Sept. 23, 1947. W. W. DAVIDSON 2,427,839

COLLATOR

Filed Feb. 5, 1944 3 Sheets-Sheet 1

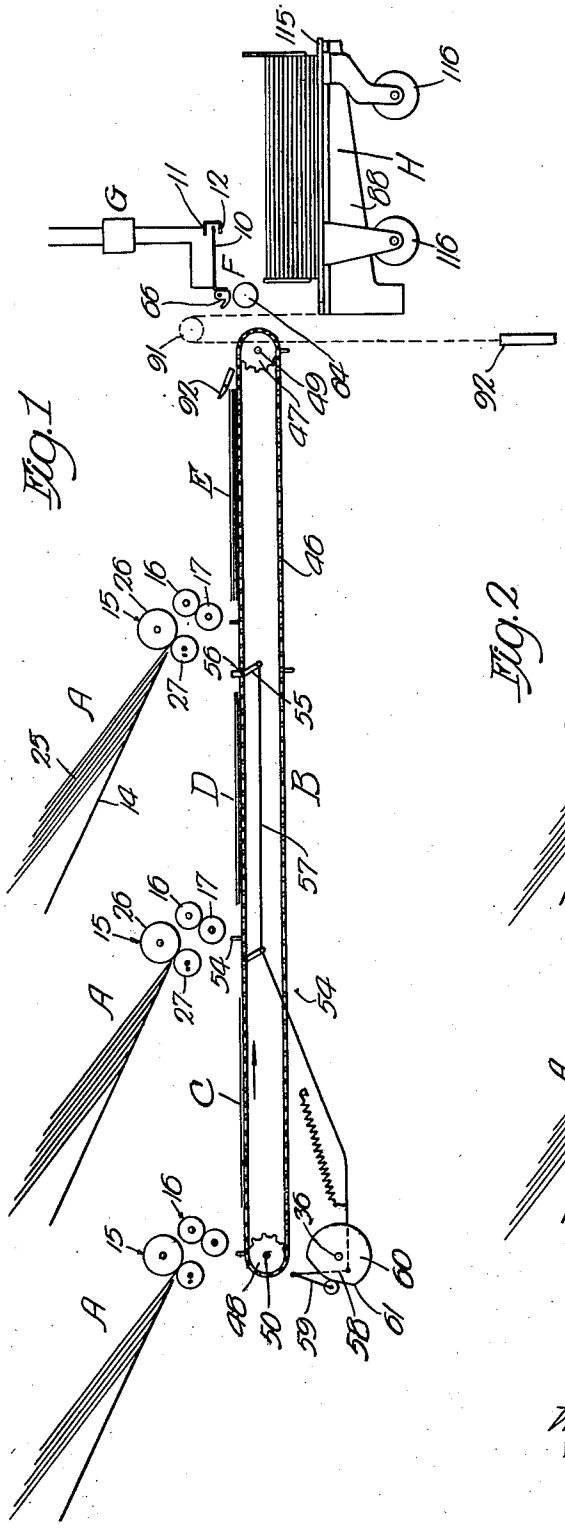


Fig. 1

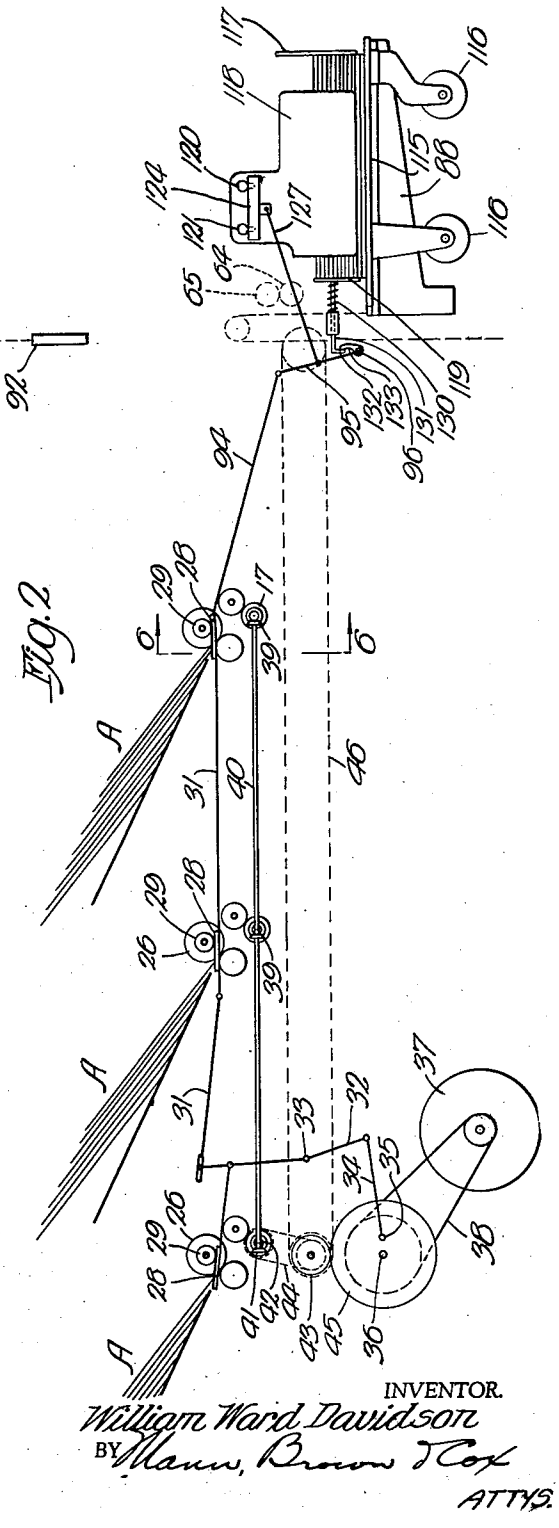


Fig. 2

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COLLATOR

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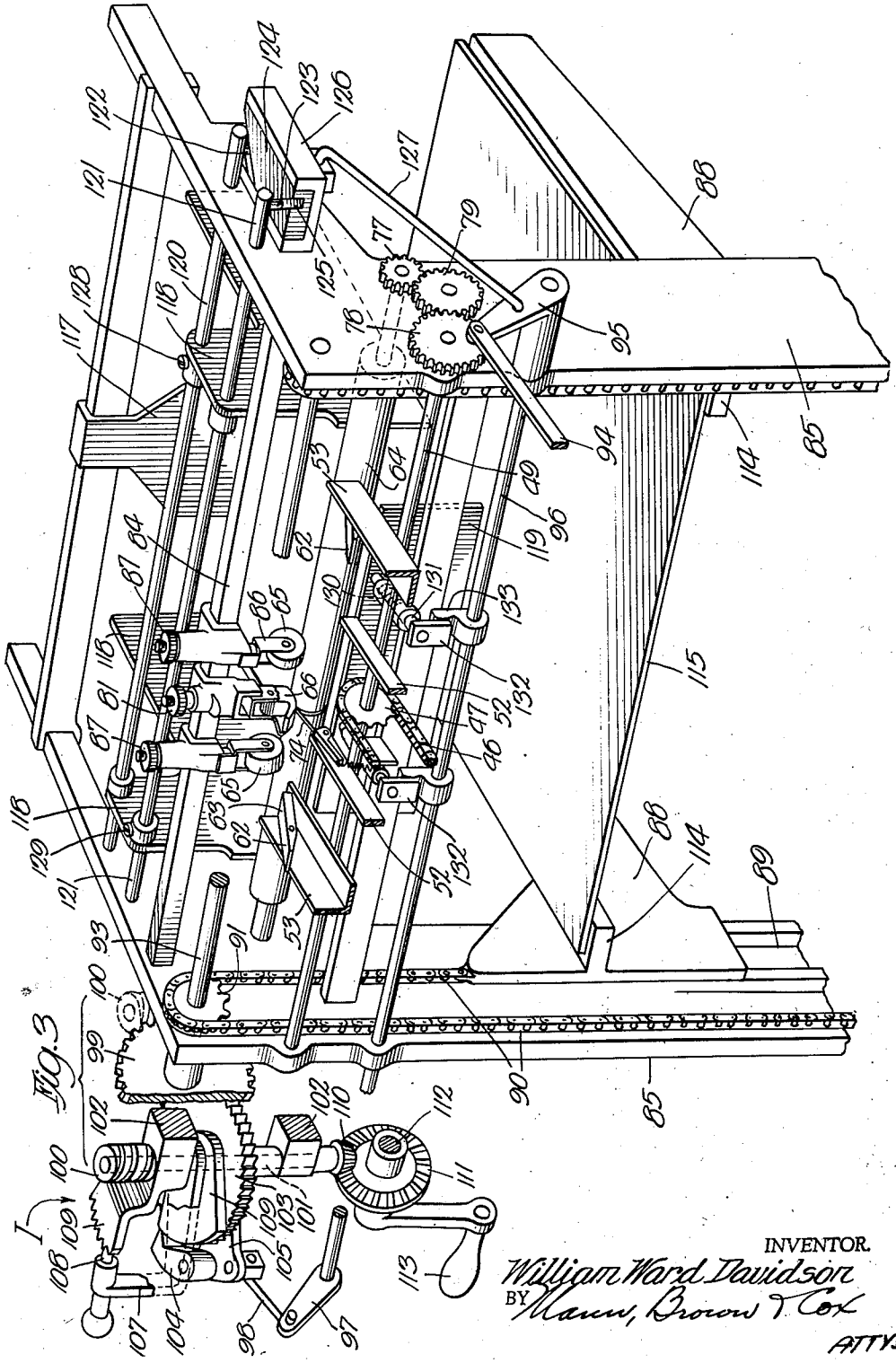


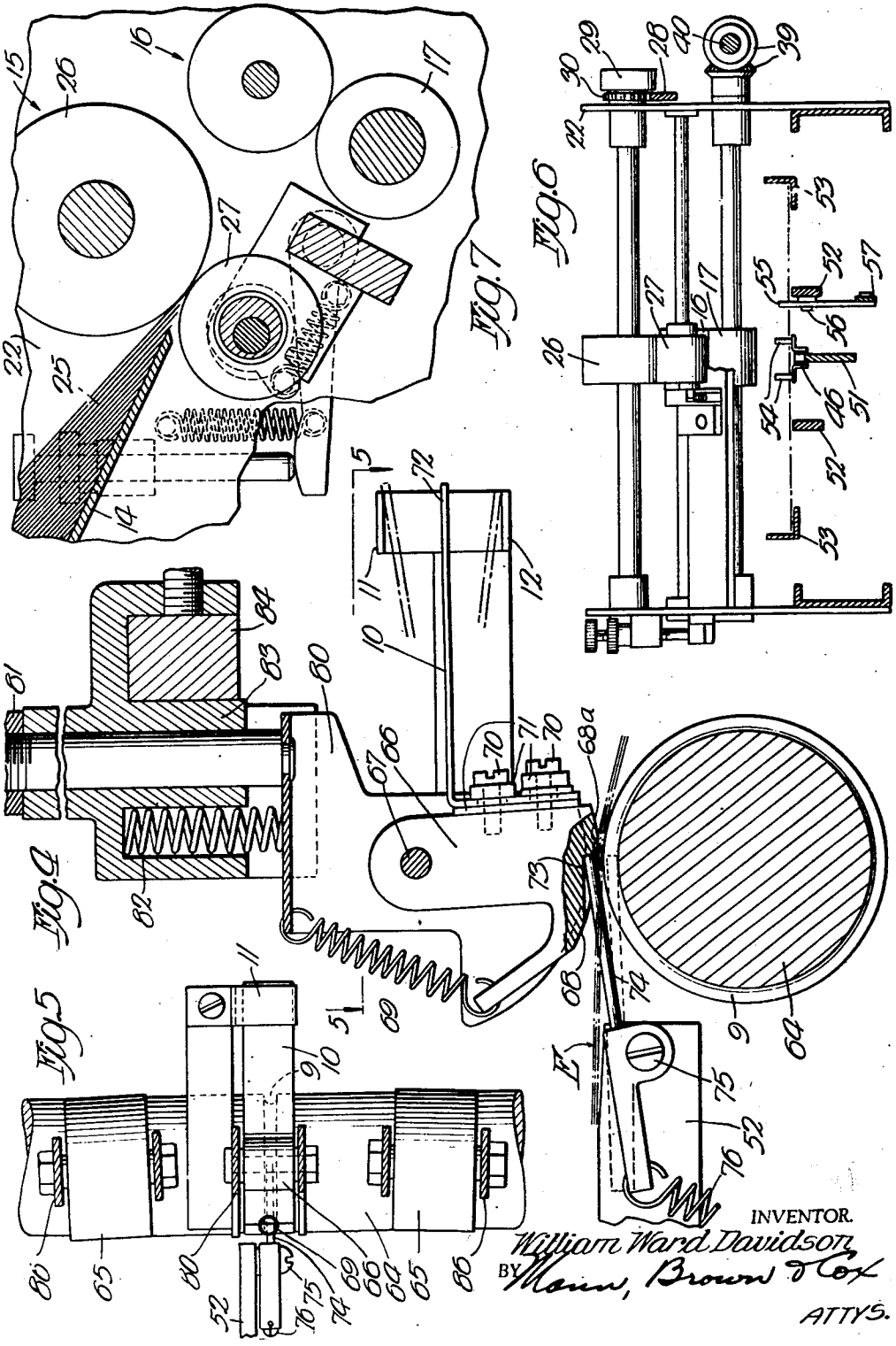
Fig. 3

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Filed Feb. 5, 1944 3 Sheets-Sheet 3



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Patented Sept. 23, 1947 2,427,839

UNITED STATES PATENT OFFICE

2,427,839

COLLATOR

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Application February 5, 1944, Serial No. 521,212

22 Claims. (Cl. 270—58)

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The principal object of this invention is to provide apparatus for assembling sheet material such as calendar sheets, checks, playing cards, pages of booklets and such like in a particular order, and generally speaking, this is accomplished by arranging a series of timed sheet feeders over a conveyor traveling in such relation to the delivery of the several feeders that it receives one sheet (or sub-group of sheets) from each feeder in order, with each sheet upon the last fed by the next preceding feeder in the series so as to form identical groups of sheets. By preference also, the sheets in each group are brought into register as they are gathered, and each group is checked or gauged to make sure that it includes all of the sheets that it should and no more than it should. For some purposes the groups are delivered to a folder, a stitcher, or other machine for carrying on the work and for some purposes the groups are assembled in stacks.

In the drawings—

Fig. 1 is a diagram showing the general organization of the feeders, the conveyor, the group checker and the stacker, as they appear in side elevation;

Fig. 2 is a similar diagram showing the same things with the addition of some driving features and the stacker wings;

Fig. 3 is a perspective view of the checker and the stacker together with details of the driving mechanism for them;

Fig. 4 is a vertical section through the group checker;

Fig. 5 is a horizontal section on the line 5—5 of Fig. 4;

Fig. 6 is a transverse section through the collator taken on the line 6—6 of Fig. 2, and

Fig. 7 is a vertical section through one of the sheet feeders.

General description

Referring to the diagram in Fig. 1.

Sheet feeders generally indicated by A are arranged in series lengthwise to the machine and their number will depend upon the number of different sheets to be put into a group. Three have been shown merely by way of illustration. Many more will be the common rule.

Immediately beneath the series of feeders is a conveyor, generally indicated by B, which travels in timed relation to the feeders to the end that a sheet C fed by feeders A will be covered by the next sheet in order as it passes the second feeder A to form a sub-group D, and so on until the final group E is formed as it passes the last of the

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feeders A, and includes one sheet, or sub-group of sheets from each feeder in the order they are arranged.

The conveyor B delivers the groups to the group checker or caliper gauge F, which checks them for thickness to determine whether or not each contains the right number of sheets.

If the stack is too thin, by reason of one or two sheets being missing, the switch arm 10 of the movable caliper member will engage a contact 11 to close a circuit leading to stop mechanism G for stopping the machine. Also if the stack is too thick the arm 10 will engage an associated contact 12 and close the same circuit to stop the machine.

From the checker the groups may go to any other machine or to a conveyor leading to another machine, or to storage, or to a stack holder H, here shown by way of example, suited to one set of conditions.

The sheet feeders

The sheet feeder best suited to the purpose is the subject of the patent to Nils Trydal, No. 2,224,138, dated December 10, 1940, issued on an application Serial No. 262,208, filed March 16, 1939.

The feeder includes a feed board 14 for feeding sheets to separator rolls generally indicated at 15 which, in turn, feed one sheet at a time to pull-out rolls, generally indicated at 16. Both the feed board 14 and the separator rolls 15 are mounted on a common frame 22 and so disposed that a pile 25 of sheets resting on the feed board as shown, will be fanned out so that the sheets will slide by gravity, edge first, against the separator rolls 15. Those separators comprise a feed or advancing roll 26 and a retard roll 27. The advancing roll 26 has a high coefficient of friction with the sheets so as to advance the top sheet against any dragging effect of which the retard roll 27 is capable. Preferably the advancing roll is made of relatively soft rubber, pure gum Anemone stock having a durometer reading of 40 having been found satisfactory. The retard roll 27 is preferably made of somewhat harder rubber, Grey Commercial compound, 78 durometer, having been found satisfactory.

An intermittent drive for the feed roll 26 is especially suitable for the present apparatus and is here shown somewhat diagrammatically as including reciprocating rack bar 28 meshing with the pinion 30 of an overrunning clutch 29, with which each drive roll 26 is equipped.

Each advance movement of the rack 28 to the right in Fig. 2 will feed one sheet from each of the feeders A to the corresponding pullout rolls 16, which are continuously driven. The overrunning clutches on the feed roll 26 permit the continuously driven pullout rolls to pull the sheets from the feeder, while the rack 28 is moving in the opposite direction.

The several racks 28 are connected through linkage 31 with a walking beam or bent lever 32, fulcrumed at 33 on the frame of the machine and driven by a connecting rod 34 from a crank pin 35 on a shaft 36, driven by a motor 37 through a chain 38.

The lower pullout roll 17 for each feeder is driven through beveled gears 39 and a line shaft 40, also driven through beveled gears 41 from a transverse shaft 42, driven by a pinion 43 through a chain 44, the pinion 43 being, in turn, driven by a gear 45 on the shaft 36. For further information about the feeders, reference is made to the above mentioned patent to Trydal.

This feeder is especially advantageous because of its ability to feed different types and different thicknesses of material either in separate sheets or in sub-groups fastened together. It is also of especial adaptability to the present purpose because the conveyor for receiving the fed sheets can be gotten so close beneath the feeders that the sheets fall on the conveyor in their proper relation undisturbed by currents of air or by the tendency of the sheet to glide when falling any considerable distance in the air. The space below the feeder is entirely clear and unobstructed, making it possible for the fed sheets to descend almost directly onto the conveyor.

In the construction found most satisfactory the lower pullout roll 17 has a diameter of 1¼" and its center is between ¾" and 1¼" above the conveyor, the surface of the conveyor depending upon the maximum thickness of the group to be assembled. It is not intended, of course, to make these details a limitation, but they are mentioned to emphasize the advantage of this feeder in delivering almost directly onto the moving conveyor or the sub-group on the conveyor.

This feeder also has the advantage of feeding each sheet from the top of the pile which makes it especially suited to a great variety of sheet materials to be collected into groups for various purposes. A sub-group of considerable size or a folded sheet can be fed from the bottom, but it is extremely difficult to feed a single sheet of a considerable stack.

This feeder also has the inherent advantage of feeding the sheet in the direction that the conveyor is moving and it approximates the same speed whereby it simply lays each sheet fed down upon the moving conveyor in approximately the proper position so that there is no inherent tendency of the fed sheets to get badly out of register, and they are easily brought into register by the propelling pins 54 and the stops 56.

Considering the feeders with their supporting side frames (not shown in the diagrammatic views of this application but disclosed in the prior patent to Trydal, above referred to) the several feeders in the series may be said to sit astride the conveyor with their pullout rolls so close to its surface and so timed with respect to the movement of the conveyor that each feeder, in turn, simply lays one sheet upon an advancing sub-group until it is fully formed.

The conveyor

The conveyor B includes an endless chain 46 running over sprockets 47 and 48 on shafts 49 and 50. The shaft 50 being fixed to the pinion 43, it will be clear that the conveyor is driven simultaneously with the feeders and by suitable proportions the speed can be made to transport the sheet C to the position of sub-group D and so on within the proper interval.

The chain 46 runs along a bar 51 (Figs. 3 and 6) on each side of which are spaced rails 52 and still further removed on each side are angle rails 53, all running lengthwise to the machine and supported on a suitable frame.

At suitable intervals the chain 46 is equipped with propelling posts or fingers 54 which serve to push the sheets and groups along the rails 52 and 53 towards the right in Fig. 1.

Registering stops are interposed in the path of the traveling groups to block their movement and thereby bring the accumulating sheets into proper register. Between the positions D and E (Fig. 1) a stop 55 is pivoted at 56 on one of the rails 52 and urged by a spring to the position in which it appears in Fig. 1. The lower end of the stop 55 is connected by linkage generally indicated by 57, with the one arm 58 of a bell crank lever having an arm 59 running against a cam 60, fixed to the shaft 36 and, therefore, driven in unison with the feeders and the conveyor. As the throw 61 of the cam moves the arm 59 the projecting part of the stop 56 is rotated to the right out of the path of the group D, where it remains until the sheets have passed beyond it to the right when it rises in time to stop the next group long enough for the propelling posts 54 to bring the constituent sheets into register.

Similar registering stops are provided between successive feeders throughout the series and connected with the linkage 57 for simultaneous operation. Beyond the last feeder it is preferable to form the stops of pivoted blocks 62 (Fig. 3) having their heavier ends 63 lying in the path of the advancing groups and under which those groups must pass as they are delivered from the conveyor.

The weight of the pivoted stops will depend somewhat on the groups to be handled.

As diagrammatically shown in Fig. 1, no registered stop 56 is associated with the first feeder A at the left, but it will be understood that such a stop may be added if desired.

Those skilled in the art will readily make other types of conveyors suited to personal preference or particular conditions. That illustrated has been chosen because of its general adaptability and its special adaptability to the conveying and collecting of sheet materials of which there are so many, particularly in the printing art.

The group checker

From the conveyor the groups of sheets pass to the group checker, which includes a ribbed steel roll 64 (Fig. 3) and two cooperating spring pressed rolls 65 having their axes of rotation at a slight angle, as indicated in Fig. 5, to make them tend to feed the opposite side portions of the top group in opposite lateral direction whereby the sheets are stretched tight along the top of the driven roll 64, between the rolls 65.

Between the rolls 65 and cooperating with the roll 64 is a caliper member 66 pivoted at 67 (Fig. 4) and having a curved surface 68 with a shoulder or rise 68*a* normally held near the top of

the roll 64, in position to gauge the thickness of the group as it passes between the rolls 64 and 65. The shoulder 68a may have a radial dimension, for example, of .004 inch. The surface of caliper 66 could be eccentric instead of having the shoulder 68a, but the shoulder is preferred.

The caliper member 66 has a spring arm 10 adjustably fixed to it by screws 70 and insulated from it by blocks 71, and its free end 72 is movable between the fixed contacts 11 and 12 (Figs. 1 and 4) to close the stop circuit and stop the machine.

In order to prevent the spring 69 from causing the caliper member 66 to stop the machine when no group is passing through the gauger, its curved surface is provided with a shouldered notch 73 to cooperate with the end of a sear 74, pivoted at 75 on one of the rails 52 and normally urged to rotate counterclockwise by a spring 76. The weight and balance of the sear is such that the light spring 76 will yield as a group of sheets is advanced by the rollers 64 and 65 to take the dotted line position shown in Fig. 4, thereby freeing the caliper member to swing in either direction under the influence of the spring 69 or the thick group passing through the apparatus. In order to allow the sear to take the dotted line position shown in Fig. 4, the roller 64 is provided with a groove 9 (Figs. 4 and 5).

When a group flexes the sear 74 to pass between the steel roll 64 and the caliper member 66, the action of the released caliper member depends upon the thickness of the group. If the group is of the desired or normal thickness, the group will wedge between the roller 64 and the shoulder 68a to cause slight counterclockwise rotation of the caliper member 66, or at least hold the caliper 66 in approximately the position shown or slightly counterclockwise of that position. When such a normal group passes clear of the caliper member the sear 74 swings upward into normal engagement with the notch 73.

If the group is thicker than normal, i. e., comprising more than the desired number of sheets, the group will shift the shoulder 68 counterclockwise to a substantial extent bringing the outer end 72 of the arm 10 against the contact 11 to stop the machine. On the other hand when the group is deficient or of less than normal thickness, there is sufficient clearance for the shoulder 68a to shift a substantial distance in the clockwise direction thereby causing the outer end 72 of the arm 10 to touch the contact 12 to stop the machine. It is to be noted that the shoulder 68a in moving in a generally oblique direction makes a relatively great shift for a minor variation in thickness of groups of sheets and that the end 72 of the arm 10 moves to even greater extent.

Stopping the machine is the preferred procedure for signalizing the arrival of an abnormal group at the checking zone. If desired the checker may signalize such arrival by causing some audible or visible indication or by causing the abnormal group to be rejected.

The roller 64 is made of steel ribbed on the surface and ground accurately to size. It is driven by pinion 77 (Fig. 3) from a gear 78 on the conveyor shaft 49 through an idler 79 with a ratio that makes the surface speed of the roller 77 somewhat in excess of the conveyor speed, whereby the feed of the gauger is enabled to take the groups quickly away from the front of the conveyor. The pivoted caliper member 66 is supported by a fork 80, adjustable by a nut 81 and a spring 82 within a bracket 83, carried by a transverse bar 84 on the end frame 85 of the machine. The adjustment makes it possible to vary the space between the curved surface 68 of the caliper member and the top of the roll 64 to suit the material being gauged.

Associated with the nut 81 is a micrometer adjustment and lock which makes it easy to adjust the caliper checker by extremely small fractions of an inch, for example, one-thousandth. As now constructed, the nut is provided with a ratchet wheel surface cooperating with spring catches which stop the nut and hold it in any particular position of adjustment, but allow it to be readily turned in making adjustment.

The rolls 65 are mounted in forks 86 adjustable in like manner within brackets 87 while being held with their axes skewed, as indicated in Fig. 5. The details of these things are omitted for the sake of clearness.

In Fig. 4 the group of sheets is shown as including three separate sheets to correspond with the assumed condition in the diagrams in Figs. 1 and 2. It is to be understood, however, that when the group is in the position shown the sear must be in the dotted line position, to which it is thrown by the advancing group as it is received between the roll 9 and the rolls 65.

The stack holder

The group checker delivers the group in the apparatus shown to a stack holder which includes a cantilever frame 88 having tongues (not shown) running in grooved guides 89 (Fig. 3) on the inside of the end frame 85. The cantilever frame 88 is suspended by chains 90 running over sprockets 91 and equipped with counterweights 92.

The frame is moved downwardly step by step as the groups form a stack upon it, thereby keeping the top of the stack in proper position to receive the groups as they arrive.

The sprockets 91 are fixed to a cross shaft 93 journaled in the end frame 85 and driven in unison with the rack bars 28 of the feeders A (Fig. 2). As shown, the rack bar 28 at the right in Fig. 2 is connected by a link 94 with an arm 95 at one end of a shaft 96 journaled in the end frame 85 (Fig. 3) and having at its opposite end an arm 97 connected by a link 98 with a pawl and ratchet mechanism, generally indicated by I in Fig. 3.

The shaft 93 is equipped with a worm wheel 99 driven by a worm 100 on an upright shaft 101, journaled in brackets 102 on the end frame 85. In Fig. 3 this shaft, with its brackets and associated mechanism, has been displaced slightly to the left in order to bring it into a visible position. The worm 100 is shown in dotted lines in its actual position but in solid lines in its displaced position.

The shaft 101 is equipped with a ratchet wheel 103, driven by a spring pressed pawl 104, pivotally mounted on a pawl carrier 105 swiveled on the shaft 101 below the ratchet 103. The link 98, which receives its motion from the driving racks 28 of the feeders, is connected with the pawl carrier 105 and therefore communicates to it and the pawl an oscillating motion timed with the operating feeders A.

Since the groups will vary in thickness according to the circumstances and the materials being grouped, it is necessary to adjust the pawl and ratchet drive to lower the stack holder in steps according to the thickness of the groups. This is

accomplished by swiveling a cam 106 on the upright shaft 101 above the ratchet wheel 103, equipping it with an arm 107, carrying a spring pressed pawl 108, adapted to engage a fixed rack 109, carried by the upper bracket 102. The surface of the cam 106 is of such distance from the axis of the shaft 101 as to hold the pawl 104 out of engagement with the teeth of the ratchet 103. By adjusting its position the engagement of the pawl with the ratchet can be reduced or extended to make the turning movement of the shaft 103 suited to the thickness of the group.

In order to raise the stack holder the lower end of the shaft 101 is provided with a beveled pinion 110 driven by beveled gear 111 on a shaft 112, journaled at the side of the end frame and fitted with a crank handle 113. Rotating the shaft 112 in the proper direction will turn the sprocket shaft 93 and raise the stack holder, the pawl 104 being out of engagement with the ratchet wheel.

Preferably the stack holder 88 is somewhat U-shaped in form to provide supporting arms 114 to catch under the sides of a small truck 115, having wheels 116.

In the raised position of the stack holder the truck merely acts as a floor of the frame, but upon reaching its lowermost position the wheels 116 rest on the floor and the truck with its stack is moved away and replaced by an empty truck, after which the stack holder is raised to the upper position and a new stack of groups is started.

The jogger

In handling some materials it will be desirable to insure register of the groups in the stack beyond that which will be incident to the feed of the checker roller 64. This is accomplished by what is called a jogger, including a fixed plate 117 (Fig. 3) two movable side plates 118, and a movable front plate 119 (Fig. 2).

The operating mechanism provided moves the two side plates 118 towards each other and the plate 119 towards the fixed plate 117 just after a group falls on the stack. The net of this movement of the plates is to give the top groups of the stack a pat at each side and at the front.

The plates 118 are carried by rods 120 and 121 mounted to slide in the end frame 85 and having their projecting ends equipped with pins 122 and 123, engaged with a cam block 124, having cam grooves 125 (Fig. 3).

The cam block slides in a cam guide 126 and is connected by a link 127 with the arm 95 that receives its motion from the feeder driving racks 28 through the link 94. Thus, at each stroke of the feeder the cam 124 is moved to shift the rod 120 in one direction and the rod 121 in the opposite direction. The right plate 118 is secured to the shaft 120 by a set screw 128, but is free to slide on the rod 121 while the left plate 118 is secured to the rod 121 by a set screw 129 and is free to slide on the rod 120. By this means each stroke of the feeders A will be accompanied by an inward movement of the plates 118 to bring the sides of the newly delivered groups E into register in the stack.

The movable plate 119 is urged against the stack by springs 130 (Fig. 3) on rods 131, equipped with fingers 132 cooperating with arms 133 on shaft 96. The detail of the support for the plate 109 and the spring action will be clear from the drawings without specific description. At each stroke of the feeder the arms 133 retract the plate 119 and when the cam block 124 is moved to bring the plates 118 against the sides of the stack, the spring 130 returns the plate 119 in timed relation to the inward movement of the plates 118, whereby, at each stroke, as each group falls upon the accumulating stack, the four plates 117, 118 and 119 are brought in such relation that the sheets forming the stack are necessarily made to register.

Operation

A pile of sheets 25 being placed on each feed board 14, and fanned out as indicated in Fig. 7, the motor is switched on. Through the mechanism shown best in the diagram of Fig. 2, it drives the several rack bars 28 with reciprocating motion and through the overrunning clutches 29, those bars drive the separator rolls 15 intermittently to the end that each feeder starts a sheet simultaneously with the others and delivers it to the pullout rolls 16, which are driven continuously and simultaneously through the beveled gears on shaft 40 (Fig. 2). Thus, each of the series of feeders delivers one sheet simultaneously with the others and the relation is such that it falls quietly and in approximately correct position on the conveyor B, which is driven in timed relation with the feeders so that the sheet from each feeder to the left is brought under the next sheet to be fed by the feeder to the right in time to receive it. Any lack of register is corrected by the pins 54 pushing the superposed sheets against the register stops 56 or 62, as the case may be.

The checker F receives each group as it leaves the conveyor and acts as a feed mechanism for the stack in the sense that it actually propels the group from the end of the conveyor into position to fall on the forming stack. In passing between the roller 64 and the two rollers 65 the group necessarily goes between the roller 64 and the pivoted caliper member 66, tilting down the detent 74 (Fig. 4) into the groove 9 in the roller 64. If the group is of normal thickness the caliper member 66 will not rotate to any significant extent and the notch 73 will remain substantially stationary to receive the detent 74 when the group releases the detent. If the group is too thin the spring 69 will swing the caliper member 66 to the left in Fig. 4 and close the circuit through contact 12, to stop the machine. If the group is too thick it will bind between the surface of the roller 64 and the caliper member 66 with the result that the latter will swing to the right in Fig. 4 and close the circuit with contact 11 and stop the machine. Whenever the machine is stopped by a group that is too thick or too thin, the attendant will remove the faulty group, reset the caliper if necessary, and restart the machine.

As long as the groups run true to size the checker will deliver them onto the forming stack, as indicated in Figs. 1 and 2, and as each group falls on the stack, the plates 117, 118, and 119 are brought together giving the accumulated stack a pat on each of the four sides to keep the sheets in proper register. All these things are done in timed relation and while the specific driving mechanism indicated more or less diagrammatically has been found satisfactory for the purposes, those skilled in the art will readily vary its form and construction, but the general scheme of the timed operation will be found advantageous.

Some users will prefer to have a checker associated with each feeder and from what has been disclosed they will readily apply a checker to the pullout rolls 16 and 17. In such an arrangement if a feeder should feed two sheets in-

stead of one, the checker would immediately detect that fact and stop the machine. Unless each checker is provided with means for actuating it when no sheet is fed at the time a sheet should be fed, the group checker illustrated should be retained so that, if any feeder should fail to feed a sheet, this checker would detect that fact and stop the machine. In that event the checker adjacent any one feeder could be omitted. In like manner there could be a group checker after each feeding position. Such an arrangement makes it impossible for the checker to be fooled by one feeder feeding more and another feeder feeding exactly the same amount less than should have been fed. Furthermore, providing a checker in connection with each feeder lends itself to a unit construction by which it is contemplated that the number of sheets or groups to be fed will determine the number of feeders in a particular collator. That being done, stock end frames are selected, a suitable length of conveyor is applied and an appropriate number of feeders are assembled thereon.

Some users will wish to have the checker not only stop the machine, but also give an audible and visible signal—the audible signal to draw attention to the fact that the machine has been stopped and the visible signal to indicate the particular feeder at fault. As a result a simple bell operated by the same switch that is closed by the swinging of the pivoted caliper member and a miniature semaphore operated by the same means or, if desired, separate means will be sufficient. The particular electrical or mechanical operations by which these things are done is so much a matter of selection that illustration has been omitted.

The form and construction of the frame is largely a matter of choice. Also, for economy of manufacture, all possible parts, such as the end frames, etc., should be stock and the intermediate portions should be readily cut from other stock in order to make it possible to quickly assemble a collator including any number of feeders, immediately after the specification has been made known. However, again in the interest of simplicity, the details have been omitted.

I claim:

1. In a collator, a series of timed sheet feeders, separating sheets from stacks and feeding separate sheets in timed succession, a conveyor traveling close beneath the feeders and receiving the fed sheets, one from each feeder in succession to form a group of sheets, and a group checker receiving each group in succession and testing it for uniformity.

2. In a collator, a series of timed sheet feeders, feeding separate sheets in timed succession, a conveyor traveling close beneath the feeders and receiving the fed sheets, one from each feeder in succession to form a group of sheets, propelling means on the conveyor for each group, registering stops for blocking the movement of the groups at fixed points in the path of conveyor travel to bring the constituent sheets into register, and means for moving some of the registering stops into and out of fixed position at said fixed points in timed relation to the feeders.

3. In a collator, a series of time sheet feeders including pullout rolls, feeding separate sheets simultaneously, and a conveyor traveling close beneath the feeders and receiving the fed sheets in series one on top of another to form groups, including one sheet from each feeders, the conveyor being so positioned as to initially receive the sheets while they are still being fed by the pullout rolls.

4. In a collator, a series of timed sheet feeders, each separating sheets from stacks and feeding separate sheets in timed succession, a conveyor traveling beneath the feeders and receiving the fed sheets, one from each feeder in succession to form a group, a group checker receiving each group in succession and including a driven feed roll over which each group passes, and a pivoted caliper finger acted upon by each group as it passes over the feed roll, and means operated by the finger to stop the feed of the sheets.

5. In apparatus of the class described, a group checker, including a driven roll, stretcher rolls cooperating with the driven roll, a pivoted caliper member between the stretcher rolls and cooperating with the driven roll, and a switch arm operated by the caliper member.

6. In apparatus of the class described, a group checker including a driven roll, a pivoted caliper member cooperating with the driven roll, a switch arm operated by the caliper member, and a sear for limiting the movement of the caliper member.

7. In apparatus of the class described, a group checker including a driven roll, a pivoted caliper member cooperating with the driven roll, a switch arm operated by the caliper member, and a pivoted sear between portions of the driven roll and the caliper member and normally limiting the movement of the latter.

8. In a collator, a conveyor traveling in a circuit, a plurality of timed sheet feeders spaced over the conveyor, each separating sheets from a stack and feeding in turn on the same part of the conveyor as it passes to form a group of superposed sheets on the conveyor, including a sheet from each feeder in succession, a group checker, receiving the groups in succession and delivering them in succession, a stack holder receiving the groups from the checker in superposed relation to form a stack, a jogger for registering the sheets in the stack on the stack holder and driving means for operating the conveyor, the stack holder, and the jogger in timed relation to the feeders.

9. In a collator, a series of timed sheet feeders, feeding separate sheets in timed succession, a conveyor traveling close beneath the feeders and receiving the fed sheets one on top of another, one from each feeder in succession to form a piled group of sheets on the conveyor, a stack holder receiving the groups in succession, movable plates to bring each newly received group into register with the stack of previously received groups, and means for operating the plates in uniformly timed relation to the feeders.

10. In a collator, a series of timed sheet separators separating sheets from piles and feeding them in timed succession, a conveyor traveling close beneath the separators and receiving the fed sheets directly from the separators, one from each separator in succession and each after the first on top of the preceding sheets to form a group of sheets on the conveyor, means for registering the front edges of the sheets in each group, and a group checker receiving each group in succession and actuated by the moving front edge of the group for testing the group at its front edge for conformity with a predetermined thickness.

11. In a collator, a series of timed sheet separators separating sheets from the tops of piles and feeding them in timed succession, a conveyor independent of the separator traveling close be-

neath the separators in the direction of movement of the sheets being fed from the separators and receiving the fed sheets directly from the separators while the conveyor travels, one from each separator in succession and each after the first on top of the preceding sheets to form a group of sheets, and means for receiving the grouped sheets from the conveyor.

12. In a collator, a series of timed sheet feeders for separating sheets from stacks and feeding separate sheets in timed succession, a conveyor traveling close beneath the feeders and receiving the fed sheets, one from each feeder in succession to form a group of sheets, a group checker receiving each of said groups in succession to test it for uniformity, and means responsive to said group checker to stop said conveyor when a group under test varies in thickness from the required uniformity.

13. In a collator for delivering groups of sheets to a group-receiving station, the combination of means to receive sheet material at a plurality of feed stations and to transport the sheet material to said group-receiving station, means to hold piles of like sheets at said feed stations, timed means to feed sheets from said piles to said transport means to form groups of sequentially arranged sheets thereon, and checking means cooperative with a moving surface of said transport means to test each of said groups for uniformity while the group is in motion towards said group-receiving station.

14. In a collator for delivering groups of sheets to a group-receiving station, the combination of, means to receive sheet material at a plurality of feed stations and to transport the sheet material to said group-receiving station, means to hold piles of like sheets at said feed stations, timed means to feed sheets from said piles to said transport means to form groups of sequentially arranged sheets thereon, and checking means cooperative with a moving surface of said transport means to test each of said groups for uniformity while the group is in motion towards said group-receiving station, said checking means having a normal group-receiving position and being releasable from said group-receiving position in response to movement of each of said groups by said transport means into testing position.

15. In a collator, means to receive sheet material at a plurality of feed stations and to transport the sheet material therefrom, a series of timed sheet feeders at said stations to feed sheets in timed sequence to said transport means to form piled groups of sheets on said transport means, checking means for contact with each of said groups in succession to test the group for uniformity, yielding means to urge said checking means into testing position, means to hold said checking means in a group-receiving position in opposition to said yielding means between testing operations, said holding means being releasable in response to movement of each group into testing position.

16. In a collator, a series of sheet feeders, a conveyor extending past said feeders to receive the fed sheets and to deliver the sheets to a group-receiving station, means to actuate said conveyor continuously and to actuate said feeders in timed relation to the conveyor whereby groups of sheets are progressively piled up in predetermined sequence on the continuously moving conveyor, and a group checker for moving contact with each of the successive piling groups of sheets to check the group for uniformity while the group is in motion towards said group-receiving station.

17. In an apparatus of the class described, a checker for a group of sheets, including means providing a moving support surface for the group of sheets, means to press said group against said moving surface to cause the group to move with the surface, caliper means movable towards said moving surface to test the group for thickness while the group is under pressure, and switch means operated by the caliper means.

18. In apparatus of the class described, a checker for a group of sheets, including means providing a moving support surface, means to force the group against said moving support surface to cause the group to move in the same direction as the surface, caliper means to cooperate with said moving surface for testing the group, yielding means to urge the caliper means towards said moving surface to test the group, and means to hold said caliper means retracted in opposition to said yielding means, said holding means being releasable in response to movement of the group into position between said caliper means and said moving surface.

19. In a collator for delivering groups of sheets to a group-receiving station, the combination of, conveyor means to receive sheet material at a plurality of feed stations and to transport the sheet material to said group-receiving station, means to hold piles of like sheets at said feed stations, and timed means separate from said conveyor means to remove sheets from said piles and to feed them in timed succession to said conveyor means, each of said feeding means being spaced closely above the conveyor means and being positioned to feed in the direction of travel of the conveying means.

20. In an apparatus of the class described, means providing a substantially unyielding support for movement of successive groups of sheets through a checking zone, a caliper means rotatably mounted on a fixed pivot substantially vertically above said support with a portion of the caliper means having a path of movement intersecting the path of movement of said groups at a point approximately vertically below said fixed pivot whereby a relatively great rotary movement of the caliper means corresponds to a given variation in thickness of a group of sheets, means to urge said caliper means in a rotary direction to carry said portion into contact with groups of sheets passing through said zone, said portion having a normal position spaced from said support by substantially the thickness of a normal group of sheets and being movable inwardly and outwardly from said normal position, and means responsive to movement of said caliper means to signalize movement of said portion either inwardly or outwardly from said normal position.

21. In an apparatus of the class described, means providing a substantially unyielding support for movement of successive groups of sheets along a given path through a checking zone, a caliper means rotatably mounted on a fixed pivot above said support with a portion of the caliper means having a path of movement intersecting the path of movement of said groups approximately at the point on said path nearest said fixed pivot whereby a relatively great rotary movement of the caliper means corresponds to a given variation in thickness of a group of sheets, means to urge said caliper means in a rotary

direction to carry said portion into contact with groups of sheets passing through said zone, said portion having a normal position spaced from said support by substantially the thickness of a normal group of sheets and being movable inwardly and outwardly from said normal position, a detent to hold said caliper means with said portion at said normal position, said detent being releasable temporarily in response to movement of a group of sheets through said checking zone, and means responsive to movement of said caliper means to signalize movement of said portion either inwardly or outwardly from said normal position.

22. In an apparatus of the class described, means providing a substantially unyielding support for movement of successive groups of sheets through a checking zone, said support having a recess, a caliper means rotatably mounted on a fixed pivot above said support with a portion of the caliper means having a path of movement intersecting the path of movement of said groups, means to urge said caliper means in a rotary

direction to carry said portion into contact with groups of sheets passing through said zone, said portion having a normal position spaced from said support by substantially the thickness of a normal group of sheets and being movable inwardly and outwardly from said normal position, a detent to hold said caliper means with said portion thereof at said normal position, said detent normally lying in an effective position extending across the path of movement of said groups and being retractable into an ineffective position in said recess in response to contact with a group moving through said checking zone.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,701,861	Niblack	Feb. 12, 1929