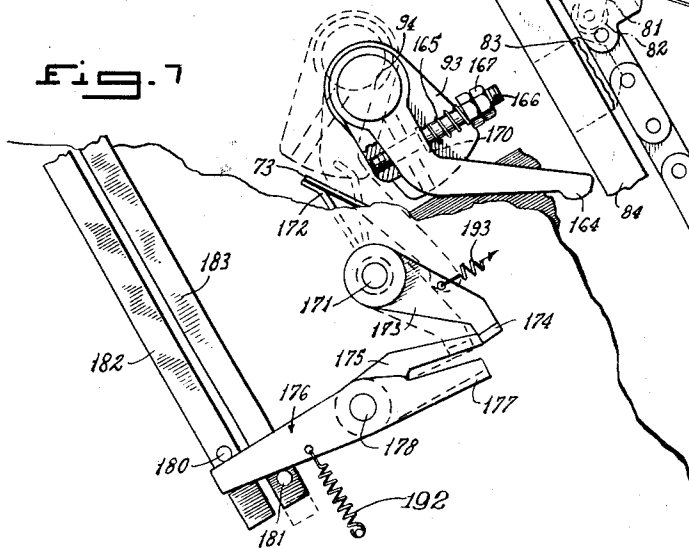
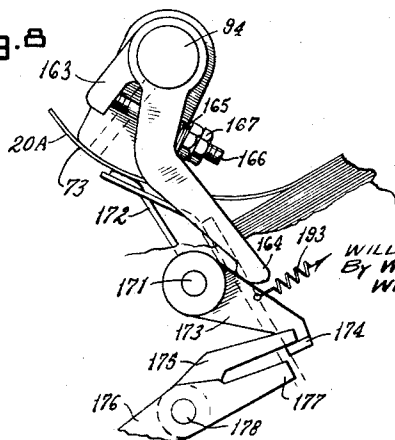


Fig. 8



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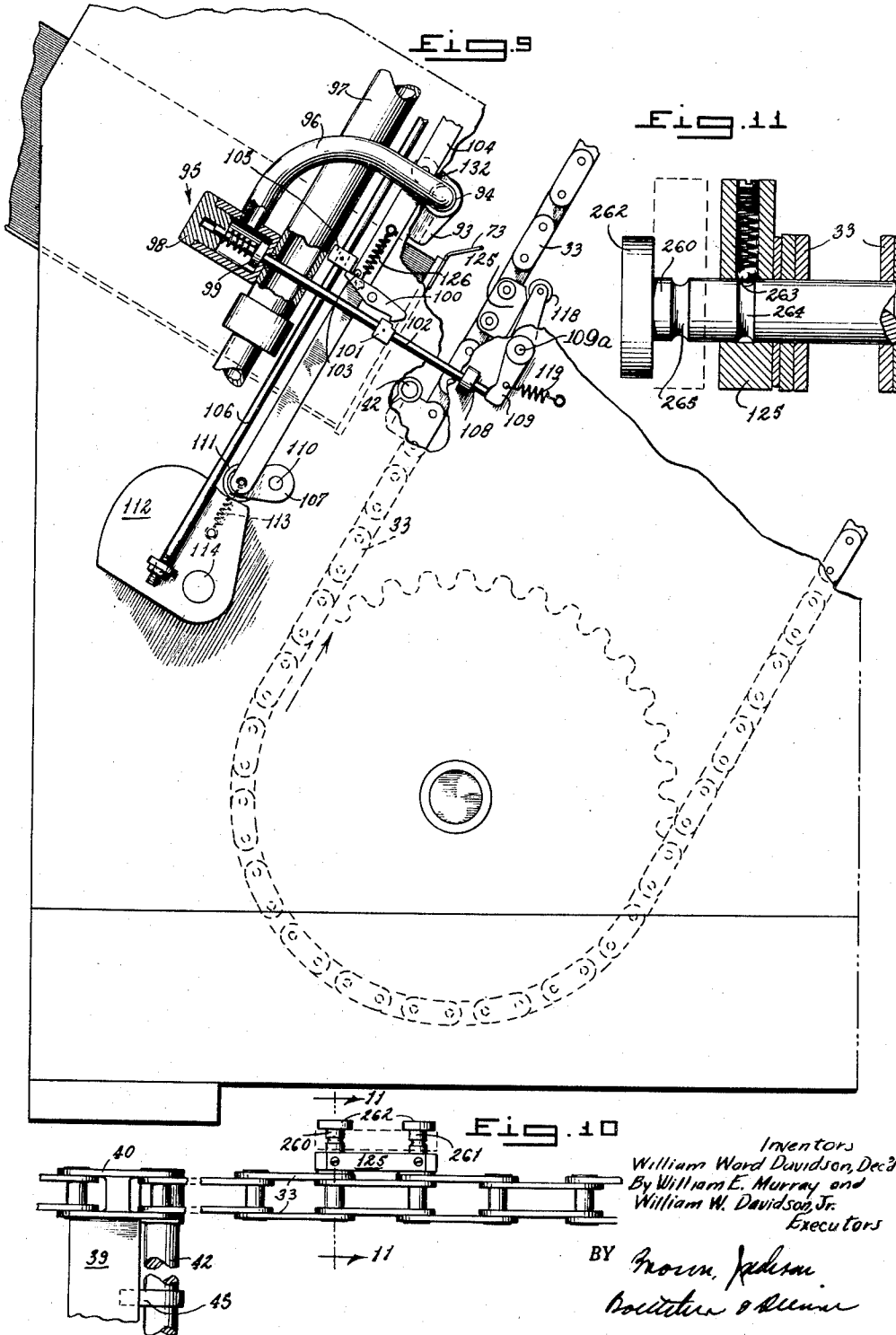
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5 Sheets-Sheet 4



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5 Sheets-Sheet 5

Fig. 12

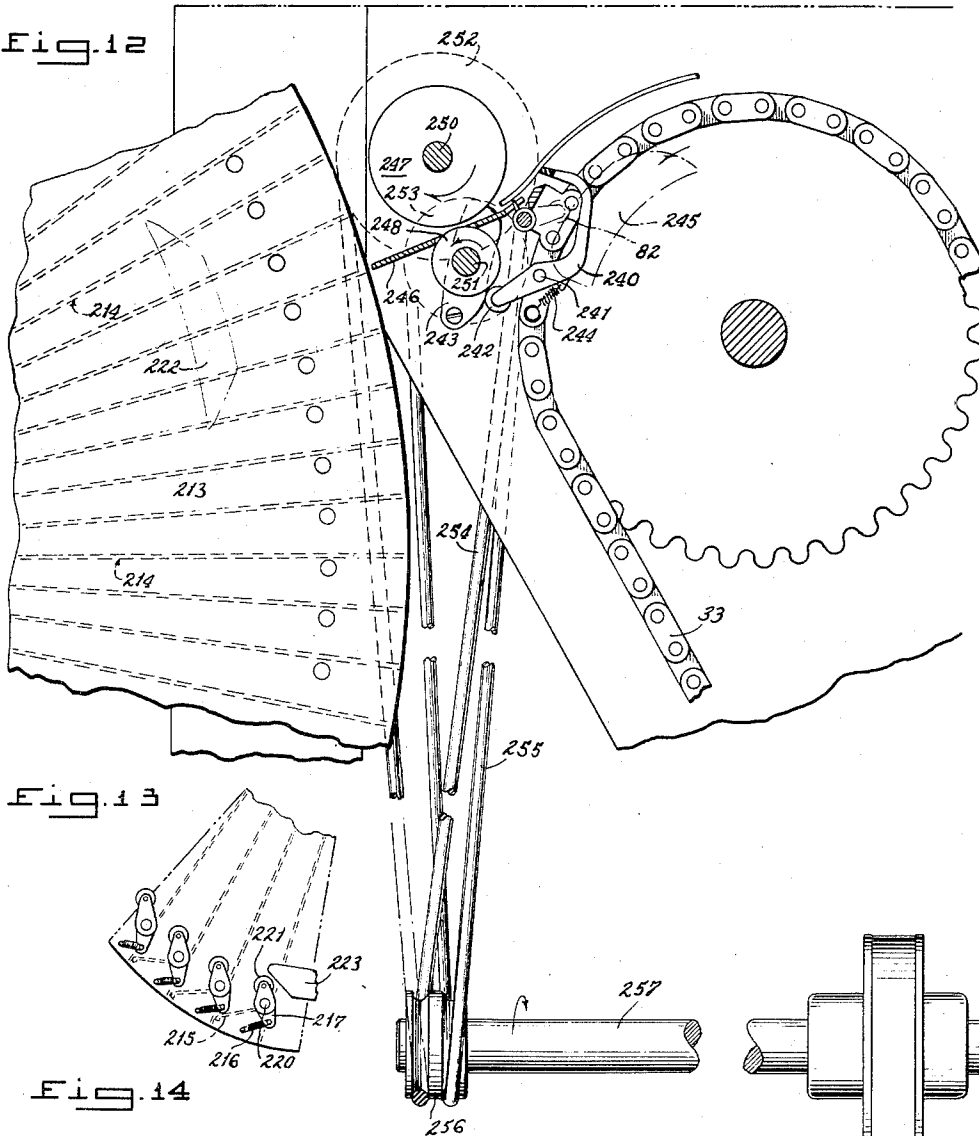


Fig. 13

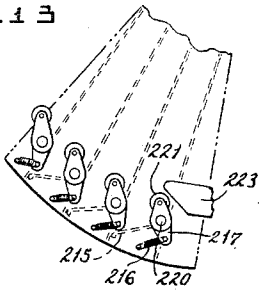
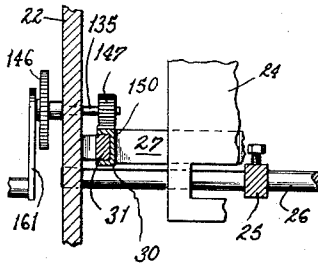


Fig. 14



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2,936,167

COLLATOR

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Application March 29, 1957, Serial No. 649,564

10 Claims. (Cl. 270—58)

This invention relates to devices and mechanisms designed particularly to provide for the collating of single sheets of paper and the like.

The need for a successful automatic device for collating sheet materials in a designated and desired sequence has been long felt and recognized. Without dwelling on the details and defects of prior devices of this character, suffice it to say that previous devices for collating sheet material have been unduly cumbersome, expensive to manufacture and complex to operate.

The device of the present invention is intended to provide new and improved collating mechanism which is particularly adapted for the collating of single sheets in a rapid and efficient manner and includes means to insure the positive assembly of loose leaf materials in a designated and preselected sequence, as desired.

In brief, the collating machine is arranged to handle several thousand sheets of material at one time while occupying a minimum amount of space. This is accomplished by arranging the device so that a line extending along the path of sheet advance, forms an obtuse angle with the horizontal on which the mechanism is positioned. It is further contemplated and intended that collating installations employing the improved device will embody a plurality of such devices positioned closely adjacent to one another, so as to present compact banks of collating devices which work in conjunction with each other to perform an overall collating operation. The new collating device is also constructed to accommodate sheet lengths which are greater than the distance between successive feeding stations. Mechanism is provided to avoid missing sheets from any feeding station and for automatically insuring that a group of such sheets, collated according to a preselected sequence, are complete as a unit prior to their discharge from the collator.

The machine, in brief, embodies a pair of rotatable endless carrier members which are spaced by multiple sheet gripper devices extending therebetween; the distance between sheet gripper devices being the distance between plural sheet holding units comprising feeder stations. The number of such sheet gripper devices further is substantially twice the number of sheet holding units, plus additional gripper bars, as required, to permit the total length of each endless carrier member to extend around pairs of circular carrier wheels. The total arrangement of the carrier system is to provide straight line travel of the gripper devices adjacent to and past the sheet holding units provided.

Means are provided additionally for advancing the sheet gripper devices in the endless carrier members a distance equal to the distance between adjacent sheet holding units or feeding stations. At each such point of arresting the endless carrier members, individual sheets are fed to the gripping devices from the sheet holding units. Each sheet gripping device includes two sets of sheet gripper members and provides for their separate alternate opening and closing. Thus, a gripping device is successively presented before each sheet holding unit where one set of sheet gripper members thereof is opened and the other is closed. Means are included whereby a sheet of material is thrust from the sheet holding unit into the open set of sheet gripper members, such sheet being fed over the edge of the closed gripper member. Such filled gripper member is then advanced to the next

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feeding station. During the advancing movement, the sheet gripper members which were last closed remain closed, and the alternate sheet gripper members over which the last sheet was fed are opened flipping up the edge of the sheet. This last named gripper member remains open while the next succeeding sheet of the collated sequence is fed thereto. By so advancing the sheet gripping device past a plurality of sheet holding units or feeder stations one-by-one, the collating of individual sheets in a desired and preselected sequence may be accomplished in a positive manner.

Means are provided for rendering the sheet gripping members on every other gripper device inoperative, and means are also provided for rendering the sheet feeding means at each holding unit or feeding station inoperative according to the inoperative gripper devices. One purpose of so altering the normal operation of the sheet feeding and gripping devices is to accommodate sheets having a length greater than the distance between sheet holding units or feeder stations. If the length of the sheets is not accommodated by rendering every other gripper device inoperative, then the functioning of two or more successive gripper devices is interrupted, as required.

Sensing mechanism to operate in association with each holding unit or feeder station is also provided to detect the failure of a sheet to be fed properly into the related sheet gripping devices. Such mechanism operates (in case of failure) to properly feed to any one gripping device and effectively to prevent closing of the sheet gripper and the advancement of the gripper device until the failure has been corrected.

In association with the collating mechanism, there is also provided a rotatable wheel containing plural storage pockets adapted to be indexed opposite the point at which the collated sheets are ejected from the collating mechanism as a unit. During such ejection, the wheel remains stationary to receive a collated unit in one of its pockets. After having so received the collated sheet unit, the rotatable means is indexed a preselected amount to present the next adjacent pocket for receiving the next ejected collated unit. Means are provided whereby the rotatable advancement of succeeding pockets of this mechanism is in response to the operation of the gripper bars of the associated collating mechanism; such rotatable advancement being inoperative, according to the inoperative gripper devices, thereby to accommodate sheets of a length greater than the normal spacing between feeder stations of the collating mechanism. The rotatable advancement of such pockets is also rendered inoperative when the advancement of the gripping devices on the collating mechanism is inoperative due to the failure of a sheet to be fed properly to an open gripping device. Means are additionally included for the automatic discharge of the collated units from the pockets of the rotatable wheel member and for selectively preventing the discharge of such units to accommodate multiple rotation of the rotating member and the presentation of a partially filled pocket to the ejection station of the collator more than once.

The main object of the invention is to provide a new and improved collating apparatus.

A further object of this invention is to provide a new and improved collating apparatus, especially adapted for collating single sheets into compiled units and the further collating of such units.

An additional object of the invention is to provide a new and improved collating apparatus of the character immediately aforesaid, in which endless conveyor means are embodied, including plural gripper devices, each of which gripper devices is equipped with multiple gripper members alternately operable at succeeding feeder stations.

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A still further object of this invention is to provide a new and improved collating apparatus, including multiple feeder stations adapted to discharge single sheets to endless conveyor means carrying multiple gripper members, each of which is suitably timed and coordinated with the operation of the feeder stations, so as to move therebetween and receive sheets thereat.

Another important object of the invention is to provide a new and improved collating apparatus in which endless conveyor means having multiple paper gripper devices, each of which receives a plurality of sheets, is so coordinated and related to multiple feeder stations as to prevent the advancement of a gripper device between feeder stations until a sheet has been properly fed thereto.

A further important object of this invention is to provide a new and improved collator employing endless conveyor means equipped with multiple gripper means, each gripper means being receptive of successive sheets of paper collated and fed thereto at spaced feeder stations, and discharged therefrom at a rotatable means containing a plurality of sheet receptive pockets, said gripper means engaging each successive sheet without relinquishing its grip on the sheet fed thereto previously.

A still additional object of this invention is to provide a new and improved collating apparatus as aforesaid, including a plurality of feeder stations (disposed at an incline to the horizontal) past which an endless conveyor means carrying multiple gripper devices moves, each gripper device receiving a plurality of sheets, so that discharge opening of such gripper devices results in the ejection of a collated unit or set of sheets to a discharge station.

A still additional object of this invention is to provide a new and improved means coordinated with the discharge of the collating unit, as immediately aforesaid, which is capable of receiving a plurality of collated units or sets of collated sheets which it in turn is capable of collating.

A still additional object of this invention is to provide a collator of the type aforesaid, having multiple feeder stations, each of which feeds a sheet of paper to gripper members carried by endless conveyor means bearing multiple gripper members, the spacing between gripper members being substantially equal to the spacing between feeder stations and including selectively operable means for rendering selected feeder stations and gripper members inoperative to accommodate the collating of sheets having a length greater than the normal spacing between feeder stations.

The above and further objects, features, and advantages of the improved collating mechanism will be understood by those familiar with the art, particularly with regard to a preferred embodiment of its concepts and teachings, as set forth in the accompanying drawings.

In the drawings:

Figure 1 is a side elevation of the collator showing the general arrangement of the machine;

Figure 2 is a perspective view showing particularly the gripper mechanism;

Figure 3 is an enlarged segmental view showing the mechanism for transmitting the drive to the chains;

Figure 4 is a partial segmental view with parts broken away showing the feed bin arrangement;

Figure 5 is a detailed view showing the drive mechanism for the various motions in the machine;

Figure 6 is an enlarged view showing the mechanism for actuating the gripper fingers;

Figure 7 is an enlarged detail view showing the sheet detector mechanism in normal position;

Figure 8 is an enlarged view similar to Figure 7 but showing the mechanism in sheet detecting position;

Figure 9 is an enlarged detail view showing the sheet delivery mechanism;

Figure 10 is an enlarged view showing a portion of the

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chain construction, particularly the sheet delivery control cam;

Figure 11 is a view taken along line 11—11 of Figure 10;

Figure 12 is an enlarged segmental view showing the mechanism for delivering the collated sheets from the gripper mechanisms to a receiving device;

Figure 13 is a segmental view showing another portion of the set receiving device; and

Figure 14 is a partial sectional view taken along line 14—14 of Figure 4.

As shown, the sheets of paper 20 or the like to be collated are stacked in a plurality of bins 21 mounted in spaced relationship between two side frames 22 of the machine. For space saving reasons, the bins are disposed at an angle of approximately 45° to the horizontal. Each bin comprises a bottom plate 23, a back plate 24 and two side members 25 (Figures 4 and 6). The side members are mounted for sliding movement on a cross connecting rod 26 so as to be capable of adjustment towards and away from each other in order that sheets of different widths may be accommodated in the bins. The back plate 24 of each bin is connected to a cross member 27 which terminates at each of its ends in the base of U-shaped members 30 (Figure 14) that ride on rails 31 secured to the side frames of the machine. When the bins are in their home or start of operation position, the cross members bank against resilient blocks 32. During the operation cycle, however, they are fed upwardly as the sheets are removed therefrom and in order that they can be so fed until the last sheet is removed therefrom, the cross members are alternately positioned above and below one another with the result that each side plate is provided with two side rails 31 on which the U-shaped members ride.

A pair of endless chains 33 are positioned beneath the bins inside the side plates. Each chain is trained over two sprocket wheels 34 and 35 mounted on shafts 36 and 37, respectively, journaled in the two side frames of the machine. The chains are provided with a plurality of grippers 38 (Figure 2), each of which comprises a cross bar 39 secured at its opposite ends to brackets 40 carried by the chains. Two coaxial shafts 41 and 42, the abutting ends of which are journaled in a coupling 43, are disposed adjacent the cross member and are journaled at their opposite ends in the brackets 40 carried by the chains. Shafts 41 and 42 carry pairs of fingers 44 and 45, respectively, which, when the shaft on which they are mounted is rotated in one direction, serve to clamp a sheet to the cross bar 39 and to release the sheet when the shaft is rotated in the opposite direction. The grippers on the chains are spaced apart a distance equal to the distance between the front ends of the bins which in the present embodiment of the invention is approximately six inches. The shaft 36 which carries the lowermost sprocket wheels 34 also carries an indexing disk 46 (Figures 3 and 5) and an arm 47 having a spring biased pawl 50 which normally is maintained in engagement with the periphery of the disk. The arm is also pivotally secured to one end of a link 51 at connection 52. At its other end, the link is connected to a lever 53 at the free end thereof. At its other end, the lever is pivotally mounted on a stud 54. Intermediate its ends, the lever is provided with a roller 55 that rides in a cam groove 56 formed in a cam block 57 carried by a shaft 60 journaled in bearing blocks 61 secured to the side frames of the machine (see Figure 5).

At one end thereof, the shaft 60 is provided with a bevel gear 62 that meshes with a bevel gear 63 which is keyed to one end of a shaft 64. At its other end, shaft 64 is provided with a sprocket wheel 65. A toothed belt 66 is trained over the sprocket wheel and over a second sprocket wheel 67 carried by a shaft 68 which extends from a gear reduction mechanism 70 coupled to a drive motor 71 by means of a slip clutch 72.

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As the shaft which carries the cam block 57 is rotated by motor 71, the link 51 is reciprocated as the lever carried roller 55 rides in the cam groove 56. On the downward stroke of the link 51, the spring biased pawl 50 carried by the arm 47 engages one of four equally spaced notches in the periphery of the indexing disk 46 to rotate the indexing disk and its associated shaft 36 a quarter turn. On the return stroke of the link, the latch is carried back to its starting position where it engages the next notch in the periphery of the indexing disk. Thus, it is seen that the chains 33 are moved intermittently beneath the bins, and the arrangement of parts is such that when the chain comes to rest a gripper mechanism is positioned adjacent a guide plate 73 at each of the bins.

When the chains 33 thus come to rest, the two fingers 45 on shaft 42 of alternate gripper mechanisms are opened while the two fingers 44 on the related shafts 41 remain closed. Simultaneously the two fingers 45 on the shafts 42 of the intermediate gripper mechanisms remain closed while the two fingers 44 on the intermediate shafts 41 open. To accomplish this, alternate shafts 42 of the gripper mechanisms 38 are provided at their outer ends with a spring loaded lever 74 (Figure 6) carrying a roller 75 which lies in the path of a cam 76 carried by a slide bar 77 slidably mounted in brackets 80 secured to the front side frames of the machine. Bar 77 is provided with a plurality of cams 76, one cam for each lever 74. Thus, there is a cam for the first, third, fifth, etc. bin. When the slide bar 77 is actuated therefore, fingers 45 on the shafts 42 of the alternate gripper mechanisms grasp a sheet which has been fed to the mechanism in a manner to be hereinafter described. In like manner the intermediate shafts 41 of the gripper mechanism 38 are provided with spring loaded levers 81 each carrying a roller 82 disposed in the path of cams 83 carried by a slide bar 84 on the rear side frames of the machine, similar to the arrangement for bar 77. Both of the slide bars are connected to each other by cross rods (not shown) so that they may be translated as a unit. The bar 84 is provided with a plurality of cams 83, one for each intermediate sheet bin. Thus, there is a cam associated with the second, fourth, sixth, etc. bins, and when the bar is actuated the fingers 44 on the shafts 41 of the intermediate gripper mechanisms grasp a sheet which has been fed from the second, fourth, sixth, etc. bins.

The front slide bar carries a link 85 pivotally secured thereto. At its other end, link 85 is pivotally connected to a lever 86 which in turn pivots on a stud 87 carried by the side frame of the machine. Intermediate its ends, lever 86 is provided with a roller 90 which rides on a face cam 91 formed on cam block 92 carried by and coaxial with shaft 60. As shaft 60 is rotated, lever 86 is pivotally oscillated and the slide bars 77 and 84 are reciprocated. As the front slide bar 77 is thus moved in one direction, the cams 76 carried thereby engage the rollers 75 carried by the arms 74 with the result that alternate shafts 42 of the gripper mechanisms are rotated to swing the pairs of gripper fingers 45 thereon away from the gripper bar 39. At the same time the rear slide bar 84 is also moved in the same direction, so that cams 83 carried thereby engage the rollers 82 on arms 81. As a result, the shafts of the intermediate gripper mechanism are rotated to swing the pairs of fingers 44, 44 mounted thereon away from the gripper bar 39 preparatory to gripping sheets from the second, fourth, sixth, etc. bins. Thereafter, when the two bars move in the reverse direction, the reverse action takes place, that is to say, the fingers 45 on the shafts 42 of alternate gripper mechanisms are closed and the fingers 44 on the shafts 41 of the intermediate gripper mechanisms are closed, so that the total effect is to grip a sheet from each bin.

As shown in Figure 9, a pair of suction heads 93 are located in front of each bin. These heads open from a

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pipe 94 which is connected to a suction valve 95 by means of a flexible tubing 96. The suction valve, in turn, opens from a pipe 97 leading from a suction pump (not shown). The suction valve comprises a conventional housing 98 having a spring controlled valve closing member 99 which in turn carries a valve stem 102 that extends through the suction pipe 97 and is journaled in a bearing means 108 carried by the one side frame of the machine. At its free end, the valve stem 102 abuts against one end of an offset lever 109 pivotally mounted between its ends on a stud 109a carried by the main frame of the machine. At its other end, the lever 109 carries a roller 118 which by means of a spring 119 is maintained in the path of a cam 125 secured to one of the chains 33. Normally, valve 95 is maintained closed, and when in this position, a pivotally mounted latch 100 is held out of engagement with a stop block 101 carried by the valve stem 102 so as to engage a stop pin 103 on follower arm 104 as well as a collar 105 carried by a rod 106. The arm 104 is slidably mounted in a guide and at its lower end it is connected to crank 107 pivotally mounted on a shaft 110. Crank 107 carries a roller 111 which is maintained in engagement with a cam 112 by means of a spring 113, one end of which is secured to the arm 104 and the other end of which is secured to the side face of cam 112 mounted on shaft 114.

At its forward end, shaft 114 is provided with two additional cams 115 and 116 (Figure 5), to the latter of which a link 117 is pivotally secured. At its other end, link 117 is coupled to a bell crank lever 120 which pivots on a pivot shaft 121 carried by the front side frame of the machine. The other end of crank 120 is provided with a roller 122 which rides in a cam groove 123 formed in a cam block 124 carried on shaft 60. This arrangement is such that as shaft 60 turns, shaft 114 and the three cams mounted thereon oscillate first in one direction and then in the opposite direction.

As the chains 33 are advanced in step-by-step fashion and the cam 125 (Figure 9) carried thereon passes under the roller 118, the pivotal lever 109 is rotated about its pivot point against the action of spring 119 with the result that the suction valve 99 is opened periodically. Simultaneously, the rearward cam 112 on shaft 114 operates to elevate both the arm 104 and the rod 106 to carry the pin 103 and the collar 105 upwardly away from latch 100. As a result, spring 126 acts to rotate latch 100 and bring it into locking engagement with the block 101 on valve stem 102 to hold the valve 99 open.

When valve 99 is so held open, the suction heads act in their fashion to separate a single sheet of paper from the stack. Thereafter, the suction heads are moved forwardly away from the stack and downwardly to deliver a sheet over guide plate 73 to the opened fingers of the associated gripper mechanism. Accordingly, the hollow shafts 94 from which the suction heads open are journaled at their front ends in a plate 130 (Figure 5) which at its lower end is provided with a roller 131 that is maintained in engagement with the periphery of the cam 115 on shaft 114. As cam 115 oscillates, the hollow shafts 94 are reciprocated with the result that the suction heads are moved towards and away from the paper stacks in the bins. The shafts 94 are provided with links 132 which are pivotally connected to a rod 133. Rod 133, in turn, is provided with a roller 134 which, due to gravity, is maintained in engagement with the periphery of the cam 116 on shaft 114. As this cam is oscillated by shaft 114, the hollow shafts 94 are first rotated in one direction to swing the suction heads downwardly to deliver a sheet to the open gripper mechanism and then in the opposite direction to swing the suction heads back to their initial position.

As stated heretofore, the several bins are arranged to be moved upwardly, this being done to insure that the front sheets in the stacks are always in position to be removed by the suction heads. As shown more clearly in

Figure 5; the staggered shafts 135 are provided with bell crank levers 136. Spring means 137 connects to one arm of such bell cranks to maintain the same in the path of pusher members 140 carried by a reciprocatory bar 141. At its lower end, the bar 141 is pivotally connected to one arm of a bell crank lever 142 by means of a link 143. The bell crank 142 is pivoted on a stud 144 carried by the front side frame of the machine and is provided with a roller 145 which, due to the weight of the bar and its associated parts, is maintained in engagement with the periphery of a plate cam 116 on shaft 114. This arrangement is such that as the cam 116 oscillates, bar 142 is reciprocated upwardly and downwardly. As the bar is thus moved upwardly, the bell crank levers 136 are rotated against the action of springs 137 with the result that the shafts 135 are rotated. As the shafts 135 rotate, ratchet wheels 146 and pinions 147 mounted thereon (see Figure 14) also rotate. As the pinions rotate, the bins are moved upwardly through the agency of racks 150 carried by U-shaped member 30 of cross bar 27 (Figures 4 and 14). At the end of the upward stroke of the bar an overbalanced dog 151 pivotally mounted on bell crank lever 136 engages the ratchet wheels with the result that when the bar moves downwardly, the bins are held in position (see Figure 5).

Means have been provided so that when the bins have been emptied they may be returned to their home positions where they rest against the resilient member 32. This means is best seen in Fig. 5 and comprises arcuate fingers 152 secured to a rod 153 slidably mounted in brackets secured to the front side frame of the machine and positioned adjacent the off-centered dogs 151. A lever 154 pivotally mounted on a stud 155 carried by the front side frame of the machine is provided intermediate its ends with a pin 156 which rides in a small arcuate slot in the rod 153. At the outer end of lever 154 is a handle 154a. A spring 157 secured at one end to a pin 160 on the front frame of the machine and at its other end to the lever 154 serves to maintain the rod 153 in a raised position with the fingers 152 spaced slightly away from the dogs 151. When the lever 154 is turned clockwise against the action of the spring 157, dogs 151 are rocked out of engagement with the ratchet wheels 146 which permits the bins to slide downwardly under the influence of gravity to their home position.

Additional means are provided to pre-position the bins above their home position in the event that less than full stacks of sheets are to be collated. This means simply comprises a lever 161 secured to each of shafts 135 and fitted with a handle 162 by means of which the shafts may be rotated to elevate the bins until the top sheet therein is positioned adjacent the suction heads, as desired.

As a further improvement, means are provided to prevent advance of the chains 33 in the event that the suction heads fail to remove a sheet from any of the bins 21 (see Figures 7 and 8). To accomplish this feature, each of the hollow shafts 94 is provided with a block 163 fixedly secured thereto. Also, each of the hollow shafts is provided with an offset finger lever 164 rotatably secured thereto and maintained in engagement with block 163 by means of compression spring 165 which is fitted over stud 166 and is retained between nuts 167 and seat 170 in the finger lever 164. The stud is threaded into block 163 and passes through a clearance hole (not shown) in the lever 164 (see Figure 7).

A pivot 171 carried by the side frame of the machine supports two arms 172 and 173 projecting from a central hub. One of the arms is in the form of a flat finger 172 and such serves to detect the presence or absence of a sheet being fed from a bin. The finger 172 is located so that, in the absence of a sheet, it will project through a slot in the guide plate 73 adjacent the leading edge of the feed bins 21. The other arm 173 is disposed so that its remote end may engage a lug 174 projecting trans-

versely from the arm 173. In normal position, lug 174 rests atop arm 175 of a bifurcated lever 176. A second arm 177 of lever 176 is spaced from arm 175 a distance sufficient to permit the projecting lug 174 to pass between these two arms if the occasion arises. This possibility will be described hereinafter. It is to be noted that arm 175 extends farther from shaft 178, about which lever 176 pivots, than arm 177. Therefore, arm 173 can be rotated clockwise a small degree, after arm 175 is withdrawn from a supporting position beneath lug 174, or until the motion of arm 173 is arrested by the engagement of finger 172 with a fed sheet 20A, before lug 174 will be moved to a position where it can block the counter-clockwise pivoting of lever 176 by interfering with arm 177.

At its lower end, lever 176 extends between two pins 180 and 181 carried by two bars 182 and 183, respectively, slidably mounted in brackets 184 secured to the front side frame of the machine. The bar 183 is provided with a projecting finger 185 (Figure 5) having a roller 186 at its outer extremity which rides on a face cam 187 secured to shaft 60.

The suction heads 93 remove a sheet of paper from the bins and the hollow shafts 94 carrying such heads are rotated to deliver the sheets to the grippers on the chains. The offset lever 164 on the shafts 94 are brought into contact with the levers 173 during the early stages of rotation of the hollow shafts 94. As the hollow shafts continue to rotate, springs 165 are compressed until shafts 94 stop rotating, this being due to the fact that blocks 163 are fixed to shafts 94, while arms 164 are free to rotate thereon as heretofore pointed out. At this interval of the operating cycle, the chains, the grippers and the sheets of paper are all stationary. Also at this time, cam 187 has been so rotated with shaft 60 that the lowermost portion thereof is opposite the roller 186. As a result, the uppermost bar 183 slides downwardly under the influence of gravity.

As bar 183 moves downwardly, the pin 181 thereon dropped to a lower position. Spring 192 keeps lever 176 in engagement with the pin 181 thereby pivoting the lever 176 about shaft 178 and removing arm 175 from its position of support beneath lug 174. Thereafter arm 164, under the influence of spring 165 which is in a state of compression, bears against arm 173 with a force greater than that exerted by spring 193 and, therefore, causes arms 172 and 173 to rotate clockwise about pivot shaft 171.

Assume first that a sheet of paper is fed, in which case the rotation of arms 172 and 173 is arrested by the engagement of arm 172 and the sheet of paper. In this arrested position, arm 173 will not have rotated a sufficient distance to carry lug 174 into a blocking position before arm 177. Under these circumstances, spring 192 continues to maintain lever 176 in engagement with pin 181 thereby causing a relatively great pivoting of lever 176. Thus, bar 182, which had been held in raised position by the engagement of pin 180 and the lower extremity of lever 176, is now permitted to fall under the influence of gravity as the lower end of lever 176 is actuated by spring 192. Downward movement of bar 182 carries operating member 194 (Figure 5), which is fastened thereto by extension 195, into engagement with a plunger 196 of a micro switch 197. Operation of switch 197 to disengage the switch contacts interrupts a solenoid circuit which permits the continued operation of the collator machine. This will be understood better after consideration is given to the situation where sheet feed has failed.

In the event that a suction head 93 fails to deliver a sheet to the grippers, the offset arm 164 bears against arm 173. However, arm 173 is not limited in motion by engagement of the feeler finger 172 with a fed sheet. Rather, arm 173 can freely rotate under the influence of lever 164. Then as arm 175 of lever 176 is withdrawn from supporting position beneath lug 174 of arm 173,

arm 173 pivots a distance sufficient to carry lug 174 between arms 175 and 177 where, by its engagement with arm 177, it blocks counter-clockwise rotation of the lever 176. Obviously if counter-clockwise rotation of lever 176 is prevented, its lower extremity will keep pin 180 and bar 182 in raised positions. Thus, member 194 will be held away from micro switch plunger 196. As a result, the switch contacts remain engaged to energize solenoid 200 (Figure 3).

Solenoid 200 has a core 201 which is connected to a pivotally supported lever 202. When core 201 is actuated by energization of solenoid 200, lever 202 is pivoted about pin 203 in a clockwise direction, as viewed in Figure 3. During such movement lever 202 engages link 50 and removes it from operative engagement with the notched disk 46. Therefore, when bar 51 is reciprocated by the driving mechanism, its motion is not transmitted to shaft 36 from which chain driving pulleys 34 are driven. It is thus seen that when a sheet is not fed to the gripper mechanism, the entire collator machine is deactivated until the machine attendant manually feeds a sheet where required. At such time, the related finger 172 and arm 173 are rotated counter-clockwise to carry lug 174 out of a blocking position with respect to arm 177. This in turn permits lever 176 to rotate counter-clockwise so that pin 180 and bar 182 will follow the extremity of lever 176 to a lowered position. The downward movement of bar 182 results in actuation of the micro switch 197 as heretofore described while solenoid 200 is deenergized. Tension spring 204 restores lever 202 to its normal position and link 50 is spring biased to its position for engaging a detent of the notched disk 46. Under these conditions, reciprocating motion of bar 51 is transmitted to the gripper driving chains and normal collating operation of the machine takes place.

Although Figure 5 shows only one sheet detector mechanism (shown in enlarged detail in Figures 7 and 8), it is understood that a similar mechanism is provided for each feed bin. Thus, failure to feed a sheet from any one bin will result in automatically stopping the collator machine. The sheet detectors are reset as the chains 34 advance the grippers to the next sheet feeding station through upward movement of bar 183 as brought about by cam 187 and roller 186. This movement, of course, is coordinated with that imparted to suction feeders 94 by bar 133, roller 134, cam 116, roller 122, and cam 123.

Turning now to consideration of the mechanism for receiving collated sheets, reference will be made to Figures 1, 12 and 13 where the receiving mechanism is shown as a drum-type device 205 supported so that rotatable motion can be imparted thereto. The side walls of device 205 are two vertically disposed, spaced circular plates 206, through which a shaft 207 extends between bearing blocks 210 supported on a base frame 211. A cylindrical core element 212, concentric with shaft 207, forms one end of plural radially extending compartments 213 for the collated sheets. Extending radially from the core element 212 to the periphery of the circular side plates 206 are a plurality of dividing members 214 which define the pie-shaped (in side elevation) receiving compartments 213 for the collated sheets. The outer, or receiving, end of each compartment is provided with a pivotal gate 215 which is maintained in a closed position, except when a set of collated sheets is being fed thereto, by springs 216 acting on lever 217 keyed to a rock shaft 220 which carries the gate 215 (see Figure 13). The opposite end of lever 217 carries a cam roller 221 which engages cam 222 (Figure 12) when the particular compartment for which it is provided is about to receive a set of collated sheets. This pivots lever 217 in a counter-clockwise direction and opens the related gate 215. When it is desired to discharge a set of collated sheets from a compartment, generally when that compartment is at or near its lowest point of travel so that the set of collated sheets can be discharged therefrom by gravity, rollers 221

engage a second cam 223 to similarly open the gate and permit the set of collated sheets to be discharged (see Figure 13).

To impart motion to the sheet receiving device, a ratchet wheel 224 is provided on the exterior surface of one of the end plates 206. Depending from shaft 207 and rotatable thereon is a link 225 carrying at its lower end a spring biased pawl 226 which engages teeth of the ratchet wheel 224 to impart rotary motion thereto. A link 227, pivotally connected to link 225, is in turn pivotally connected to a lever 230 by which it is reciprocated. Movement of the lower end of the lever 230 to the right (as viewed in Figure 1) acting to advance or rotate receiving device 205 while a leftward movement simply resets the pawl 226 preparatory to the next advancing movement. Lever 230 itself is supported for oscillating movement on a stub shaft 231 secured to the side frame of the machine, while its other end carries a roller 233 which lies in the path traveled by cams 125 carried by chains 34 and heretofore used for effecting the suction feed of sheets from the bins. Consequently, when a cam 125 engages roller 233, lever 230 is moved counter-clockwise and link 227 is pulled to the right to index the sheet receiving device to bring the next empty compartment to a sheet receiving position. After cam 125 has passed roller 233, spring 234 acts to restore the members just described to their normal position in readiness for the next advancing operation. A spring biased pawl 235 prevents backward movement of sheet receiving device 205 as the advancing pawl 226 is restored to normal position.

To facilitate the removal of a set of collated sheets from the gripper chains and the delivery thereof to the receiving drum 205, a sheet kicker 240 is provided on each chain 33 for each gripper mechanism 38. The kickers are pivotally supported by pin means 241 extending through a chain link, and each kicker carries a roller 242 at one end which at the proper instant engages a cam 243 supported on the side frame of the machine. A tension spring 244 normally maintains the kicker 240 in a non-actuated position when roller 242 is not engaged with cam 243.

In operation, when a gripper mechanism carrying a set of collated sheets approaches the station where the sheets are transferred to the receiving mechanism, the gripper operating roller 82 engages cam 245 to open the gripper fingers and release their hold on the set of collated sheets. At almost the same time, roller 242 engages cam 243 to pivot the kicker 240 and raise the leading edge of a released collated set out of the gripper mechanism for deposit on a delivery apron 246 where a pair of feed rollers 247 and 248 positively drive the same into a compartment of the receiving drum, the gate for such compartment, of course, having been previously opened.

The feed rollers are mounted on shafts 250 and 251 as are pulleys 252 and 253, respectively, and are driven by belts 254 and 255 passing over the pulleys and down to the double pulley 256 mounted on the extreme end of the extension 257 of shaft 64. Thus, it is apparent that the feed rollers are continuously rotated from the main motor drive of the machine.

In the event that a set of collated sheets is to contain more individual sheets than is normally accommodated by the number of feeding stations at one time, so that there are more sheets in a collated set than stacking bins 21, cam 223 may be moved to an inoperative position wherein it will not open the compartment gates to discharge the collated sheets from the receiving mechanism 205. In this manner, when the compartment containing some collated sheets, e.g., sheets 1 to 14, again reaches the receiving station, it will receive several new collated sheets, e.g., sheets 15 to 28, for example, etc. This procedure may be continued many times, thus permitting the collating of units having many more sheets than the machine can normally accommodate at one time.

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It was pointed out above that the chain and grippers carried thereby are given an intermittent motion, with each advance of the chain carrying a gripper mechanism to the next sheet delivery mechanism for receipt of a sheet from the bin associated with the sheet delivery mechanism. Consequently, the separation of the gripper mechanisms on the chains will be equal to the distance between sheet delivery mechanisms which in turn will be dependent on the spacing of the feed bins. If the length of the sheets to be collated is less than the separation of the gripper mechanisms on the chains, then each gripper mechanism can be effective to grip and carry a collated set of sheets. On the other hand, if the length of the sheets to be collated exceeds the separation of the gripper bars, then it is obvious that each gripper mechanism cannot grasp or carry a collated set. Whether or not a gripper mechanism carries a set of collated sheets is not controlled by control of the gripper mechanism itself but rather by control of the sheet feeding mechanisms.

In the preferred embodiment of the present invention the sheet delivery is controlled by cam 125 which is provided on chain 33, one cam being provided for each gripper mechanism. Referring to Figures 10 and 11, it will be observed that cam 125 is slidably mounted on two pins 260 and 261, each of which serves as a pin for the links of chain 33. The pins terminate in an integral disk element 262 which limits movement of cam 125 along the pins. The pins are of a length to permit the cam to assure either of two distinct positions, one the operative position (shown in full line), one the inoperative position (shown in phantom line). The cam itself can slide between these positions and is held in the selected position by the spring urged ball 263 which co-acts with an appropriate detent 264 or 265. In the operative position cam 125 is in position to engage rollers 118 of the sheet feeding mechanisms so that a sheet is fed to the gripper with which the cam is associated. Also, the cam is in position to engage roller 233 and advance the sheet receiving drum 205 to bring an empty compartment into position to receive the collated set from the gripper mechanism with which the cam 125 is associated.

If, on the other hand, cam 125 is in an inoperative position, roller 118 will not be engaged and sheets will not be fed to the gripper mechanism with which the inoperative cam is associated when that particular gripper mechanism is stopped before a feed bin. Neither will that cam engage roller 233 to advance receiving drum 205 inasmuch as the gripper mechanism does not carry a set of collated sheets and cannot deliver sheets to the receiving mechanism. Hence there is no need to advance receiving drum 205. In operation, every cam 125 can be made operative, or every other cam 125 can be made operative, or every third cam 125 can be made operative, etc., depending on the length of the sheets to be collated.

From the foregoing it is believed that those familiar with the art will readily appreciate and recognize the improved advancement which the present invention constitutes in this art. Consequently, while there is herein shown and described the features and aspects of invention as related to a preferred embodiment thereof, it will be understood that numerous changes, modifications, and substitutions of equivalents may be made therein without necessarily departing from the spirit and scope of the invention. Therefore, it is not intended to be limited to the particular form of invention herein shown and described except as may appear on the following appended claims.

What is claimed is:

1. In a device for collating sheet materials, the combination comprising, a plurality of spaced feeder stations, endless conveyor means movable in a path adjacent and past said feeder stations, multiple gripper de-

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vices each having plural sets of gripper fingers carried on said conveyor means, said gripper devices being spaced from one another on said conveyor means a distance equal to the spacing of said feeder stations, means for arresting each of said gripper devices at each of said feeder stations in succession, means movable between said feeder stations and said gripper devices for transferring a single sheet of material to each gripper device arrested adjacent thereto, and means for operating said gripper devices to transfer sheets engaged by one set of gripper fingers to another of said sets of gripper fingers.

2. In a collator, the combination comprising, multiple feeder stations spaced from one another, endless conveyor means movable in a path adjacent and past said feeder stations, gripper means carried by said conveyor means in spaced relation to one another, the spacing between said gripper means being equal to the spacing between said feeder stations, means arresting said gripper means at each feeder station in succession, means feeding a single sheet of material to each of said gripper means at each of said stations, each gripper means including first finger means for receiving the sheet fed from the station and second finger means for gripping the sheets previously fed to the respective gripper means, and means for causing one of said finger means of each gripper means to grip all of the sheets fed to the respective gripper means and for releasing the other of said finger means for receiving a sheet of material at the next feeder station.

3. In a collator, the combination comprising, multiple feeder stations spaced from one another, conveyor means movable in a path adjacent and past said feeder stations, gripper means carried by said conveyor means in spaced relation to one another, the spacing between said gripper means being equal to the spacing between said feeder stations, means arresting said gripper means successively at each feeder station, means feeding sheet material to each gripper means at each of said feeder stations, each gripper means including first finger means for receiving the sheet fed from the station and second finger means for gripping the sheets previously fed to the respective gripper means, means operative between stations for causing one of said finger means of each gripper means to grip all of the sheets fed to the respective gripper means and for releasing the other of said finger means for receiving a sheet of material at the next successive feeder station, means opening said gripper means at a selected point along the path of movement of said conveyor means, thereby to release the sheets as a collated set, and means to receive sheet sets discharged from said gripper means and to deliver them to a point remote from said conveyor means.

4. In a collator, the combination comprising, endless conveyor means movable in a given path, a plurality of feeder stations disposed adjacent and in spaced relation to one another along the path of travel of said conveyor means, multiple spaced gripper bars carried by said conveyor means, the spacing between said gripper bars being equal to the spacing between said stations, means arresting each gripper bar at successive feeder stations, first finger means cooperable with each bar for receiving the sheet fed from each station, second finger means cooperable with each bar acting to grip the sheets previously fed to the respective bar, means for causing one finger means cooperable with each bar to grip all of the sheets fed to the respective bar and for releasing the other finger means cooperable with the respective bar for receiving a sheet at the next successive feeder station, means workable between said feeder stations and said conveyor means for delivering single sheets to each gripper bar as each is indexed opposite each feeder station, means for discharging collated sets of sheets from each gripper bar, means for receiving said discharged sets of sheets, said receiving means including multiple compartments each movable opposite the point of discharge for

said gripper bars, and means for discharging sheets from each of said compartments as selected.

5. In a device for collating single sheets, the combination comprising, endless conveyor means movable in a given path, multiple feeder stations disposed adjacent and at equally spaced intervals along the path of said conveyor means, multiple gripper means carried at spaced intervals along said conveyor means, the spacing of said gripper means on said conveyor means being equal to the spacing of said stations along said path, means for arresting said conveyor means to dispose one of said gripper means opposite each feeder station simultaneously, means for delivering a single sheet from each feeder station to each of said arrested gripper means simultaneously, each gripper means being advanced from each succeeding feeder station to feeder station and receiving a sheet at each feeder station, said gripper means each including a pair of finger means, means operative between stations for closing one finger means and then opening the other, whereby one finger means is open at each station to receive the sheet fed from the respective station and to the other finger means is closed to grip all of the sheets previously fed to the respective gripper means, means at a selective point along the path of said conveyor means for opening said gripper means to discharge the multiple sheets carried thereby, and means adjacent said conveyor means for receiving said sheets as a collated unit and for maintaining successive units separated.

6. A collator for sequentially gathering single sheets of paper and the like in preselected sequence, comprising, endless conveyor means movable in a given path, plural feeder stations along said path adjacent said conveyor means, multiple gripper means carried at spaced intervals on said conveyor means, means for arresting each gripper means at successive feeder stations, means for feeding a single sheet from each feeder station to each gripper means, each gripper means receiving a sheet at each feeder station is the same as indexed adjacent thereto, said gripper means each including a pair of finger means, means operative between stations for closing one finger means and then opening the other, whereby one finger means is open at each station to receive the sheet fed from the respective station and the other finger means is closed to grip all of the sheets previously fed to the respective gripper means, and means for opening both finger means of each gripper means at a preselected location along said path for discharging a set of collated sheets carried thereby.

7. A collator comprising plural spaced feeding bins, endless conveyor means movable in a path passing successively adjacent said bins, means moving said conveyor means past said feeding bins, plural gripper devices spaced along said conveyor means, the spacing of said gripper devices along said conveyor means being equal to the spacing of said bins along said path, means for arresting each gripper device at successive feeding bins, each gripper device comprising plural sets of gripper fingers, means feeding a single sheet to a single set of said gripper fingers at each feeding bin, means operating said gripper devices and effecting a transfer of successive sheets between alternate sets of said gripper fingers of each gripper device between successive feeding bins, and means for discharging all sheets gathered by each gripper means as a unit.

8. A device for collating sheet materials, comprising plural feeding bins for sheets to be collated, endless conveyor means movable in a path adjacent and past said bins, said bins being spaced from one another along said path, plural gripper devices carried in spaced relation to one another by said conveyor means, the spacing of said gripper devices on said conveyor means being equal to the spacing of said feeding bins along said path, means for periodically arresting said conveyor means for disposing a gripper device opposite each feeding bin,

means for transferring a single sheet from each feeding bin to an adjacent gripper device, said gripper devices being indexed to each feeding bin in succession, dual finger means on each gripper device for receiving and gripping a sheet being fed thereto without releasing sheets previously fed thereto, means for operating alternate finger means at alternate feeding bins and for transferring engagement of sheets previously fed to the gripping devices between said finger means, means for discharging all sheets from each gripping device at a selected point along the path of said conveyor means, rotatable sheet receiving means disposed adjacent said conveyor means and receptive of the sheets discharged from said gripper devices, said sheet receiving means comprising plural compartments, means for indexing said compartments opposite said point in timed relation to the movement of said conveyor means so that the sheets discharged from each gripper device are received in individual compartments of said sheet receiving means, and means for discharging sheets from said compartments at a point remote from said conveyor means.

9. In a device for collating individual sheet materials and the like, the combination comprising, an endless conveyor means, multiple feeder stations disposed in spaced relation along one side of said conveyor means, plural gripper devices carried by said conveyor means, the spacing between adjacent gripping devices being substantially equal to the spacing between adjacent feeder stations, each gripper device comprising at least two sets of independently operable gripper fingers, each engageable with the same gripper bar means for arresting said gripping devices at successive sheet feeding stations, means for feeding individual sheets from each feeding station to an adjacent arrested gripper device, cam means for alternately opening the sets of gripper fingers at successive feeder stations whereby sheets may be engaged by said gripper devices at each feeder station without releasing engagement of sheets previously fed thereto, the successive feeding of sheets to alternate sets of fingers serving to transfer engagement of sheets between the finger sets and collate said sheets in an organized sequence as a unit beneath one set thereof, means adjacent said conveyor means for discharging said units from said gripper devices, and means for receiving discharged units, for maintaining the same separate and for collating said units as selected.

10. A device for collating sheet materials, comprising, plural feeder stations, endless conveyor means movable in a path adjacent and past said feeder stations, said stations being equally spaced along said path, plural spaced gripper means carried by said conveyor means at intervals according to the spacing between feeder stations, means intermittently arresting said conveyor means for disposing each gripper means opposite each feeding station, means for feeding single sheets to each gripper means at each feeder station, the intermittent movement of said conveyor means moving each gripper means to successive feeder stations for receiving successive sheets, means for discharging sheets from said gripper means, means for receiving such discharged sheets and maintaining the same separated, and means for selectively rendering each feeder station, said discharge means and said receiving means inoperative as selected gripper means are brought into a normally operating relation therewith in order to accommodate sheets of a length greater than the spacing between adjacent feeder stations.

References Cited in the file of this patent

UNITED STATES PATENTS

70	1,711,647	Milmoe	May 7, 1929
	2,536,356	Dager	Jan. 2, 1951
	2,578,176	Dager	Dec. 11, 1951
	2,589,428	Pearce	Mar. 18, 1952
	2,589,676	Crissy	Mar. 18, 1952
	2,621,040	Rinehart	Dec. 9, 1952