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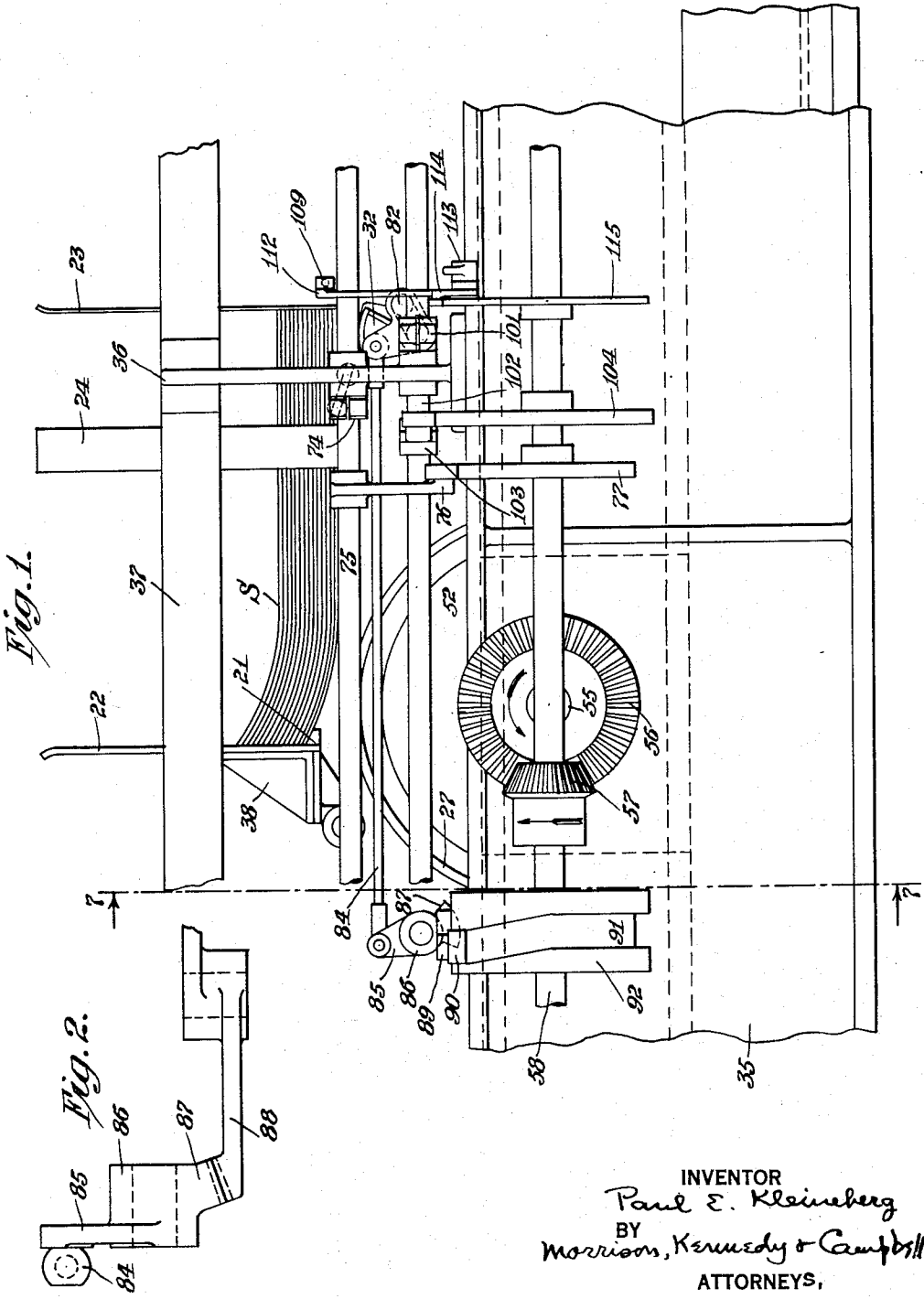
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2,082,064

SHEET FEEDING

Filed Nov. 9, 1935

4 Sheets-Sheet 1



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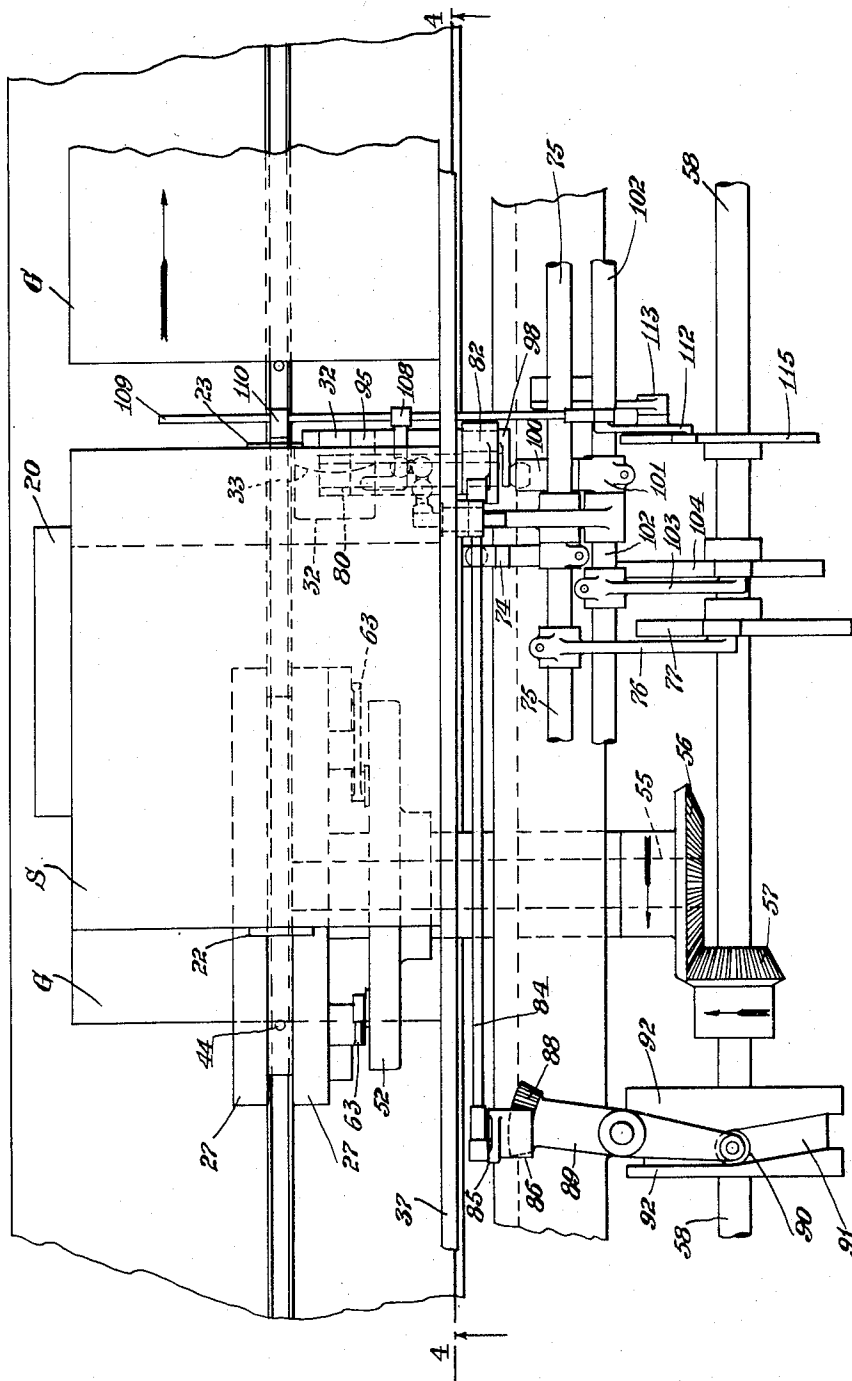
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4 Sheets-Sheet 2

Fig. 3.



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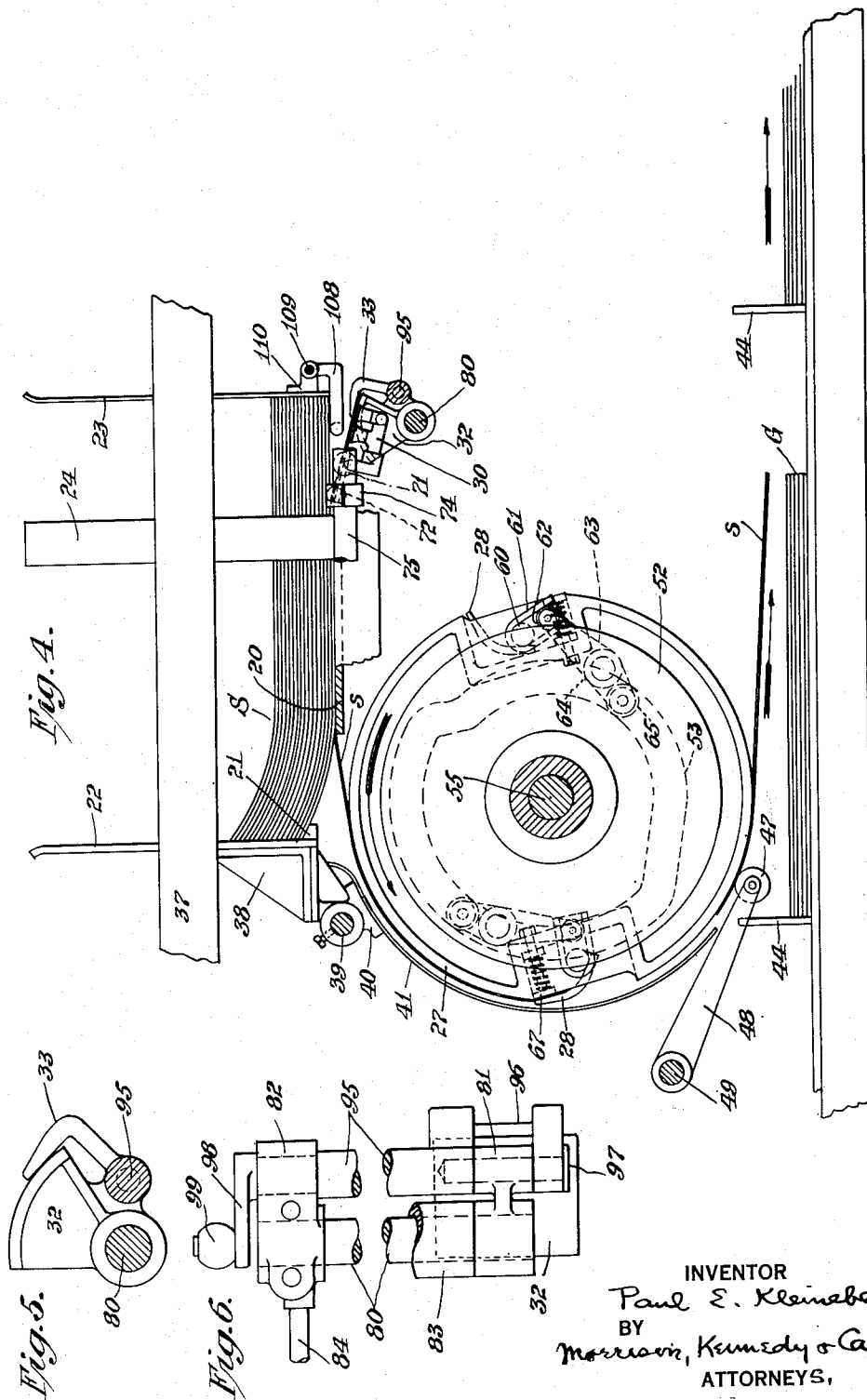
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SHEET FEEDING

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4 Sheets-Sheet 3



June 1, 1937.

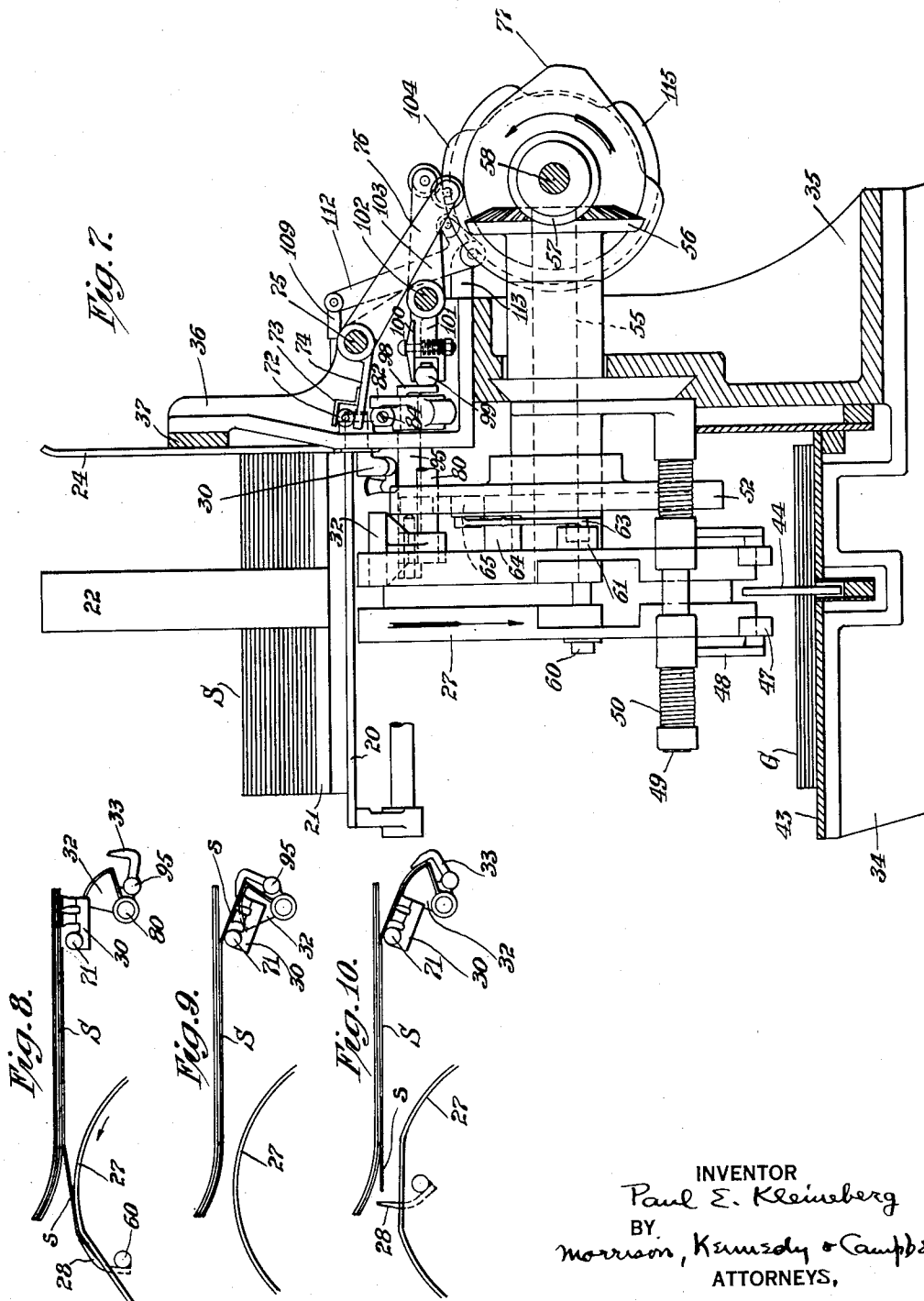
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SHEET FEEDING

Filed Nov. 9, 1935

4 Sheets-Sheet 4



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## UNITED STATES PATENT OFFICE

2,082,064

## SHEET FEEDING

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Application November 9, 1935, Serial No. 48,956

19 Claims. (Cl. 271—32)

This invention relates to sheet feeding, involving both method of and mechanism for feeding sheets, having particular reference to the feeding of sheets successively from the bottom of a stack or pile thereof, by separating downwardly and extracting the successive sheets and delivering them to a desired point of disposal or further operation.

In using the word sheets herein, it is intended to cover various thin or sheet-like members or components, such as single sheets of paper, folded sheets or signatures to be incorporated in books or pamphlets, covers for books, pamphlets, etc. For convenience the sheet feeding mechanism hereof is shown as designed and adapted for use with a signature gathering machine, such for example as that shown in my copending application Serial No. 695,605, filed October 28, 1933, Patent No. 2,020,321 issued November 12, 1935; although manifestly the delivery from the sheet feeding method or mechanism hereof may lead to various other kinds of apparatus such as printing or other presses, and embossing machines.

The general object of the present invention is to render more simple, reliable and convenient the feeding of sheets from underneath stacks thereof, and to permit increased speed of separating, extracting and delivering the sheets. A particular object is to provide a method of manipulation of the sheets which will be an improvement upon that illustrated in said copending application, especially by way of permitting the handling of each sheet from two opposite edges or ends, so that the detaching and separating downwardly of each lowermost sheet may be remote from the extraction and delivery thereof, thus avoiding conflict and congestion of mechanisms and permitting the greatest effectiveness of operation and design, at the same time allowing the operations on one sheet to be begun before the complete extraction of the preceding sheet from the stack.

Other and further objects and advantages of the present invention will be explained in the hereinafter following description of an illustrative embodiment thereof or will be understood by those conversant with the subject. To the attainment of such objects and advantages the present invention consists in the novel method of sheet feeding, the novel mechanism therefor, and the novel features of operation, combination and construction herein illustrated or described.

In the accompanying drawings, Figure 1 may be considered as a front elevation of a portion of a sheet or signature gathering machine with the present invention applied thereto.

Fig. 2 is a left elevation of a detail.

Fig. 3 is a top plan view of the machine and mechanism shown in Fig. 1.

Fig. 4, looking from the front, is a sectional elevation taken substantially at the line 4—4 on Fig. 3.

Fig. 5, on a larger scale, shows in front elevation the preliminary sheet gripping and pulling device operating at the right hand end of the stack.

Fig. 6 is a bottom view of part of the connections for the gripping and pulling device.

Fig. 7 is a general left elevation and section of the machine and mechanism shown in Figs. 1, 3, and 4, taken substantially on the section line 7—7 of Fig. 1.

Figs. 8, 9, and 10 are successive diagrams in front view indicating the relative arrangement and cooperation of the devices effecting the separation and extraction of each sheet.

The drawings show a stack S of sheets or signatures and at various places single sheets or signatures s in the process of extraction and delivery, for example to the accumulating signature groups G in a gathering machine. The stack S is shown resting upon an underneath support or plate 20 which is shorter than the length of the stack at each end, and may comprise rollers to facilitate the pulling and extraction of the lowermost sheet. For convenience of description the side nearest the observer in Figs. 1, 3, and 4 will be referred to as the front side of the stack and the opposite side the back side thereof. The end shown at the left will be referred to as the left end and the opposite as the right end of the stack. As the extraction is leftward, as will be explained, the left end edge of each signature will be referred to as the foremost or fore edge, and the right end edge as the hindmost or hind edge of the signature; and its leftward extraction an advancing movement, its rightward pull a retraction. These various terms are used only in a relative sense since all matters of position or direction may be varied at will.

The body of the stack S rests upon the underneath supporting plate 20, but its left end is free therefrom, and the extreme left edge of the stack is shown rested upon a supplemental support or bar 21, and this is spaced from and preferably slightly higher than the plate 20 so that the left end of the stack is held deflected or curved upwardly at this point.

The parts accommodating the signature stack may be referred to as a hopper or holder, comprising the underneath support 20 and rest 21, and at the left end an upright bar, strip or gage

22, with a similar bar or gage 23 at the right end and a bar or gage 24 at the front side, these three uprights serving as gaging members assisting the placing of supplies of sheets in the hopper.

Having thus described the sheet stack and its supporting hopper, the general method of handling may conveniently be first outlined, with special reference to Fig. 4 and the diagrams Figs. 8, 9, and 10. In Figs. 4 and 8 the first or bottommost sheet *s* is shown being pulled out or extracted leftwardly by a gripper means 28 engaging the sheet left edge and drawing it from underneath the stack for delivery, for example part way around a rotary drum 27 and thence upon the accumulating groups *G*. As soon as the lowermost signature has been pulled out leftwardly far enough to clear the under side of the second or next lower signature at its right end, such next signature may be immediately engaged, and then detached and separated downwardly from the stack, a suction device 30 being shown for this purpose. In Fig. 9 the suction detacher has bent downwardly the right edge of the second sheet, while the first sheet has been drawn out completely and delivered. The detached right edge of the second sheet is then engaged by a pulling device 32 with gripper 33, as seen in Figs. 4 and 9, which device thereupon retracts or rocks rightwardly to a limited distance, pulling the sheet rightwardly to a limited extent, as in Fig. 10. The action removes the left end edge of that sheet from the support of the bar 21, so that the left end of the sheet drops below the stack into a position exposed for gripping and extracting, as seen in Fig. 10. Following this position the pulling gripper releases the right edge of the sheet and the extracting device engages and commences the leftward extraction of the second sheet, in accordance with Fig. 8, whereafter the described steps are repeated.

While the detacher thus described moves reversely in and out, or oscillates in action, it may on the contrary be such as to rotate continuously according to one form disclosed in said patent; and the same observation refers to the depresser or separator hereinbelow described; these two elements constituting a sort of escapement, bringing sheets singly to gripping position for the pulling and extracting operations. Various other and general features described in said patent may be availed of herein, without disclosure, and the description of the present invention is restricted mainly to features of differentiation.

By this method of feeding it is possible to apply the sheet separating and the sheet extracting means at opposite ends of the stack, but working in cooperation as explained, and the preliminary separating and gripping of one end of each sheet being commenced before the complete extraction of the preceding sheet, thus accomplishing certain of the objects mentioned.

Referring more in detail to the mechanism there is shown in Fig. 7 a general base 34 upon the front of which is mounted an upright wall 35, see also Fig. 1, having a flat flange at the top, and thereupon a number of upright brackets 36 extending upwardly and giving rigid support to a continuously extending longitudinal frame bar 37 on which the front side upright 24 and other parts are mounted. At the left side of each upright 22 are shown angle members 38 and these give support to an underneath cross rod 39 supporting a block 40 on which is mounted

a guard wall 41 protecting the side of the drum 27 around which the sheets travel.

On the base, to the rear of the wall 35 is shown a flat plate or table 43 on which the signature groups *G* may accumulate and may be advanced, for example from left to right by a conveyor comprising a series of spaced pusher pins 44 on a conveyor chain 45, as is well understood in gathering machines.

The extracting drum 27 is shown as comprising spaced cylindrical disks with a recess between them and each having two recesses, one at each side, in each of which a gripper or finger 28 works. There is thus a double gripper at each side. As each sheet is gripped and extracted it is carried around counterclockwise, beneath the guard 41, and is released by the gripper when near the bottom of the drum, so that the sheet is discharged and finally delivered while in forward motion, that is, traveling in the same direction as the conveyor 44, 45 which receives the successive sheets from the feeding apparatus; in this case the conveyor traveling oppositely to the extracting direction, the drum reversing the sheet movement. To insure the continued travel and proper delivery of each sheet after the drum gripper opens there is provided an opposite pair of idle rolls 47 bearing upon the two sides of the drum and supported upon swinging arms 48 mounted on a cross rod 49, with springs 50 also located on the rod and operating to press the arms and rollers resiliently toward the drum periphery.

Mounted in front of the drum is a fixed cam disk 52, shown circular in form, containing a cam groove 53, as best outlined in Fig. 4, for the operating of the drum grippers. The drum itself is mounted on a transverse shaft 55 extending through the center of the cam 52 and through a suitable bearing on the frame wall 35, the front end of the shaft carrying a bevel gear 56 engaged by a bevel pinion 57 on a longitudinal shaft 58, which may run the whole length of the gathering machine and may be considered as the main or operating shaft. The gear has double the number of teeth of the pinion so that the drum makes only a half turn in each cycle, and delivers a sheet in each half turn or cycle, with smooth, continuous rotation.

Each part of each drum gripper 28 swings in the recess in one of the drum sides. The two are mounted on a pivot stud 60, see Figs. 4 and 7, with a forked extension 61 within which plays a stud 62 on a lever 63, in such manner that the swing of the lever causes a sudden closing movement of the gripper so that it may close in upon and grip the left end of the paper sheet *s*, as shown in Fig. 8, while the drum and gripper are moving counterclockwise in extracting direction. This action is controlled from the fixed cam 52, as will next be described, on principles explained in said patent.

The gripper operating lever 63 is shown fulcrumed on a boss 64 extending frontwardly from the rotary drum, and the short lever extension beyond its fulcrum carries a cam roll 65 which extends frontwardly in engagement with the cam groove 53 of the fixed disk 62. Fig. 4 shows the contour of the cam groove 53. The two grippers are shown, one on each side of the drum, that on the right side being open and that on the left side having closed due to the contour of the fixed cam, which operates each gripper as it comes to position to engage and grip each sheet, releasing each gripper as the foremost edge of the sheet

reaches the lower position of tangency, slightly to the right of the friction rollers 47. To cushion the gripper closing action and prevent injury to the sheet material there is shown a spring button 67 beneath the contacting ends of each gripper.

With the described arrangement the sheet extraction and delivery are along the longitudinal line of further travel or conveyance of the sheet, which is advantageous; but in some cases the sheets extracted in the manner described might be transversely delivered to a conveyor, similar to the long prevailing manner of depositing signatures upon the conveyor of a gathering machine.

Having described the extracting device 27 or drum with gripper there will next be described the sheet detaching device, and thereafter the pulling device which grips and pulls to a limited extent rightwardly the lowermost signature before releasing it for extraction leftwardly.

The detaching device is shown as comprising one or more suction cups 69, which may be simple suckers as of soft rubber, or may be of a more rigid type, with connections through the hollow body of the detacher to suitably controlled pneumatic means for applying and releasing suction, all in coordination with the other operations, in a manner generally well known. The body of the suction detacher 30 is provided with a pivot shaft 71 mounted on the frame upright 36. The front end of this short shaft has a leftwardly extending arm 72, as indicated in Figs. 1 and 4, having a spherical stud at its extremity, by which the rocking movements of the detacher may be effected.

The timed connections for the operation of the detacher may commence with a fork 73 at the rear end of a rock arm 74 which is fixed upon a longitudinal rock shaft 75. This rock shaft may be of indefinite length, with similar connections to bring about the operations of sheet detachers for any desired number of sheet stacks or hoppers, as in a gathering machine; and this comment applies to the shafts and connections to the other devices of the machine. For rocking the shaft 75 it is shown as having a front rock arm 76, the end of which carries a stud resting upon the periphery of a cam 77 turning continuously with the main shaft 58. Thus in each cycle or rotation of the main shaft the suction detacher goes through the cycle of operations indicated in Figs. 8, 9, and 10.

Referring next to the pulling device 32, shown with its body in the form of a segment, this is mounted on a transverse rock shaft 80. These parts are shown in enlarged view in Fig. 5, and the shaft is shown in the bottom view Fig. 6 wherein the shaft is seen to carry a rear rocker 81 and a front rocker 82, and the shaft turning in a suitable bearing 83. The two rockers are shaped to give support to the shaft 95 of the gripper finger 33 as will be described.

The bodily swinging movements of the pulling segment 32 between advanced position shown in Figs. 4 and 9 and retracted position shown in Figs. 8 and 10 may be effected by automatic connections, for example as follows: The front rocker 82 on the shaft 80 is shown as connected by a long rod 84 with an upright rock arm 85 near the left end of the machine. The rock arm 85 has a hub 86 on a horizontal bearing stud, and the hub carries a toothed sector 87, as shown more clearly in the enlarged view Fig. 2, this being in effect a section of a bevel gear. The bevel sector 87 meshes with a bevel sector 88 mounted at the

rear end of a horizontal rock lever 89 turning on a fixed vertical stud and having at its front end a follower 90 engaging in the groove 91 of a disk cam 92 turning with the operating shaft 58. By these connections each rotation of the main shaft causes the pulling device or segment 32 to go through its swinging retracting and returning movements as described.

The gripper 33 of the puller is mounted on a shaft 95 offset from the puller shaft 80, and turning in the rockers 81 and 82, so that while the gripper may swing bodily with the puller segment it may also swing relatively thereto as indicated in the diagrams. In the bottom view Fig. 6 the rear end of the gripper shaft 95 is shown as formed with a yoke 96 which straddles the rocker 81, a pin 97 engaging the rocker and the two sides of the yoke, affording the rear bearing for the gripper shaft. The front end of the gripper shaft 95 carries a rock arm 98 with a stud or ball 99 at its extremity, shown as located approximately at the axis of the puller shaft 80, so that the ball is not displaced by the rocking of the shaft.

The automatic connections for working the gripper finger 33 may be as follows: The gripper shaft rock arm 98 has its ball 99 engaged by a fork 100 mounted at the rear end of a rock arm 101, in turn mounted on a longitudinal shaft 102. The gripper is controlled by the rocking of the shaft 102, which for this purpose has a forwardly extending arm 103, the end of which carries a follower engaging upon the periphery of a cam 104 on the main shaft 58. This cam is shaped to co-ordinate the gripper movements with the movements produced by the cams 77 and 92 on the shaft 58 as already described.

An additional operating device or instrument is sometimes desirable, herein referred to as a sheet depresser, entering in between each downwardly detached sheet and depressing and holding depressed this sheet, separated from those above it, to insure that the pulling device gripper will engage the depressed sheet and that sheet only, for pulling and subsequent extracting operations. As seen in Fig. 3 the suction detaching device is near the right hand front corner, which is an advantage in the case of the handling of signatures, which may be stacked with their folded back edges extending longitudinally and bearing against the front gage 24. This position of the suction detacher insures that the entire signature corner, rather than merely a part of the signature will be lowered. The function of the depresser is thereupon to enter above the detached corner, rendering permanent its separation from the signatures above, the depresser then preferably moving toward the central portion of the right hand end or hind edge of the signature, so as to separate downwardly that edge in preparation for its gripper engagement and pulling as already described.

For this purpose a depresser or finger 108 is shown, mounted for example slidably, to be retracted frontwardly from beneath the stack and to be moved rearwardly to enter above the detached signature corner. For this purpose the depresser or finger 108 is shown mounted on a transverse sliderod 109 sliding in a rear bracket 110. The depresser is shown as in its operative position in Figs. 3 and 4, but as soon as the gripper has engaged the signature, as in Figs. 4 and 9, the depresser may slide forwardly clear of engagement with the signature stack, to be returned again above the detached corner. These

frontward and rearward movements of the depresser may be effected by sliding the rod 109 by an operating arm 112 pivoted upon a bracket 113, the long end of the arm being pivoted to the rod 109, and its short end 114 having a follower running upon the periphery of a cam 115 on the main shaft 58. The contour of the cam is such as to shift the depresser rearwardly and forwardly in coordination with the movements of the suction detacher and the pulling gripper, as described.

The method of this invention, and the mode of operation of the apparatus hereof, may be outlined as follows: In the stack holder or hopper the pile of sheets is supported centrally underneath, with both ends exposed, but the extreme left or foremost edge supported, preferably at a higher level, with a gap between the central and edge supports. The first operation on each sheet is its separation downwardly from the stack at the right or hindmost end edge; and this is shown as comprising two steps, first, the detaching of the lowest sheet or signature, for example by suction and preferably at the corner; followed by the depression of the hind edge, by the entry of the depresser above the detached corner; these two devices acting like an escapement and positioning the sheet edge to be engaged or gripped. Next, the pulling device engages, by gripping, the downwardly separated hind edge and thereupon pulls it retractingly or rightward partly out from beneath the stack. This need be only a short movement, sufficient to cause the lowest sheet to lose its support at its fore or left edge, so that this edge drops substantially away from the remainder of the stack. Finally, the extractor engages and grips this free left or fore edge of the lowest sheet and, the puller having released the sheet, the sheet is then extracted advancingly or leftward completely for delivery, as to the traveling conveyor which takes away the sheets in procession. The cams 71, 92, 104, and 115 are shaped to afford the described sequence of operations.

While the stack holder has been described as comprising an abridged underneath main support which leaves the stack ends exposed below and in combination therewith a fixed edge support at the fore end spaced from the main support, nevertheless the edge support, while preferable, not an essential element, since the left or fore edge of the stack might be unsupported but intermittently lifted at the time the extracting gripper engages the retracted fore edge of the lowest sheet, as for example by operating the extracting means in a manner to contact and lift or hold up the stack at the left edge while its gripper engages the lowest sheet; or on the other hand the stack fore end might be allowed to sag and the lowest sheet separated downwardly, as by air blast, into reach of the extracting gripper.

An illustrative sheet feeding method and apparatus have thus been described affording the advantages recited, but as the principles involved may be embodied in various forms, it is not intended to limit the invention to the illustrated embodiment except so far as specified in the claims.

1. Sheet feeding apparatus comprising a holder for a stack having an abridged underneath main support leaving the stack ends exposed below, and an edge support at the fore end spaced from and higher than the main support whereby to hold upbent the stack fore end, means for separating downwardly from the stack the hind end of the bottom sheet, a device for

gripping such separated hind edge and pulling the sheet partly out retractingly thereby releasing its fore edge from said edge support, and releasing the hind edge with the sheet in such partly retracted position, while the bottom sheet is still above the main support, and means for gripping such fore edge and extracting the sheet completely from the stack.

2. Apparatus as in claim 1 and wherein the separating means comprises a movable detaching device to contact and swing downwardly the bottom sheet edge, and a movable depressing device to enter above the detached sheet edge and hold it in position for the engaging and pulling means.

3. Apparatus as in claim 1 and wherein the sheet extracting means comprises a rotary device or drum turned in coordination with the other elements and carrying a gripper operated to grip each sheet whereby the rotation extracts and delivers it.

4. Apparatus as in claim 1 and wherein the pulling means comprises an oscillating body member and a gripper finger, and timed connections to cause the finger to enter above the sheet hind edge and grip it against the body, and the body and finger then to swing retractingly, and the finger then to release the sheet, and the parts then to return to original position.

5. A signature feeding machine of the type having a longitudinal traveling conveyor for advancing longitudinally the fed signatures, a hopper to support a stack of signatures with their back edges longitudinal and their lateral end edges exposed beneath the end of the hopper, and for such hopper a detacher for separating downwardly the lowest signature corner at one end adjacent its back edge, a depresser for entering above such detached corner and deflecting downwardly the signature lateral end edge at such end, gripping means for gripping each signature at such end and pulling it partly from the stack, gripper means for gripping each signature at the other end, drawing it longitudinally from the hopper and delivering it with advancing longitudinal motion to the conveyor, and timed means for coordinately actuating the conveyor, the detacher, the depresser and the respective gripper means.

6. A signature feeding machine of the type having a longitudinal traveling conveyor for advancing longitudinally the fed signatures, and comprising in combination, a hopper to support a stack of signatures with their back edges longitudinal and their lateral end edges exposed beneath the end of the hopper, and for such hopper means for separating downwardly the lowest signature corner at one end adjacent its back edge and for deflecting downwardly the signature lateral end edge, gripper means comprising a first gripper for gripping each deflected signature at said end and pulling it longitudinally to a short extent and releasing it, and a second gripper at the other end for gripping each signature, extracting it from the hopper and delivering it longitudinally to the conveyor, and timed means for coordinately actuating the conveyor, the separating and deflecting means, and the gripper means.

7. A signature feeding machine of the type having a longitudinal traveling conveyor having pushing means for advancing longitudinally the fed signatures and comprising in combination, a hopper to support a stack of signatures with

their back edges longitudinal and their lateral end edges exposed beneath the ends of the hopper, and for such hopper means for separating the lateral end edge of each lowest signature from the signatures above it at the hind end, and means for gripping such separated signature and pulling it slightly from position, and other gripper means, operating at the fore end, for gripping and extracting the signature longitudinally from the hopper and delivering it with longitudinal advancing motion to the advancing conveyor, and timed drive connections for coordinately actuating the conveyor and said means.

8. In a machine as in claim 7, means at the hopper fore end for holding deflected upwardly the signature stack at that end whereby when the lowest signature is pulled therefrom it drops into reach of the fore end gripper means.

9. Sheet feeding apparatus comprising a holder for a stack having an abridged underneath main support leaving the stack ends exposed below, and an edge support at the fore end spaced from the main support, means for separating downwardly from the stack the hind end of the bottom sheet, a gripper and means operating it for gripping such hind edge and pulling the sheet partly out retractingly, thereby releasing its fore edge from said edge support, and for releasing the sheet in such partly retracted position, and other means for engaging the fore edge of the sheet and extracting the sheet completely from the stack.

10. Sheet feeding apparatus comprising a holder for a stack having an abridged underneath main support leaving the stack ends exposed below, and an edge support at the fore end spaced from the main support, means for separating downwardly from the stack the hind end of the bottom sheet, means for engaging such hind edge and pulling the sheet partly out retractingly thereby releasing its fore edge from said edge support, and releasing the sheet in such partly retracted position, and means for engaging such fore edge and extracting the sheet completely from the stack; said separating means comprising a movable detaching device to contact and swing downwardly the bottom sheet edge, and a movable depressing device to enter above the detached sheet edge and hold it in position for the engaging and pulling means.

11. Apparatus as in claim 1 and wherein the pulling means comprises an oscillating body member and a gripper finger, and timed connections to cause the finger to enter above the sheet hind edge and grip it against the body, and the body and finger then to swing retractingly, and the finger then to release the sheet, and the parts then to return to original position.

12. The method of feeding and delivering signatures singly from the bottom of a stack thereof comprising supporting the stack centrally underneath and separately supporting its foremost edge, with an unsupported gap between such edge and center support, separating downwardly and engaging the hindmost edge of the bottom signature and pulling it retractingly sufficiently for the signature to lose its support of its foremost edge only while retaining its center support with the stack, the released foremost edge of the signature thereupon dropping naturally by reason of such release to a gripping position below its original supported position, and then gripping such dropped foremost edge by a gripping action applied at a point sufficiently high to grasp the

edge in its naturally dropped position and thereupon pulling the signature forwardly completely out from above its center support and from the stack for delivery.

13. The method of feeding sheets or the like singly from the bottom of a stack thereof comprising supporting the stack centrally underneath and separately supporting its foremost edge slightly higher than its center, with an unsupported gap between such edge and center support, separating downwardly the hindmost edge of the bottom sheet and gripping and pulling it retractingly sufficiently for the sheet to lose its support of its foremost edge, causing the foremost edge thereupon to drop below its supported position, while still supported with the stack by such center support, and then engaging such dropped foremost edge and pulling the sheet out completely for delivery from its center support.

14. Sheet feeding apparatus comprising a holder for a stack having an abridged underneath main support leaving the stack ends exposed below, and an edge support at the fore end spaced from the main support, means for separating downwardly from the stack the hind end of the bottom sheet, gripper means for engaging such hind edge and pulling the sheet partly out retractingly thereby removing its fore edge from said fore edge support, and for releasing the sheet in such partly retracted position, whereby such bottom sheet lowers itself from the stack at its fore end, while the sheet remains supported with the stack on the main support, and means for directly gripping such self-lowered fore edge and extracting the sheet completely from the stack.

15. Signature feeding apparatus comprising a holder for a stack having an abridged underneath main support leaving the stack ends exposed below, means for separating downwardly the hind edge of the bottom signature, means for engaging such separated hind edge of the bottom signature and pulling the signature partly out retractingly thereby offsetting its fore edge and for then releasing the signature in such partly retracted position, whereby such bottom signature lowers itself from the stack at its fore end while still resting on the main support, and means for gripping such fore edge and extracting the signature completely from the main support.

16. Automatic sheet feeding apparatus comprising a holder for a stack having an abridged underneath main support leaving the stack ends exposed below, and a fore edge support spaced from and slightly higher than the main support, to hold the sheets bent up at their fore edges, timed means for separating downwardly from the stack the hind end of each bottom sheet in succession, timed means for engaging such hind edge and pulling the sheet partly out retractingly thereby offsetting its fore edge from said edge support permitting the fore edge to drop, and for releasing such hind edge with the sheet in such partly retracted position resting on the main support, timed means for engaging such dropped fore edge and extracting the sheet completely from the stack, and delivering it, and a conveyor receiving the successively delivered sheets and carrying them away.

17. Apparatus for feeding flexible sheets or signatures successively from the bottom of a stack, comprising a preliminary sheet engaging and pulling means to retract at the hind end the bottom sheet partly, and a final sheet engaging and extracting means operating on the partly re-

tracted sheet at the fore end, in combination with means for supporting the stack in such manner that when the bottom sheet is partly retracted the sheet remains centrally supported with the stack but its fore edge will drop away from the stack for engagement by such extracting means.

18. Apparatus for feeding flexible signatures or sheets successively from a signature supply supported in a hopper, comprising such hopper, the same having a hopper wall against which the first signature bears at its middle portion, and having means for holding the signatures in a strained position with their fore ends curved away from flatness toward the interior of the hopper, a preliminary signature retracting means arranged to grip at its hind end and retract partly the first signature and there release it, thereby effecting withdrawal and release of its fore end from said holding means and permitting the same to relax and return towards substantial flatness and thereby separate itself away from the second signature, and a final signature extracting and delivering means located to operate at the fore end of the partly retracted first signature to grip its released fore end and draw the

signature completely out and deliver it from the hopper.

19. Apparatus for feeding flexible signatures or sheets successively from a signature supply supported in a hopper, comprising such hopper, the same having a hopper wall against which the first signature bears at its middle portion, and having a stationary part cooperating therewith for holding the signatures in a bent condition with their fore ends curved away toward the interior of the hopper, a separating means for separating the hind end of the first signature from the second signature, a preliminary signature gripping and retracting means arranged to grip at its hind end and retract partly the separated first signature and release it, thereby effecting withdrawal and release of its fore end from said holding means and permitting the same to relax and thereby separate itself away from the second signature, and a rotary signature extracting and delivering means located to grip the relaxed fore end of the partly retracted first signature and draw the signature completely out from the hopper.

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