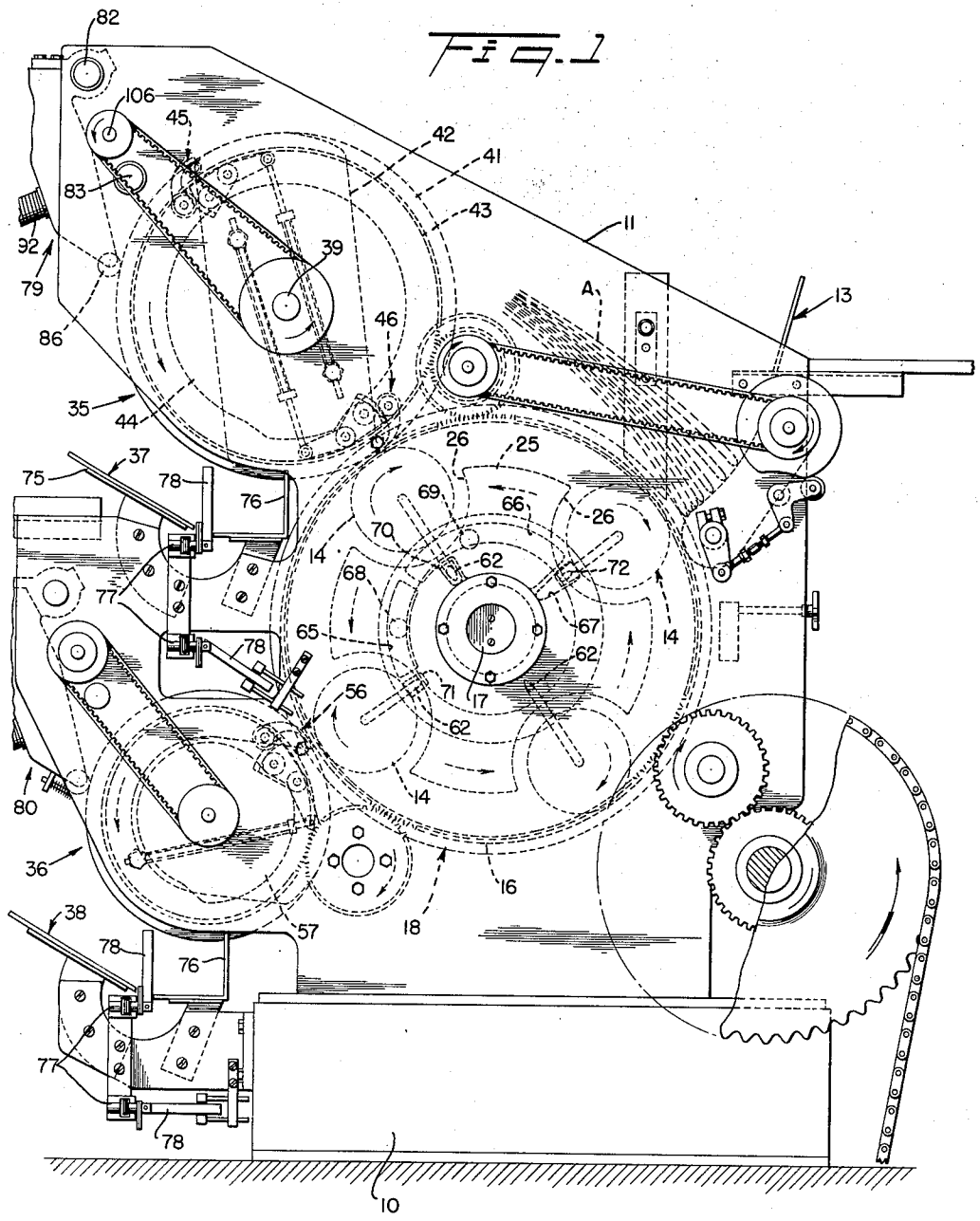
Sept. 1, 1964 O. L. GORE 3,147,007

SIGNATURE HANDLING APPARATUS

Filed Dec. 28, 1959 5 Sheets-Sheet 1

FIG. 1



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SIGNATURE HANDLING APPARATUS

Filed Dec. 28, 1959 5 Sheets-Sheet 2

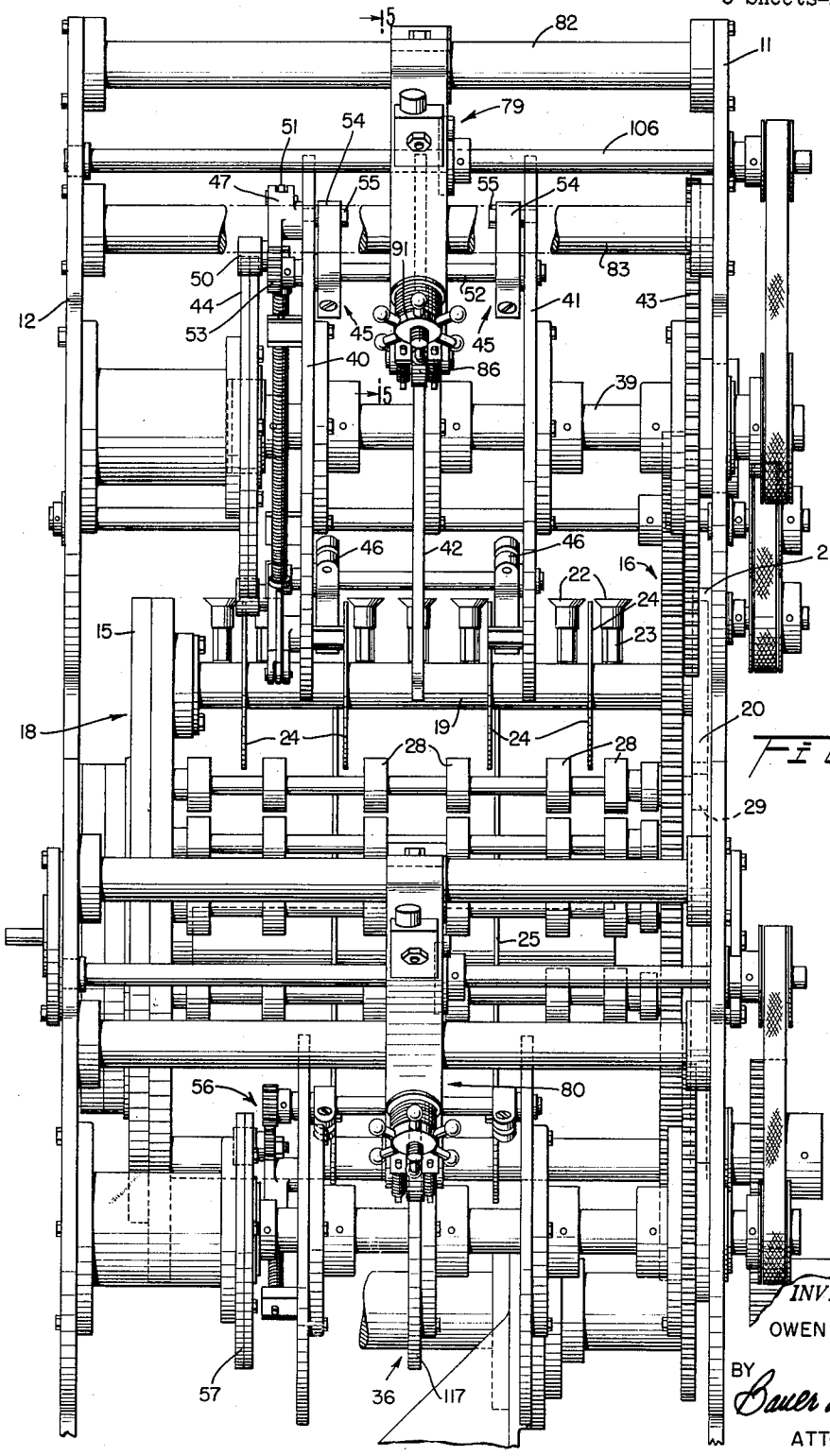

Fig. 2

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SIGNATURE HANDLING APPARATUS

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Fig. 3

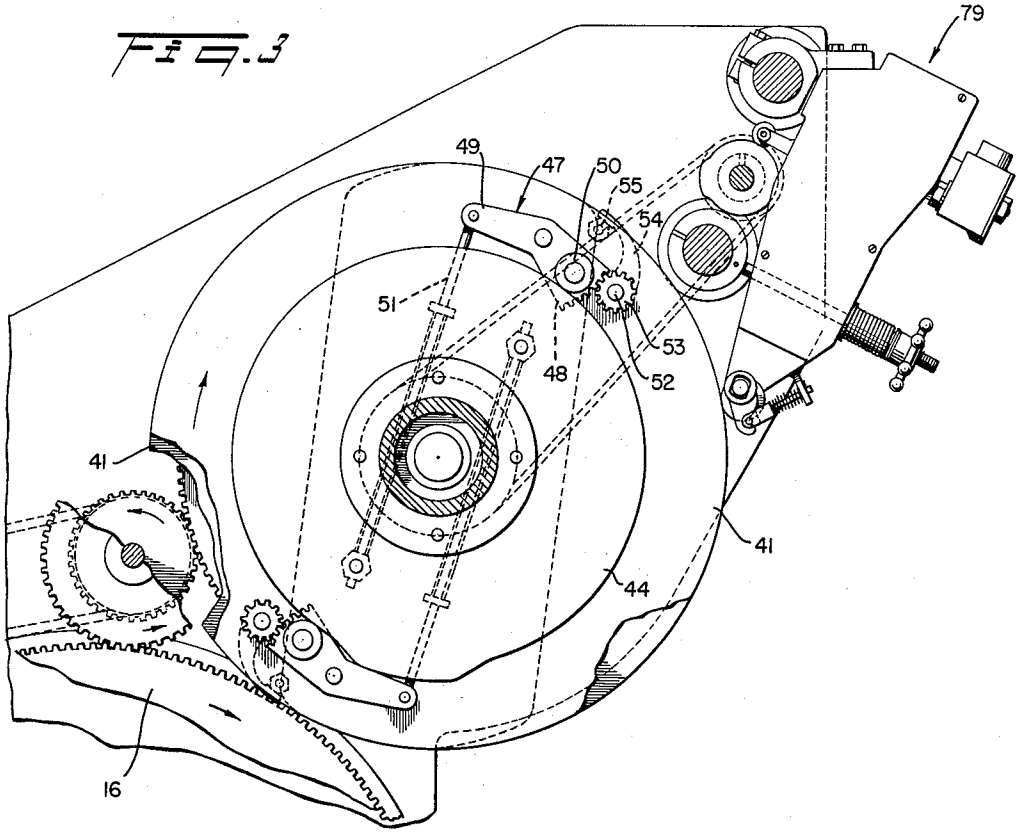
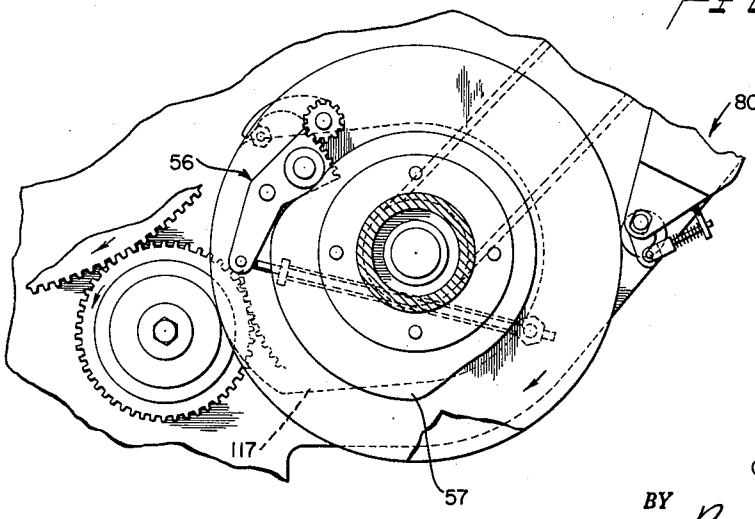


Fig. 4



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SIGNATURE HANDLING APPARATUS

Filed Dec. 28, 1959 5 Sheets-Sheet 4

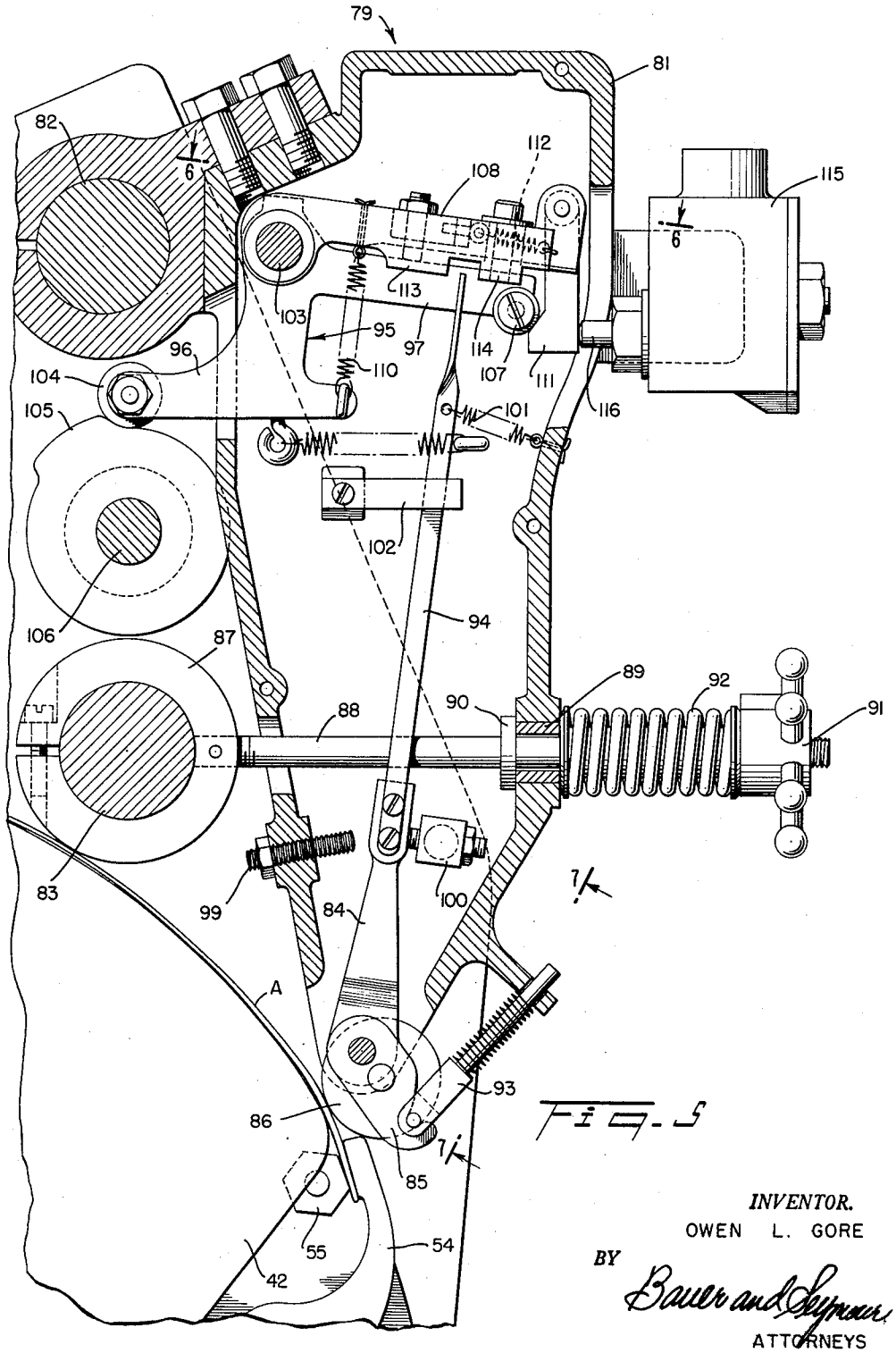

Fig. 5

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Fig. 6

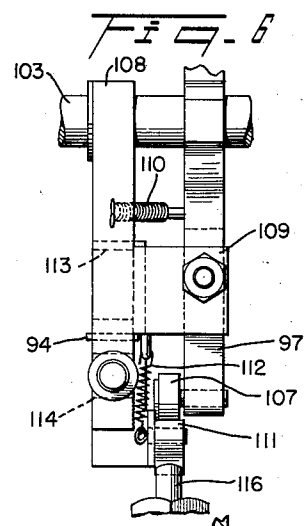

Fig. 8

Fig. 7

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United States Patent Office

3,147,007

Patented Sept. 1, 1964

3,147,007

SIGNATURE HANDLING APPARATUS

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Filed Dec. 28, 1959, Ser. No. 862,278
12 Claims. (Cl. 270—56)

This invention relates to a signature collating apparatus and more specifically to a method and apparatus for feeding signatures in rapid succession from a series of hoppers to a plurality of conveyors where the signatures are gathered together to form completed books, magazines or the like.

One object of the present invention is to provide a signature collating apparatus of new and improved construction which is efficient and rapid in operation, rugged in construction and which requires substantially less space for its installation than signature collating apparatuses of the same general character heretofore known.

Another object of the invention is to provide a signature collating apparatus of improved construction which will transfer signatures at a rapid rate from a supply hopper to a plurality of signature gathering conveyors.

Another object of the present invention is to provide an improved signature collating apparatus in which the signatures are removed from a supply hopper at a high rate of speed and alternately fed to a plurality of signature transfer means.

Another object is to provide a novel apparatus which will feed sheets of paper at a rapid rate from a supply hopper and alternately deposit the fed sheets on a plurality of slower moving conveyors.

Another object is to provide a novel apparatus which will selectively remove designated signatures from a signature transfer means and deposit the same on a predetermined conveyor.

Another object is to provide a novel sheet collating apparatus which will rapidly transfer sheets from a supply hopper and deposit the same on a plurality of sheet gathering conveyors and which will measure the thickness of each sheet as it is being so transferred.

A still further object is to provide an improved signature calipering mechanism operable with a signature transfer mechanism.

The above and further objects and novel features of the invention will more fully appear from the following detailed description when the same is read in connection with the accompanying drawings. It is to be expressly understood, however, that the drawings are for the purpose of illustration only and are not intended as a definition of the limits of the invention.

In the drawings, wherein like reference characters refer to like parts throughout the several views,

FIG. 1 is a side elevational view showing the general arrangement of the various parts of the signature feeding mechanism;

FIG. 2 is an end elevational view showing the general arrangement of the various parts of the signature feeding mechanism;

FIG. 3 is a side elevational view, partly in section, taken along line 3—3 of FIG. 2 and showing the upper transfer reel and caliper means together with the drive mechanism therefor;

FIG. 4 is a side elevational view, partly in section, taken along line 4—4 of FIG. 2 and showing the lower transfer reel and caliper means together with the drive mechanism therefor;

FIG. 5 is a side elevational view of the signature caliper means taken along line 5—5 of FIG. 2 with the outside casing thereof broken away to show the inner mechanisms;

FIG. 6 is a top plan view of the signature caliper means taken along line 6—6 of FIG. 5;

FIG. 7 is an end elevational view of the lower portion of the signature caliper means taken along line 7—7 of FIG. 5; and

FIG. 8 is a cross sectional end view of a portion of the main rotor and one signature transfer means taken at the suction end of the main rotor and showing the structure by which vacuum is supplied to the suction cups in each signature transfer means mounted on said rotor.

Referring to the drawings, one form of a signature handling and feeding mechanism constructed and operated in accordance with the present invention is herein illustrated as being embodied in a signature gathering machine of new and improved construction wherein a series of supply stacks or hoppers containing piles of printed and folded sheets referred to as signatures are simultaneously fed from said hoppers by a corresponding series of signature transfer means. Each of the signature transfer means alternately deposits a signature on two spaced apart pusher type conveyors so that the signatures from each hopper are successively assembled flatwise one upon another into groups on each conveyor for subsequent stitching and/or binding operations to form complete books, magazines or the like. It will be understood that this novel signature handling and feeding mechanism may also be embodied in other machines for handling and feeding plain sheets of paper as well as signatures. For the sake of simplicity and brevity in illustrating and describing the present invention, and since all the feeders are identical in construction, arrangement and operation, only one of the series of signature handling mechanisms is illustrated and described.

In this specification such terms as front and back, upper and lower and the like are employed in a relative sense and are not intended as limitations as to position, direction and the like of various parts.

Referring to FIGS. 1 and 2, a base **10** supports a pair of spaced apart vertically extending plates **11** and **12** to which the various parts of the signature handling mechanism are secured. Signatures designated as A are stacked by hand or other means in a hopper **13**. Beneath the hopper a plurality of rotating signature transfer means **14** are carried in a circular orbital path on a rotor **18** formed by a pair of spaced apart discs **15** and **16**. Discs **15** and **16** are secured together by suitable tie rods and are secured to a rotatable shaft **17**, the ends of which are mounted in suitable bearings in plates **11** and **12**. The outer peripheral edge of disc **16** is provided with gear teeth by which the discs **15** and **16** and shaft **17** are rotatably driven. While the transfer means **14** are being carried in an orbital path by the rotation of discs **15** and **16**, each is independently rotated about a shaft **19** by means of the engagement of gear **20** which is secured to one end of the shaft, with a stationary gear **21** secured to the side plate **11**.

Each of the signature transfer means **14** is of identical construction and operation and therefore a description of one will be sufficient for an understanding of all. Each transfer means includes a plurality of suction cups **22** mounted on the ends of supports **23** which, in turn, are mounted on the shaft **19**. Suction cups **22** are mounted in axial alignment so that all engage and act at the same time upon the lowermost signature in the hopper. Axially disposed along shaft **19** and located between adjacent suction cups are a plurality of signature disc supports **24** which are secured for rotation with shaft **19**. Upon rotation of shaft **19** past the hopper **13**, the suction cups **22** grasp the folded edge of the lowermost signature in hopper **13** and carry said edge in a planetary orbital path and the discs **24** support the leaves of the signature

in their planetary orbital movement. Secured in the space between discs **15** and **16** by means of the tie rods and rotatable therewith are a pair of spaced apart guide discs **25** having cut away portions **26** which are radially spaced apart from but complementary to the shape of discs **24** and the rotational path of each set of suction cups **32**. The leaves of each signature are thus further guided in their plentary orbital path and prevented from falling into the center of the feeder. As the suction cups **22** are carried into contact with the folded edge of the lowermost signature in the hopper **13**, suction is applied thereto, in a manner hereinafter to be described, so that said folded edge is secured to the suction cups. Since the suction cups are being rotated in a clockwise direction (as viewed in FIG. 1) and at the same time they are being carried in a counterclockwise direction, the signature is peeled from the bottom of the hopper and wound around the support discs **24**. It will also be noted that all of the folded edges of the signatures are purposely stacked at the same end of the hopper so that the orbital moving suction cups may engage the same as they approach the hoppers.

A plurality of spaced apart shafts **27** are rotatably mounted between discs **15** and **16** and along their peripheral edges. A plurality of rolls **28** are secured to each of the shafts **27**. Secured to one end of each shaft is a gear **29** of the same diameter as rolls **28** and which meshes with the stationary internal gear **21** so that as rolls **28** are being carried in an orbital path by the rotation of discs **15** and **16** they are independently rotated on their shafts **27**. Rolls **28** and shafts **17** are mounted intermediate each transfer means **14** along the peripheral edges of discs **15** and **16** and serve to support the weight of the signatures in the hopper as they pass beneath. Because gears **29** and rolls **28** are of the same diameter there is no slippage between the lowermost signature in the hopper and the rolls as the rolls pass beneath the hopper and, consequently, no slippage as the lowermost signature is removed from the hopper by a peeling action as set forth above.

The hopper **13** may be of any suitable construction wherein the bottom of the pile of signatures are supported by rolls **28** and wherein the folded edges of the signatures are fed downwardly with the folded edge of the lowermost signature supported out of the path of movement of the rolls **28** and of each of the transfer means **14** except for the period of time when the suction cups **22** are engaging said folded edge of the lowermost signature. Such a hopper construction and feeding means is disclosed in the copending application of Owen L. Gore and Leo C. Williams, Serial No. 753,733, filed August 7, 1958, now U.S. Patent No. 3,089,693.

A pair of transfer reels **35** and **36** are rotatably mounted between support plates **11** and **12** and in proximity to the path of travel of the plural signature transfer means **14**. A horizontally extending conveyor **37** is located beneath transfer reel **35** and a horizontally extending conveyor **38** is located beneath transfer reel **36**. The transfer reel **35** comprises a shaft **39** having its ends secured in suitable bearings in support plates **11** and **12** and having secured thereto a pair of spaced apart sheet or signature support discs **40** and **41**, a caliper disc **42** positioned between discs **40** and **41**, and a driven gear **43** positioned adjacent the support **11**. A cam **44** is fixedly secured to the support plate **12** and is positioned adjacent the outer surface of disc **40**. A pair of grippers **45** are located in axial alignment and adjacent the inner surfaces of discs **40** and **41**. A second pair of grippers **46** are also positioned in axial alignment and adjacent the inner surfaces of discs **40** and **41** and are positioned 180° away from grippers **45**. Grippers **45** and **46** are of identical construction and operation and therefore a description of one will be sufficient for an understanding of all. Referring more particularly to FIGS. 2 and 3, there is shown a crank **47** having arms **48** and **49** which is pivotally mounted at its center to the outside surface of disc **40**. The outer end of arm **48** is in the form of a gear segment and has a cam follower **50** pivotally mounted thereto and adjacent the gear segment. The cam follower **50** is constantly held in operational contact with cam **44** by means of a rod member **51** which is pivotally secured at one end to the outer end of arm **49** and has its other end slidably retained in a bracket fixed to the inner surface of disc **40**. A collar is integrally formed on rod **51** and a spring is telescopically mounted over said rod and compressed between the collar and the bracket. Thus, rod **51** is constantly urged upwardly and crank **47** is constantly urged clockwise to force the cam follower **50** into operational contact with cam **44**. A gripper shaft **52** has one end rotatably mounted in suitable bearings in disc **41** and its other end extending through and supported in suitable bearings in disc **40** and mounted thereto is a toothed gear **53** which meshes with the gear segment on arm **48**. Fixedly secured to shaft **52** and adjacent the inner surfaces of each of the discs **40** and **41** are a pair of gripper arms **54**. Gripper pads **55** are secured to discs **40** and **41** and extend horizontally inwardly toward each other and are positioned in the normal arcuate path of the outer end of the gripper arms **54**. Thus, as the cam follower **50** rides on the low part of the cam **44**, the outer end of the gripper arms **54** are in contact with the gripper pads **55** and serve to hold the folded portion of a signature therebetween. When the cam follower **50** rides up onto the high part of the cam **44**, the crank **47** is rotated in a counterclockwise direction as viewed in FIG. 3, which in turn rotates the shaft **52** and the gripper arms **54** in a clockwise direction and away from the gripper pads **55** to release a signature which is held therebetween. The signature transfer reel **36** and its pair of grippers **56** are of the same construction and operation as the transfer reel **35** and its grippers **45** and **46**. However, as will be described hereinafter, since the transfer reel **36** is of smaller diameter than transfer reel **35**, has only one set of grippers and rotates at twice the speed of reel **36**, the gripper operating cam **57** has a different contour than cam **44**.

The signature collating apparatus is driven from a source of power, not shown, through a chain drive and suitable gears intermeshing with the gear at the peripheral edge of disc **16** as shown in FIG. 1 to drive the rotor **18**. The transfer reels **35** and **36** are driven through suitable gearing from the rotor **18** as well as is the feeding mechanism from the hopper **13**. The drive mechanisms are so arranged and proportioned that each signature transfer means **14** makes four complete revolutions as the rotor **18** makes one complete revolution. The feeding mechanism on the hopper **13** makes four complete cycles of operation as the rotor **18** is making one complete revolution. The transfer reel **35** makes one complete revolution for one complete revolution of the rotor **18** while transfer reel **36** makes two complete revolutions for one complete revolution of the rotor **18**. The row of suction cups **22** on each transfer means **14** are rotated once during each complete revolution of said transfer means, through a point of intersection with the arcuate plane which extends between the peripheral edges of discs **15** and **16**. It will thus be apparent that for each complete revolution of the rotor **18** each row of suction cups **22** on each of the signature transfer means **14** will pass through this point of intersection four times. It is at this point of intersection that the folded edge of the lowermost signature in the hopper is engaged by the suction cups and removed from said hopper and the point where the gripped folded edge of each signature is transferred either to the reel **35** or the reel **36**. The pairs of grippers **45** and **46** on the reel **35** are opened and closed under the control of cam **44** and this operation is so coordinated with the movement of rotor **18** that each pair of grippers are opened as they approach the point where their path of movement intersects the path of movement of the

suckers 22 on the transfer means 14 and are closed upon pads 55 to grips a signature therebetween at the point of intersection of these two paths. Likewise, the pair of grippers 56 on the transfer reel 36 are opened and closed by means of the cam 57 which is so positioned that these grippers are opened as they approach the point of intersection of the path of movement of the grippers and the path of movement of the suckers on the transfer means 14 and are closed upon pads 55 to grip therebetween the folded edge of a signature at said point of intersection. The movements of these various parts are so coordinated in relation to the rotation of the rotor 18 and the transfer means 14 that the suckers 22 on each signature transfer means 14 first engage the folded edge of the lowermost signature and remove it from the hopper 13 and then transfer it to the coordinated gripping action of the grippers on either the transfer reel 35 or the transfer reel 36. It will be noted, as shown in FIG. 1, that the grippers 45 and 46 on the transfer reel 35 will be in position to grip a signature carried on every other one of the signature transfer means 14 while the grippers 56 on the transfer reel 36 will be in coordinated position to grip the signatures on the alternate signature transfer means 14. Thus, in one complete revolution of the rotor 18 two signatures will be transferred to the transfer reel 35 and two signatures will be transferred to the transfer reel 36.

FIGS. 1 and 8 show the means by which the suction is controlled and applied to suction cups 22. The shaft 19 has a bore 60 extending therethrough which is open at the end adjacent disc 15 and closed at the end adjacent disc 16. The suction cup supports 23 have bores 61 extending therethrough which serve to connect the internal area of the suction cups 22 with the bore 60. Four radially extending bores 62 are formed in disc 15 and each communicates near its upper end with a bore 60 in a shaft 19 of each transfer means 14 and each extends outwardly at its lower end through the outer surface of disc 15. An annular ring member 63 made of a relatively soft material such as graphite is mounted to the face of a steel ring 64 and both rings are mounted about one end of shaft 17 in such a manner that the graphite ring is adjacent the rotating disc 15 and is prevented from rotating with the disc but is capable of moving in a horizontal plane toward the disc 15. Recessed into the face of ring 63 which is adjacent the disc 15 are five arcuately shaped chambers 65, 66, 67, 70 and 71. A hose 68 is mounted at one end in an aperture in ring 63 which communicates with the chamber 65 and is connected at its other end to a suitable source of vacuum (not shown). One end of a hose 69 is suitably secured to the ring 64 and communicates with the chamber 66 and is connected at its other end to a suitable source of vacuum (not shown). One end of a hose 72 is suitably secured to the ring 64 and communicates with chamber 67 and is connected at its other end to a suitable source of vacuum (not shown). Chambers 70 and 71 are connected to atmospheric pressure through the steel ring 64 by any suitable means. It will be observed from FIG. 1 that alternate opposing pairs of bores 62 in the disc member 15 extend radially inwardly toward the shaft 17 a greater distance than the other opposing pairs of bores 62. Chamber 67 has a radial width which extends across the path of movement of both the inner and outer radially spaced bore openings 62. Chamber 66 has a radial width which extends across the paths of movement of both the inner and outer radially displaced bore openings 62 up to a point substantially adjacent a line which is in radial alignment with the gripping position of the grippers on the transfer reel 35 at which point the radial width is decreased to cover only the path of movement of the outer radially displaced bore openings 62. Chamber 65 has a radial width extending over the path of movement of the outer radially displaced bore openings 62 and extends up to a point adjacent the radial alignment with the gripping position of the grippers on transfer reel 36. Atmospheric chamber 70 is in radial alignment with the gripping position of the grippers on transfer reel 35 and atmospheric chamber 71 is in radial alignment with the gripping position of the grippers on the transfer reel 36. The hoses 68 and 69 are generally connected to the same source of vacuum so that the vacuum is maintained in both of these chambers. The hose 72 is connected to a source of vacuum of greater intensity so that the vacuum in chamber 67 is of greater intensity than that which prevails in chambers 65 and 66. In operation, it will be seen that when the suction cups 22 of any transfer means 14 is rotated into position to grip the folded edge of the lowermost signature in the hopper 13, either a radially inwardly displaced or outwardly radially displaced bore opening 62 will be in communication with the chamber 67 so that a high intensity vacuum will be created in the suction cups 22 at the time that the initial contact with a signature in the hopper 13 is made. Suction is maintained in the suction cups 22 of all the signature transfer means 14 as they move toward the transfer reels 35 and 36 through communication with the vacuum in chamber 66. As the signature transfer means 14 which has a radially inwardly extending bore opening 62 approaches the transfer reel 35, the bore opening 62 will move out of communication with chamber 66 and into communication with the atmospheric chamber 70, thus venting the suction from the suction cups in that transfer means. At the same time, a pair of grippers from the signature transfer reel 35 move into position and grip the folded edge of the signature and move the same away from the rotor 18. The next succeeding signature transfer means 14 has a radially outwardly extending bore opening 62 and the vacuum in these suction cups 22 is maintained by the communication of bore opening 62 with chambers 66 and 65 as it moves past the transfer reel 35 and toward the transfer reel 36. It will also be noted that as this signature transfer means 14 moves past the transfer reel 35 the grippers on that transfer reel are not in operative position. As this signature transfer means 14 approaches the transfer reel 36 its outwardly radially extended bore opening 62 communicates with the atmospheric chamber 70 at the point where the grippers 56 are in gripping position on the folded edge of the signature carried in the transfer means so that said signature is released thereby as the transfer means 14 continues in its rotational planetary movement. It will thus be seen that the signatures are removed at a rapid rate from the hopper 13 and alternately fed to the transfer reels 35 and 36 and deposited on the conveyors 37 and 38, respectively. It is to be further noted that signatures are fed out of the hopper 13 at twice the speed that they are carried away on the conveyors 37 and 38.

The conveyors 37 and 38 are of identical construction and operation and extend transversely of the series of signature handling and feeding mechanisms. Since both conveyors 37 and 38 are of identical construction and operation, a brief description of one will be sufficient for an understanding of the construction and operation of both. As shown in FIG. 1, the conveyor 37 comprises the usual longitudinally extended signature receiving trough 75 that is inclined upwardly and rearwardly from the horizontal. The trough 75 is provided with a rear wall 76 against which the signatures slide when they are deposited in said trough in the manner above described by the signature transfer reel 35. The trough 75 is secured by any suitable means to a forward portion of the vertical support plates 11 and 12. In this connection, it will be noted that the forward edges of the vertical support plates 11 and 12 have been cut away directly beneath and adjacent the transfer reels 35 and 36 to permit free passage of the conveyors 37 and 38. Associated with the trough 75 is the usual conveyor chain 77 which is continuously driven and is provided at spaced intervals therealong with vertically projecting signature engaging pushers or fingers 78 for advancing the deposited signatures along said trough from one signature handling and

feeding mechanism to the next signature handling and feeding mechanism in the series and gathering the same flatwise one on top of the other to form a completed book or magazine, as is well understood in the art.

Associated with each of the signature transfer reels 35 and 36 are signature calipering mechanisms 79 and 80, respectively, of identical construction and operation and therefore a description of one will be sufficient for an understanding of both. The signature calipering mechanism 79 comprises a frame 81 which is held in adjusted position to a pair of parallel rods 82 and 83 which have their ends secured in the vertically extending support plates 11 and 12, as more clearly shown in FIG. 1. Mounted in a suitable opening in the lowermost end of frame 81 is a crank having arms 84 and 85 pivotally mounted at its center to the frame. Crank arm 85 is bifurcated as shown in FIG. 7 and has a roller 86 pivotally mounted therein. As shown in FIG. 1, the caliper disc 42 is generally rectangular in shape with its outer ends having the same arcuate shape as the peripheral edge of the support discs 40 and 41 and lying in the same plane. The caliper mechanism 79 is horizontally adjusted along rods 82 and 83 so that the roller 86 is in vertical alignment with the caliper disc 42. The lower support for the caliper mechanism 79 comprises a clamp mechanism adjustably secured to the rod 83 and having an integrally formed rod 88 which is threaded at its outer end and which extends through suitable openings at both sides of the frame 81 as more clearly shown in FIG. 5. An elongated sleeve 89 having a flanged end portion 90 bearing against the inner surface of the forward wall of frame 81 and having an internally threaded hand wheel at its other end is threadedly mounted to the outer end of the rod 88. A coil spring 92 is telescopically mounted over the sleeve 89 between the outer surface of the forward wall of frame 81 and the hand wheel 91, thus retaining or pushing the forward wall of frame 81 in to constant contact with the flange 90. It will thus be seen that by rotating the hand wheel 91, the lower end of the frame 81 together with the roller 86 may be adjustably moved closer to or further away from the path of movement of the outer peripheral edge of the caliper disc 42. In this manner, there is provided an adjustment for the desired signature thickness. Moreover, if a jammed or an extra thick signature should pass between roller 86 and the extended peripheral surface of the caliper disc 42, the entire frame 81 would yield forwardly under the tension of spring 92 without causing damage to the other parts. A pair of spring-urged pin members 93 press downwardly on the top surface of the arms 85 and this assures that the rollers 86 will be held in contact with the caliper disc 42. An upwardly extending caliper finger 94 is secured to the crank arm 84. A pair of adjustable stop members 99 and 100 limit the arcuate movement of the crank arm 84 and caliper finger 94. To provide a dampening effect on the movement of the finger 94, there is attached near its upper end a coil spring 101 which is also secured to the forward part of frame 81 and tends to pull the finger 94 in a clockwise direction as viewed in FIG. 5. Positioned just below spring 101 are a pair of spaced apart dampening plates 102 which are secured to the frame 81 and are positioned in the path of movement of the finger 94. Plates 102 are spaced apart a sufficient distance to cause a frictional drag on finger 94 as it passes therebetween. A shaft 103 having its ends fixedly mounted in the ends of frame 81 is positioned near the upper rear wall of said frame, as more clearly shown in FIG. 5. A crank 95 having a forwardly extending arm 97 and a rearwardly extending arm 96 is pivotally mounted at its center to the shaft 103. Arm 96 extends through a suitable opening in the rear wall of the frame 81 and has a cam follower 104 mounted at its outer end. A cam 105 is securely mounted to a shaft 106 which is rotatably mounted at its outer ends to the upwardly extending plates 11 and 12 and is positioned in operational alignment with the cam follower 104. Shaft 106 is connected through suitable drive means to the shaft 39 on the transfer reel 35 in such a manner that the cam 105 makes two complete revolutions for every one revolution of the transfer reel 35. A spring is secured to the arm 96 and to the frame 81 to constantly urge the cam follower 104 into operational contact with the cam 105. A cam follower 107 is rotatably mounted at the outer end of the crank arm 97. A caliper arm 108 is horizontally spaced apart from crank arm 97 and is pivotally mounted at one end to the shaft 103 and has a horizontally extending shoulder 109 which overlays the top surface of crank arm 97. A spring 110 having one end secured to the arm 108 and its other end secured to the crank arm 97 holds shoulder 109 in constant contact with the upper surface of crank 97. At the other end of arm 108 there is pivotally mounted an offset and downwardly depending cam member 111 which is positioned in vertical alignment with the cam follower 107. A spring 112 biases cam 111 into contact with the cam follower 107. Secured to the bottom surface of the caliper arm 108 and depending downwardly therefrom are a pair of spaced apart caliper trip locks 113 and 114. A microswitch 115 is mounted to the forward end of the frame 81 and has a spring loaded actuating plunger 116 which extends through a suitable opening in the wall of frame 81 and is positioned adjacent the forward wall of the cam member 111. As the cam follower 104 rides on the low part of cam 105, the crank arm 97 and the caliper 108 are maintained in a substantially horizontal and parallel position, as shown in FIG. 5. When the cam follower 104 rides up onto the high part of the cam 105, the crank 95 is pivoted about shaft 103, and crank arm 97 and caliper arm 108 are pivotally swung downwardly. As will be seen in FIG. 6, the caliper arm 108 is positioned in the same vertical plane as the caliper finger 94. Thus, if the caliper finger 94 is so positioned that its outer end is in the open area between the caliper trip locks 113 and 114 which is the area indicating a normal thickness of signature being carried on the transfer reel 35, then as the cam follower 104 rides up onto the high part of the cam 105 both the crank arm 97 and the caliper arm 108 will pivotally move downwardly together. There will be no relative motion between the cam follower 107 and the cam 111 and the cam 111 will move away from the microswitch actuating plunger 116. However, should a signature of extra thickness or no signature be between the outer peripheral surface of the caliper disc 42 and the roller 86, then the finger arm 94 will move either to the left or right, respectively, and will be in vertical alignment or in the path of movement of either the caliper trip lock 113 or the caliper trip lock 114. In such case, when the cam follower 104 rides up onto the high part of the cam 105, the arm 97 will pivotally move downwardly and carry with it the cam follower 107 but the caliper arm 108 will be retained by the outer end of the caliper arm 94 and held in its substantially horizontal plane which in turn will hold the cam 119 stationary, thus imparting relative motion between the crank arm 97 and the caliper arm 108. When relative motion between these two parts occurs, the cam follower 107 will ride upon the cammed surface of the cam 111 thus pushing it outwardly or to the right as shown in FIG. 5 which in turn depresses the spring actuating plunger 116 to actuate the microswitch 115. When the microswitch 115 has been actuated, it will either close a circuit to ignite a warning light or open a circuit to shut off the apparatus, or control any other circuit or apparatus as desired. It will be observed from FIG. 3 that each signature is gripped at its folded edge between the gripper 54 and the gripper pad 55 with the leaf portions of the signature extending along the peripheral edge of the disc members 40 and 41. It will also be noted that the calipering or the measuring portion of each cycle of the calipers is controlled or actuated by the

high part of the cam **104**. The operation of the calipering mechanism and of each transfer reel is so coordinated that the cam follower **104** rides up onto the high part of the cam **105** after the gripped folded edge of the signature has passed beneath the roller **86** of the caliper. This is desirable so that there will not be a false reading due to the additional thickness of the signature at its folded edge and to get the true thickness of the leaves of the signature as they are compressed between the outer peripheral surface of the calipering cam **42** and the surface of the roller **86**. The calipering mechanism **80** which is associated with the signature transfer reel **36** is of the same construction as the calipering mechanism **79** described above. The only differences in the two calipering mechanisms being in the speed in which the caliper means **80** is operated in relation to its transfer reel **36** and in the shape of the calipering cam **117** which has only one short peripheral surface aligned in the same arcuate plane as the peripheral edge of the discs **40** and **41**. However, it is to be noted that these differences arise from the fact that the transfer reel **36** has only one pair of signature grippers **56** and makes two complete revolutions for every one complete revolution of the rotor **18**.

While the foregoing description and the accompanying drawings do set forth with more or less particularity one embodiment of the invention, it is to be expressly understood that said invention is not limited to said embodiment. Various changes may be made therein particularly in the design and arrangement of the parts illustrated, as well as in the mode of operation and the manner of use, without departing from the spirit and scope of the invention, as will now be clear to those skilled in the art.

What is claimed is:

1. An apparatus for handling signatures, sheets and the like comprising a hopper for receiving and holding a supply of signatures, a plurality of first signature transfer means spaced about the periphery of a frame, means for rotating said frame in proximity to the bottom portion of said hopper, means for rotating each of said first signature transfer means as said frame is being rotated, signature gripping means on the peripheral edge of each of said first transfer means, means to selectively control the operation of the gripping means on each of said first transfer means, a plurality of second signature transfer means radially disposed about said first transfer means and rotatably mounted in proximity to the orbital path of said first transfer means, gripping means on the peripheral edge of each of said second transfer means, means to drive said second transfer means in timed relation to said first transfer means so that the path of movement of the grippers of a preselected second transfer means and the path of movement of the grippers of a preselected first transfer means will intersect and said grippers will simultaneously be in the same plane whereby for each rotation of the frame for said first transfer means the signatures carried by each of said first transfer means are alternately transferred to each of said second transfer means.

2. An apparatus for handling signatures, comprising a rotatable frame, a plurality of first transfer means spaced about the periphery of said frame, means to rotate each of said first transfer means on said frame, signature gripping means on the peripheral edge of each of said first transfer means, a pair of second signature transfer means radially disposed about said first transfer means and rotatably mounted in proximity to the orbital path of said frame, gripping means on the peripheral edge of each of said second transfer means, means to drive each of said second transfer means in relation to said first transfer means so that the grippers on each of said second transfer means simultaneously pass through the same plane as the grippers on alternate first transfer means.

3. An apparatus for collating signatures comprising a series of horizontally aligned hoppers for retaining supplies of signatures, a pair of spaced apart conveyor means horizontally extending in proximity to said hoppers, means associated with each hopper for transferring said signatures to said conveyor means comprising a frame rotatable in proximity to the bottom portion of said hopper, a plurality of first transfer means spaced about the periphery of said frame and rotatable thereon, gripping means on the peripheral edge of each of said first transfer means, a pair of second transfer means radially disposed about said first transfer means and each of which is rotatably mounted in proximity to the path of movement of said first transfer means and each in proximity to one of said conveyors, gripping means on the peripheral edge of each of said second transfer means, means to drive each of said second transfer means in relation to said first transfer means so that the grippers on each of said second transfer means simultaneously pass through the same plane as the grippers on alternate first transfer means.

4. An apparatus as set forth in claim 3 wherein said gripping means on each of said first transfer means comprises suction cups, means to connect the suction cups in each of said transfer means to a source of vacuum as the suction cups of each transfer means sequentially moves into contact with the lowermost signature in the hopper and to disconnect said vacuum source only when the suction cups of each of said first transfer means simultaneously pass through the same plane as the grippers on either of the second transfer means.

5. An apparatus for handling signatures comprising a hopper for retaining a supply of signatures, sheets or the like, a pair of horizontally extending and spaced apart conveyor means positioned below said hopper, signature transfer means associated with said hopper for transferring signatures from said hopper to said conveyors and comprising a plurality of first transfer means rotatable in proximity to the bottom portion of said hopper, gripping means on each of said first transfer means and operable as each rotates into contact with the lowermost sheet in said hopper to remove and transfer the same, a pair of second transfer means radially disposed about said first transfer means and each of which is rotatably mounted in proximity to one of said conveyor means and to the path of movement of said first transfer means, gripper means on each of said second transfer means and rotatable through a path which intersects the path of movement of the grippers on each of said first transfer means, means to rotate each of said second transfer means in relation to the rotation of said first transfer means so that the grippers on each of said second transfer means simultaneously pass through the same plane as the grippers on alternate first transfer means.

6. An apparatus as set forth in claim 5 including means to operate the grippers on each of said first transfer means to engage a signature as each of said transfer means passes below said hopper and to cause the grippers on each first transfer means to disengage the signature when said grippers simultaneously pass through the same plane as the grippers on either of said second transfer means.

7. An apparatus as set forth in claim 6 including means to operate the grippers on each second transfer means to engage a signature as said grippers simultaneously pass through the same plane as the grippers on alternate first transfer means and to disengage said signature when said signature is disposed over the conveyor associated with said second transfer means.

8. An apparatus as set forth in claim 5 wherein each of said second transfer means comprises a pair of spaced apart disc members to support the leaves of a signature, a pair of gripping means in axial alignment and each positioned adjacent the peripheral edge of each support

disc, and a caliper disc support positioned between said signature disc supports and having an arcuate surface substantially the length of a signature, said surface being in the same plane as the periphery of said signature support discs and having one end in axial alignment with said grippers.

9. An apparatus as set forth in claim 8 including a caliper means operatively associated with each of said second transfer means comprising a pivotally mounted roller biased toward and positioned in alignment with the path of said caliper disc, whereby upon rotation of the second transfer means the leaves of a signature carried thereby will be compressed between the caliper roller and the caliper disc, means to selectively control the operation of said caliper means, control actuating means operatively secured to said caliper roller whereby said control will not be actuated when a signature of predetermined thickness is carried on said second transfer means but will be actuated by the movement of said roller occasioned by the absence of a signature or the presence of a signature of a greater than desired thickness.

10. An apparatus for handling signatures comprising a hopper for retaining a supply of signatures, sheets or the like, a pair of horizontally extending and spaced apart conveyor means positioned below said hopper, a signature transfer means operatively associated with said hopper for transferring signatures to said conveyors and comprising a plurality of first transfer means sequentially rotatable in proximity to the bottom portion of said hopper, means to rotate each of said first transfer means about its own axis and simultaneously therewith rotating all of said first transfer means about a common axis, gripper means on each of said first transfer means and operable as each rotates into contact with the lowermost sheet in said hopper to remove and transfer the same, a pair of spaced apart second transfer means each of which is operatively positioned in proximity to one of said conveyor means and to the path of movement of said first transfer means, gripper means on each of said second transfer means, means to operate each said second transfer means so that the grippers on each of said second transfer means intersect the path of movement of the grippers on alternate first transfer means and to remove each sheet from said first transfer means in the same rotational direction whereby the leaves of each signature are removed immediately away from said first transfer means and are deposited in flatwise condition on said conveyor.

11. An apparatus for feeding signatures comprising a hopper for retaining a supply of signatures, a plurality of first transfer means spaced about a frame, means for rotating said frame in proximity to said hopper, means for rotating each of said first transfer means simultaneously with the rotation of said frame, signature gripping means positioned on the peripheral edge of each of said first transfer means, a plurality of second transfer means rotatably mounted and operatively disposed in proximity to the path of said frame, a plurality of spaced apart conveyor means wherein one of each of said conveyors is operatively associated with one of each of said second transfer means, signature gripping means on each of said second transfer means, means to drive each of said second transfer means so that the gripper means thereon intersect the path of movement of the gripper means on alternate first transfer means and means to operate the gripper means on each second transfer to engage a signature when the same is in alignment with a gripper means of said first transfer means and to release said signature when the same is in alignment with the conveyor means associated with the second transfer means.

12. An apparatus for handling signatures comprising a hopper for retaining a supply of signatures to a frame, a plurality of first transfer means rotatably mounted to said frame, signature gripping means on each of said first transfer means, means for simultaneously rotating said frame and each of said first transfer means about separate axes wherein each of said first transfer means sequentially passes into operational proximity with said hopper and the gripper thereon engages a signature therein, a plurality of second transfer means rotatably mounted and operatively disposed at fixed points in proximity to the path of movement of each of said first transfer means, means to rotate each of said second transfer means, gripper means on each of said second transfer means, a plurality of spaced apart conveyor means wherein one of each of said conveyor means is operatively associated with a specific second transfer means, means to operate the gripper means on each of said second transfer means to engage a signature when said gripper is adjacent the gripper means on alternate of said first transfer means, and to release said signature when said gripper is operatively aligned with the conveyor means associated with said second transfer means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,353,445	Crafts	July 11, 1944
2,711,896	Kleineberg et al.	June 28, 1955
2,810,575	Holmen	Oct. 22, 1957
2,830,813	Hepp	Apr. 15, 1958
2,903,260	Faeber	Sept. 8, 1959