

[54] ROTARY GATHERING MACHINE

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[51] Int. Cl. **B65h 39/02**

[58] Field of Search **270/58-59,**
270/12, 15, 17, 54, 45-46, 51-52, 55-56

[56] References Cited

UNITED STATES PATENTS

3,578,310 5/1971 Carson..... 270/58 X

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[57] ABSTRACT

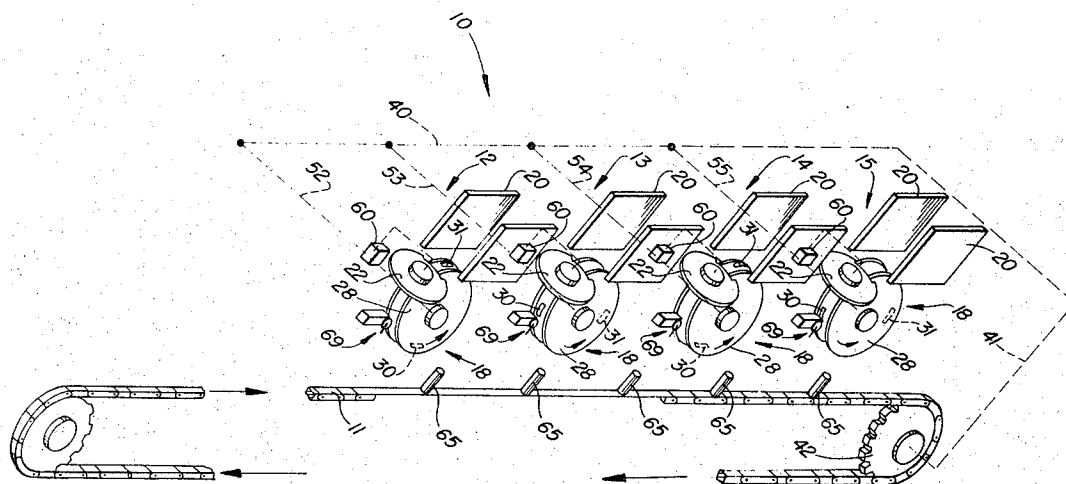
A signature gathering machine includes a signature gatherer conveyor. A plurality of hoppers are spaced along the gatherer conveyor and are adapted to receive signatures therein. Associated with each hopper is a means for removing signatures from the hopper and conveying the signatures to the gatherer conveyor. The means which removes and carries the signatures includes a drum having a pair of grippers which rotate about an axis transverse to the direction of movement of the signature conveyor and which release the signatures in the direction of movement of the gatherer conveyor. The gatherer conveyor has a plurality of pins projecting therefrom which engage signatures and move the signatures past the hoppers to

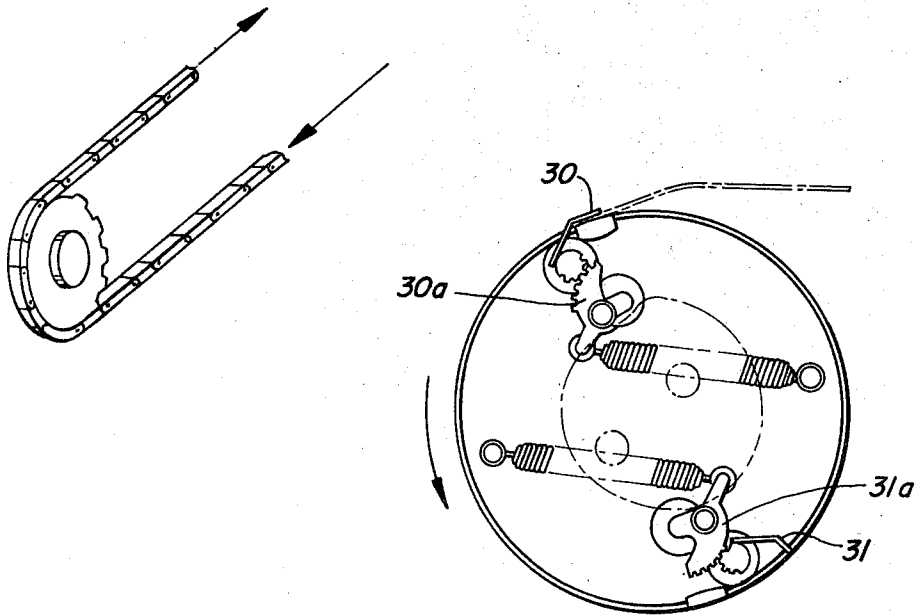
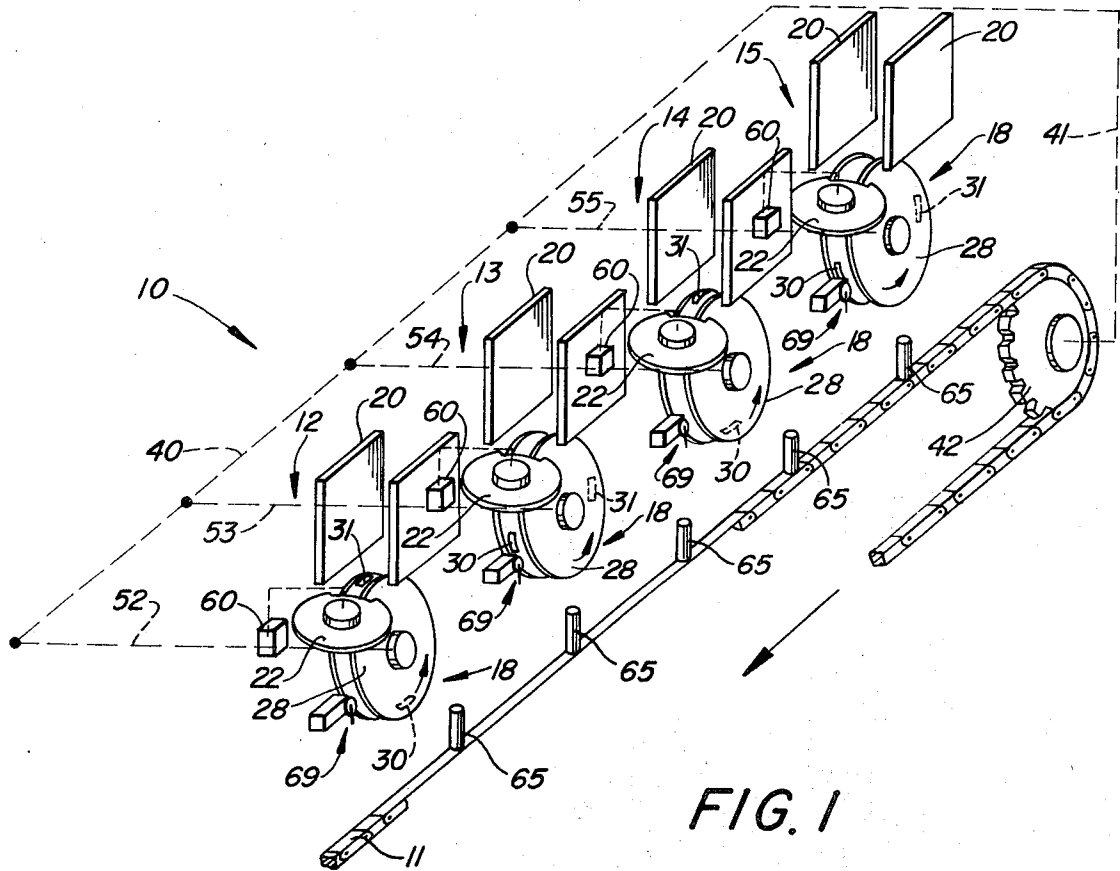
a subsequent handling station. Adjacent pins are spaced apart a distance which is less than the distance between the hoppers and the grippers on adjacent hoppers are dephased with respect to each other. Each hopper includes a separator having a disc which separates the signatures from the hopper so as to be gripped by the grippers. The separator may be operated at either twice the speed of the grippers or at the same speed as the grippers.

In one mode of operation of the machine, the separator disc operates at a speed to separate two signatures per each revolution of the gripper drum and both grippers on the drum convey signatures to the gatherer conveyor. The spacing between pins on the signature conveyor is less than the spacing between hoppers and the gatherer conveyor speed is less than gripper speed. An individual signature is dropped from each hopper into each pocket defined by adjacent pins on the gatherer conveyor. This operation enables relatively short signatures to be handled at either a very high output rate of books per minute (one-third more than conventional), or for the standard output of books per minute enables the signatures to be handled and collected at a slower speed (one-third less than if the units were not dephased).

In another mode of operation of the gatherer, the separator disc is operated to separate one signature per each revolution of the gripper drum and the gripper drum and the gatherer conveyor are operated in the same speed relationship as in the first mode. In this mode of operation, each hopper deposits signatures in alternate pockets on the conveyor. The signatures deposited from adjacent hoppers may be the same signature so that every pocket on the signature gatherer conveyor receives the same signatures, or may be different signatures to provide different completed books.

11 Claims, 9 Drawing Figures





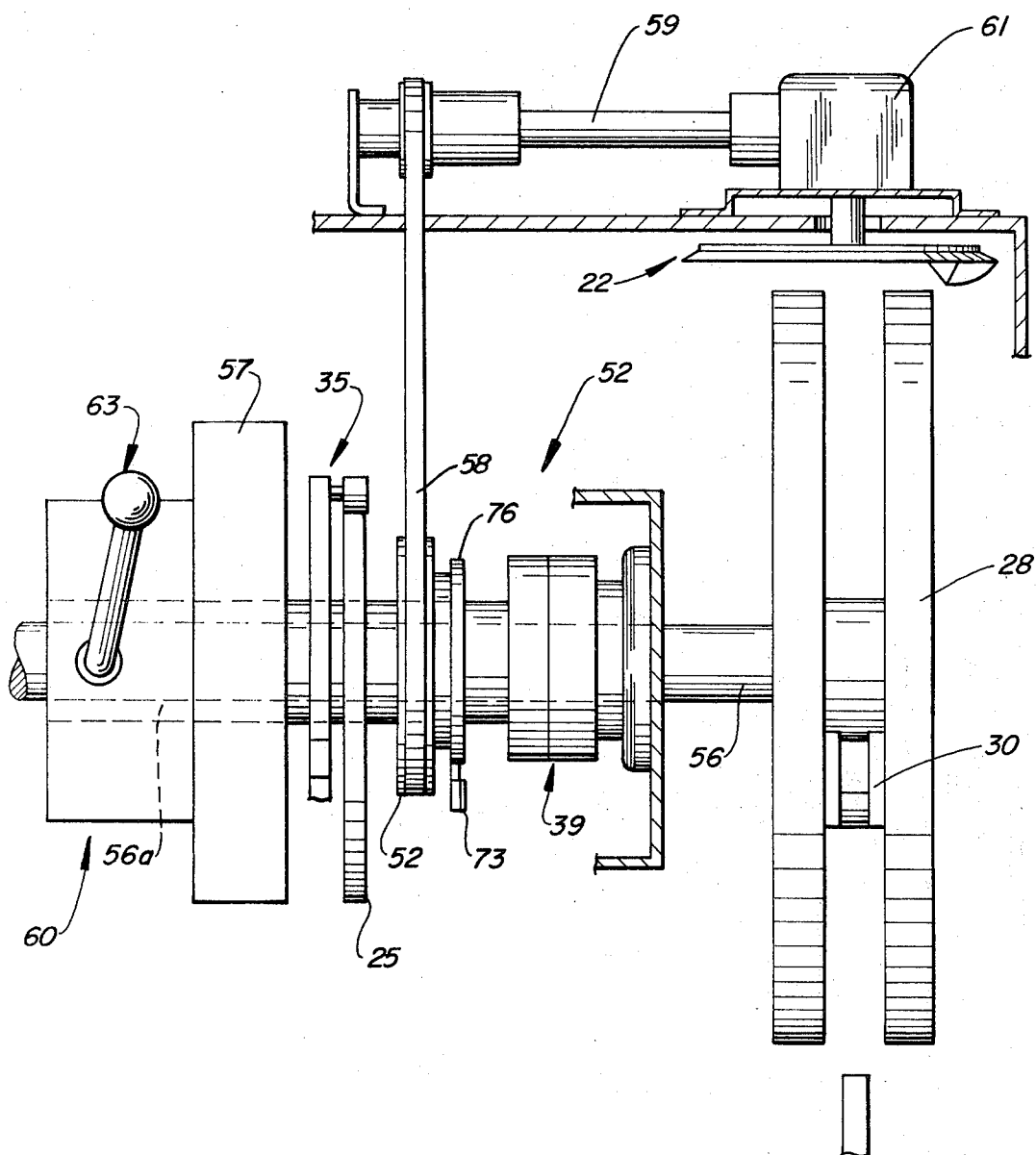


FIG. 2

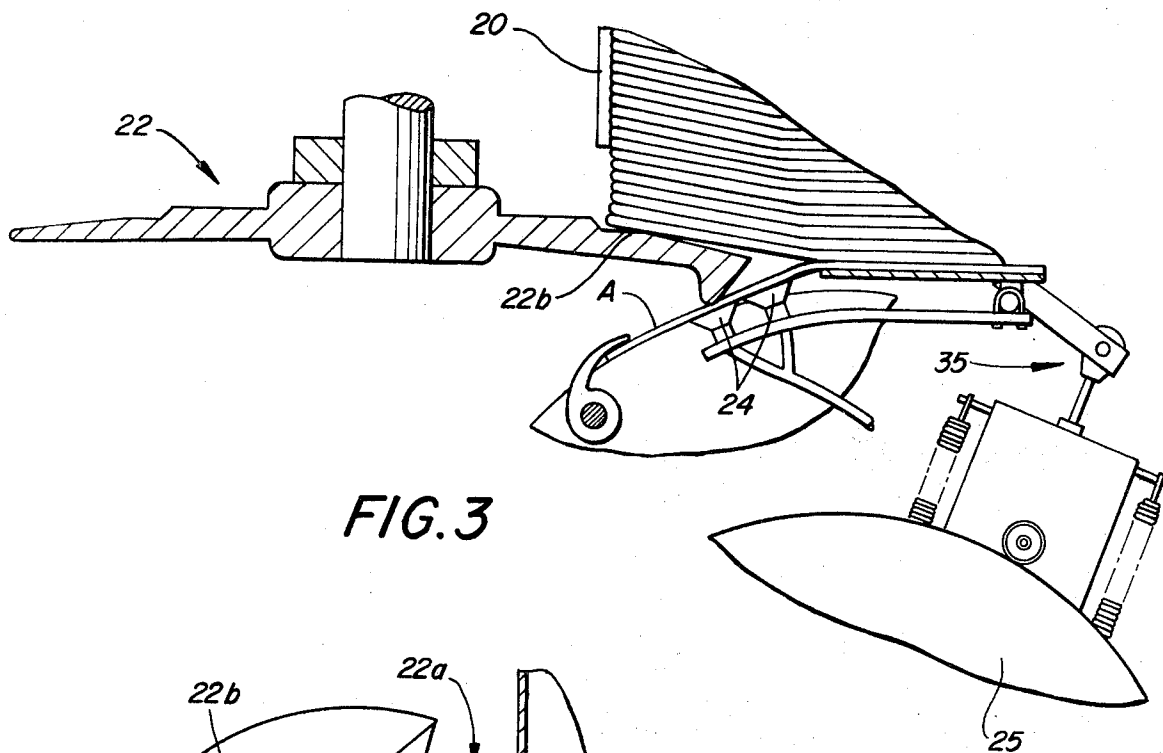


FIG. 3

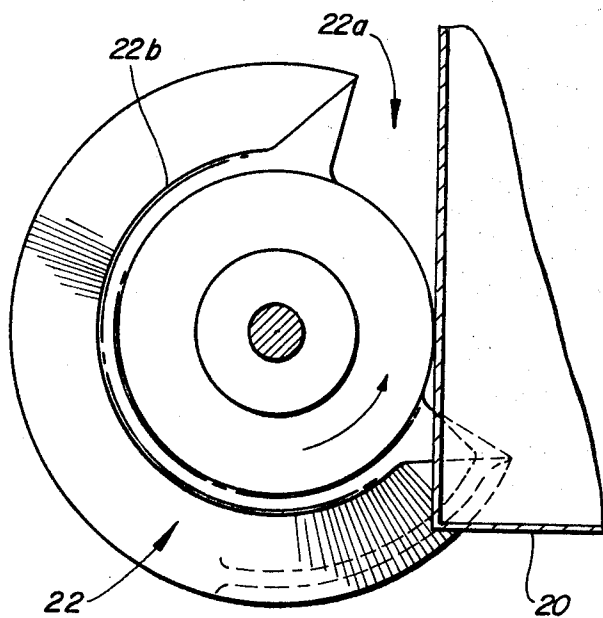


FIG. 4

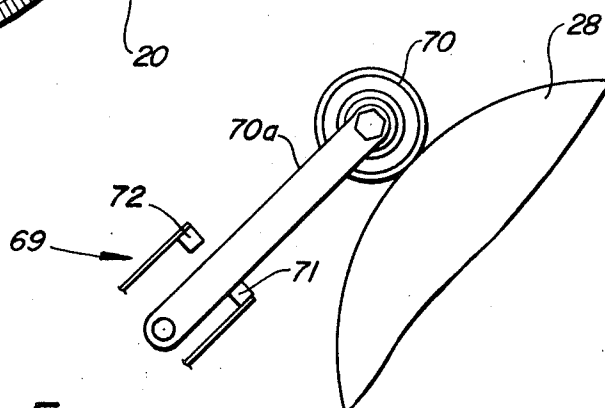
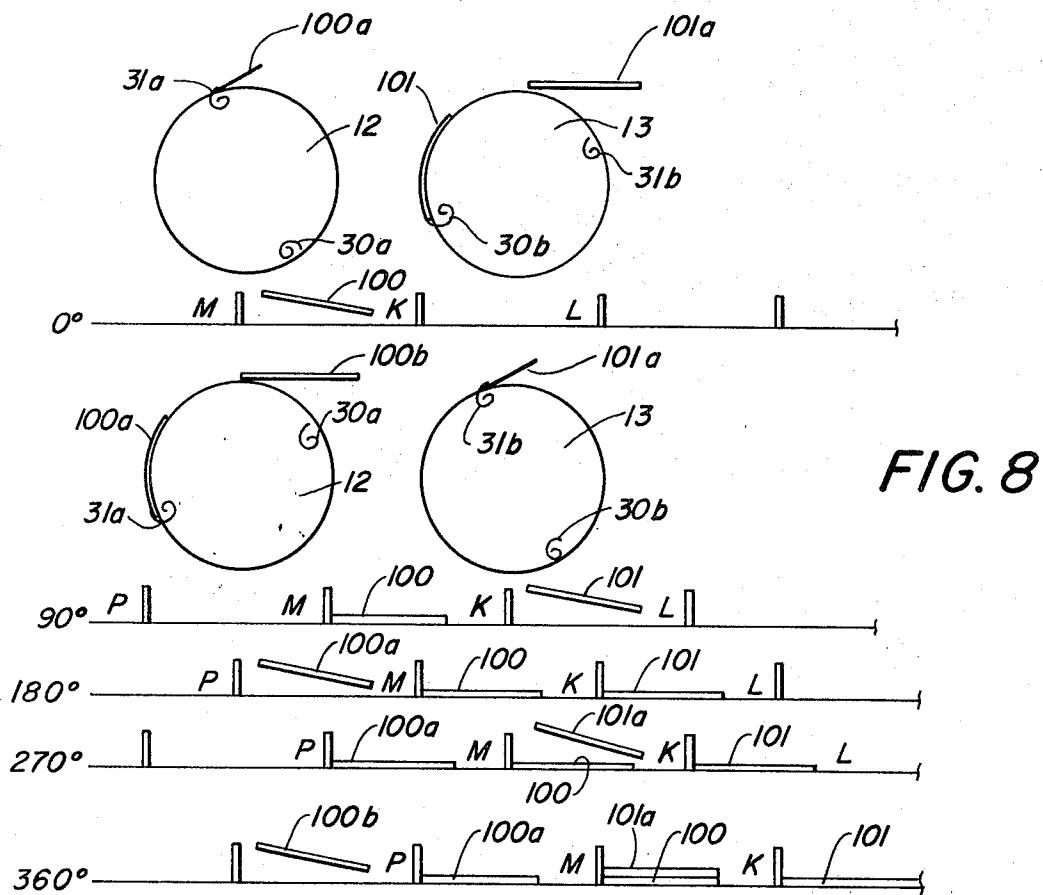
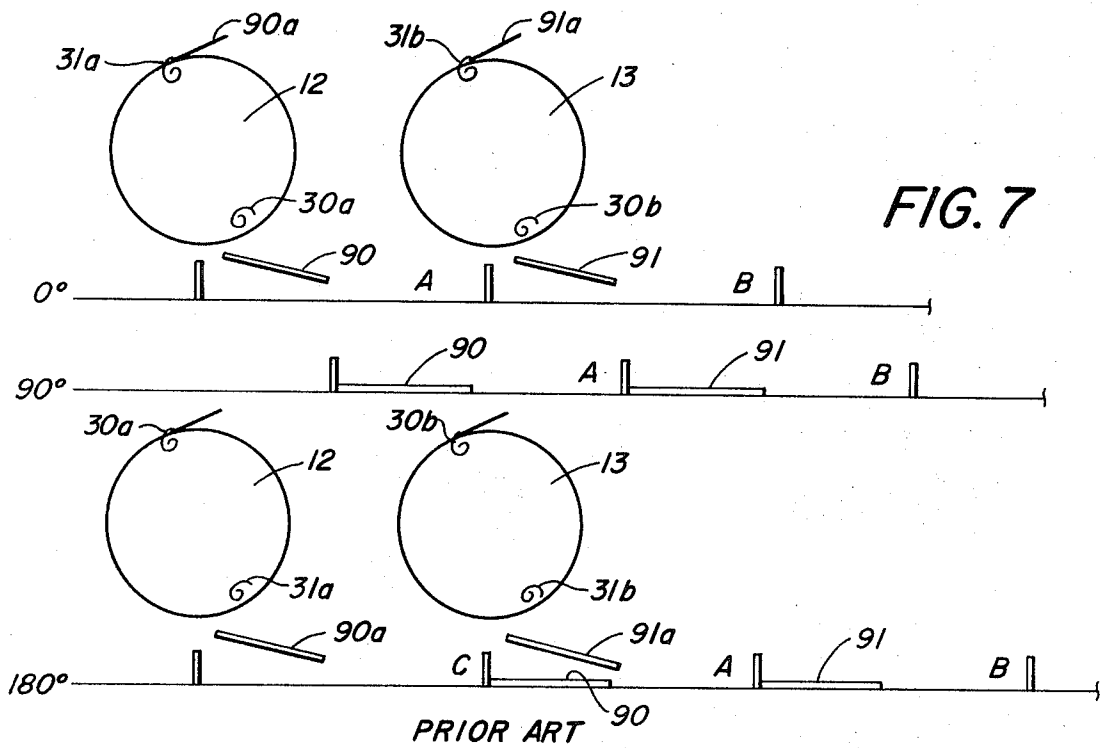


FIG. 5



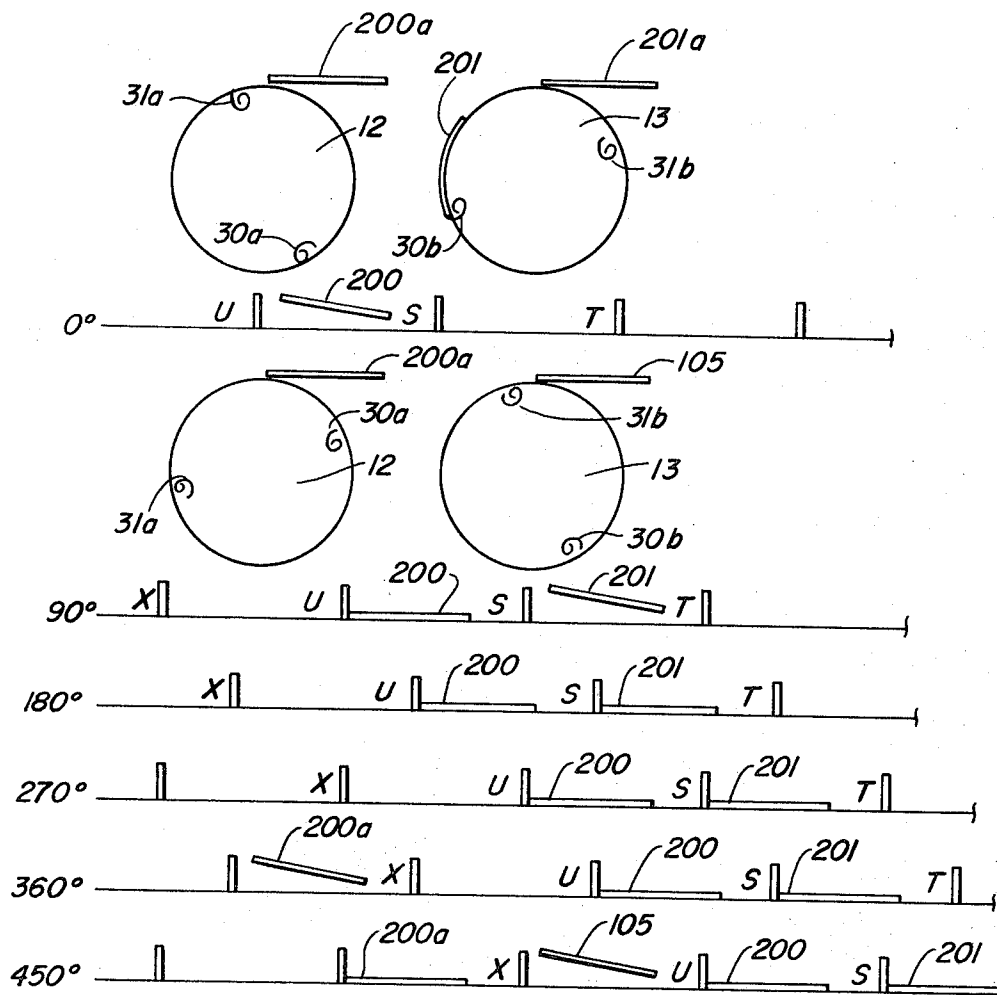


FIG. 9

ROTARY GATHERING MACHINE

BACKGROUND OF THE INVENTION

The present invention is directed to a signature gatherer machine, and particularly a signature gatherer machine which has a plurality of rotary drums which rotate transverse to the direction of movement of a signature conveyor and which feed and deposit signatures on the signature conveyor in the direction in which the signature conveyor moves. Machines of this general type are shown in U.S. Pat. Nos. 2,020,321; 3,311,368; and 3,702,187.

Signature gatherer machines are known which include a signature gatherer conveyor which moves past a plurality of hoppers and which conveyor has a plurality of pins which are spaced apart and which receive and push signatures thereon as they move past the hoppers. It is also known that such machines have been constructed in which a gripper drum carrying a pair of grippers engages the signatures and carries those signatures from the hopper and releases them for deposit on the signature conveyor in the direction of conveyor movement so that as the signatures are released, they are moving in the direction of signature conveyor movement and drop into the pockets or spaced between adjacent pins on the signature conveyor.

Such known machines also include suitable controls in order to deactivate the machine in the event any hopper feeds a double signature or fails to feed a signature. Moreover, such machines include a separator disc at each hopper and which is driven to separate the signatures individually from the hopper so that they can be gripped by the gripper on the gripper drum and carried with the drum. The operation of such known machinery is such that the grippers in all hoppers are acting in a phased relationship, namely, one where a gripper in every hopper grips a signature at the same time and releases a signature at the same time. As a result, the spacing between the pins on the signature conveyor has conventionally been a distance equal to the spacing between hoppers. Accordingly, once the machine is started and operating to produce completed books, when the signature conveyor moves through a distance equal to the space between the hoppers, a completed book is fed from the machine. However, in the event that the signatures are rather small in size, it should be apparent that the entire capacity of the signature conveyor is not utilized and that the output of the machine, in terms of books per hour, for small size signatures would be equal to the output for large size signatures. In addition, the handling of small size or light signatures is rather difficult and creates problems particularly at extremely high speeds.

SUMMARY OF THE INVENTION

The present invention is directed to a rotary gatherer of the above-mentioned type in which books made up of smaller size or light signatures can be produced at either a higher output at present machine speeds, or, alternatively, can be produced at the same machine output of books per minute, but by operating the machine at a much slower rate of speed in order to maintain more control over the feed of the individual signatures. This is the concept to which the present invention is directed.

Specifically, the gatherer embodying the present invention is provided with a signature gatherer conveyor which moves past a plurality of hoppers, and at each hopper there is a drum which rotates transverse to the direction of signature gatherer conveyor movement and which drum has a pair of grippers thereon which are adapted to engage signatures and convey those signatures from the hopper and release them for deposit between pins located on the signature conveyor with the deposit being in the direction of conveyor movement. A suitable separator disc mechanism is arranged to separate the signatures from a stack in the hopper for engagement by the grippers.

In accordance with the present invention, the grippers on adjacent hoppers are located in a dephased relationship with respect to each other and the pin spacing on the signature conveyor is less than the distance between hoppers. In addition, a machine embodying the present invention may incorporate a two-speed gearbox interposed between the gripper drum and the separator so that the separator may be driven at a speed so that two signatures are separated from the stack in the hopper for each revolution of the gripper drum or may be driven at a speed one-half thereof so that only one signature is separated from the stack for each revolution of the gripper drum. In addition, one of the grippers on each of the transfer drums may be deactivated so that only one gripper on each drum is operated.

As a result of the above-noted construction, a machine embodying the present invention may be operated in two different modes. One mode involves the deposit from each hopper of a signature between each set of pins on the signature gatherer conveyor. In this mode of operation, the speed of the signature gatherer conveyor may be reduced, for example, by one-third from that of the conventional machine, or if the signature gatherer conveyor is operated at conventional speeds, for example, one-third more books per minute would be produced. The pin spacing on the conveyor in the embodiment specifically described herein is such that the space between adjacent pins is two-thirds the distance between hoppers. Each of the grippers on the gripper drum engages a signature and drops a signature in each pocket on the signature conveyor as the signature conveyor moves therepast. As a result of this construction, at present signature conveyor speeds the output of books is increased, or, alternatively, the speed of the signature conveyor and the entire machine can be reduced so that the same book output per minute can be achieved but with the machine operating at much lower speeds so as to maintain and provide more efficient and better control of the signature feeding.

The machine also can be operated in a mode where one of the grippers on each drum is deactivated so that only one gripper on each hopper is operated to deposit signatures on the signature gatherer conveyor. The separator can be operated to separate only one signature per revolution of the gripper drum and the caliper for sensing whether double signatures or no signature at all has been fed will operate to sense either absence of a signature or a double signature only once per revolution of the drum. In this mode of operation, the signature conveyor and gripper drum operate at the same speed relationship as in the previously described mode. In this operation, each gripper drum will deposit a signature at every other pin in the signature conveyor. Two adjacent hoppers may feed identical signatures to

the chain conveyor so that every pocket receives the same signatures, or, alternatively, different signatures may be fed to provide different book outputs. Again as a result of this type of operation, the machine may provide an output of books per hour substantially in excess of the number of books per hour produced by conventional machinery by operating at the same speed as the conventional machinery. The machine, alternatively, can provide the same output of books per hour, but yet operate at a much slower speed than present machinery.

DESCRIPTION OF THE FIGURES

Further features and advantages of the present invention will be apparent to those skilled in the art to which it relates from the following detailed description of a preferred embodiment thereof made with reference to the accompanying drawings in which:

FIG. 1 is a schematic perspective view of a gatherer machine embodying the present invention;

FIG. 2 is a somewhat schematic but more detailed view on an enlarged scale of one portion of the machine of FIG. 1;

FIG. 3 is a somewhat schematic view illustrating the separation of the signatures from a hopper;

FIG. 4 is a plan view of a part of the apparatus of FIG. 1;

FIG. 5 is a schematic view of a sensing mechanism utilized in the apparatus of FIG. 1;

FIG. 6 is also a schematic view illustrating the operation of the grippers at a hopper;

FIG. 7 is a view illustrating the operation of a prior art machine; and

FIGS. 8 and 9 are schematic views illustrating different modes of operation of the machine of the present invention;

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is preferably embodied in a signature gatherer machine, generally designated 10 in FIG. 1. The signature gatherer machine 10 includes a signature gatherer conveyor 11 which moves through a plurality of feeding stations designated 12-15. The size of the conveyor 11 and pins 65 thereon is exaggerated in FIG. 1 as compared to the other parts of the machine 10. Any number of feeding stations may be provided and at each feeding station 12-15 there is a feeding mechanism 18 for feeding signatures to the signature conveyor 11.

Each of the mechanisms 18 at each of the feeding stations 12-15 include a hopper 20 which contains signatures lying in a flat stacked condition and in a near horizontal plane. A separator disc 22 is located adjacent the lowermost portion of the stacked signatures and rotates about a vertical axis and operates to separate the lowermost signature from the stack of signatures. The separator disc 22 cooperates with a pair of sucker members 24 (see FIG. 3) which are actuated by a cam 25 which rotates with a transfer drum 28 of the mechanism 18.

In the disclosed embodiment, the transfer drum 28 has a pair of grippers 30 and 31 thereon which are located diametrically opposite each other and both of which are operable to engage and grip signatures which are separated from a stack of signatures and carry those signatures to the signature conveyor 11. The transfer

drum 28 and grippers 30 and 31 rotate in a counter-clockwise direction as viewed in FIG. 1, as indicated by the arrows, and the upper run of the signature conveyor 11 which receives the signatures moves toward the right in FIG. 1. As a result, the grippers 30, 31 release the signatures in the direction of movement of the conveyor 11. After the signature is released, it is conveyed in the direction of movement of the conveyor and guided into the pockets on the conveyor by a suitable driven roller and guide mechanism (not shown) associated with each drum 28, and which mechanism is known.

Any conventional mechanism may be utilized for actuating the separator suckers 24 and controlling the application of suction thereto. The separator suckers 24 preferably move under the control of the cam 25, which rotates in a timed relationship to the drum 28. A suitable mechanism, generally designated 35, is provided for controlling the movement of the separators 24 from the cam 25. It should be apparent that the mechanism 35 must operate the suckers 24 in timed relationship with the movement of the grippers 30, 31 and with the separator disc 22 in order to reach up and extract the lowermost signature from the stack of signatures through a gap 22a in the separator disc. The particular structure of the separator disc may vary, but preferably is constructed as disclosed in U.S. Pat. No. 3,752,187, and that disclosure in U.S. Pat. No. 3,752,187 is incorporated herein by reference. The suckers 24 move a portion of the signature into a position, such as shown at A in FIG. 3, at which position a gripper 30 or 31 may engage the signature to remove it from the hopper. Moreover, the separator disc has a portion which also forces the separated signature downwardly to be gripped. The upper surface of the separator disc functions to support the remainder of the pile in the hopper, all as described in U.S. Pat. No. 3,752,187.

When the sucker members 24 have lowered the forward end of the signature and bent it downwardly from the flat stacked position to the position shown at A in FIG. 3, the rim 22b of the separator disc 22 moves under the remainder of the signatures and supports the remainder of the signatures so that the gripper 30 or 31 may engage and grip the lead edge of the signature. Of course, the suction to the sucker members 24 must be timed through suitable valving such as valve mechanism 39 (FIG. 2) in order to terminate the suction prior to the gripper moving the signature around with the drum 28.

The grippers 30, 31 may take any conventional construction and may be actuated by a conventional mechanism. As illustrated in FIG. 6, the grippers 30, 31 are rotated by geared bellcranks 30a, 31a, respectively, which mesh with gear drivingly connected with the grippers. The gripper fingers are retained in the closed position to hold the signature during transfer of the signature. The gripper fingers are opened by a stationary plate cam that causes a roller to rotate the geared bellcrank as the drum rotates. Gripper action is timed with the suckers 24 and separator disc 22 functions to effect proper signature feed and delivery. As the gripper fingers close over a signature, the signature is pulled from the feed tray to rotate on the gripper drum. The signature is then released to drop onto the conveyor 11 at the proper time.

A suitable drive arrangement is provided for the signature conveyor 11 and for each of the drums 28 at each of the feeding stations 12-15. Preferably, a common main drive shaft 40 is provided and which is shown schematically in FIG. 1. A suitable drive indicated by the dotted line 41 is provided for interconnecting the main drive shaft 40 and one sprocket 42 around which the signature conveyor 11 is trained. The signature conveyor is driven at a speed less than the speed of the gripper drum 28 and is the present example at two-thirds the speed thereof.

In addition, suitable drives designated by the reference numerals 52, 53, 54 and 55 are provided for driving the drums 28 at each of the signature feeding stations 12-15. The drives 52-55, of course, may incorporate timing belts, etc., for effecting the drive to the drum 28 at each feeding station. Since the drives 52-55 are identical in construction, only the drive 52 for the feeding station 12 will be described in detail.

As shown in FIG. 2, the drive 52 includes a drive shaft 56 which is driven from the main drive shaft 40 through a suitable gearbox 57. The shaft 56 carries on its outer end, as shown in FIG. 2, the drum 28. The drum 28 carries the grippers 30, 31 which engage the signatures and carry the signatures from the hopper to the signature conveyor. A sleeve 56a encircles a part of the shaft 56 and a suitable two-speed gearbox 60 is provided for driving the sleeve at the same speed of rotation as the shaft 56 or at twice the speed of rotation of the shaft 56, for purposes to be described hereinbelow. A suitable manual shaft handle 63 is associated with the gearbox 60 and is movable to change the speed relationship between the shaft 56 and sleeve 56a.

A suitable timing belt drivably connects the sleeve 56a with a shaft 59. The shaft 59 is drivably connected to drive the separator disc 22 through suitable gearing 61. The two-speed gearbox 60 may take any one of a plurality of constructions and will not be described in detail. However, it is constructed so that the separator disc 22 may be rotated at a first speed so that the gap 22a in the disc 22 aligns with the suckers 24 for each gripper 30 and 31 (twice the angular speed of the drum 28) or may be rotated at a speed one-half the first speed so that the gap aligns with the suckers for only one gripper 30 or 31. (This is the same angular speed as the drum 28.)

In addition to the separator disc 22 being drivably connected through the belt 58 to the sleeve 56a, the cam member 25 for actuating the sucker mechanism 35 is also drivably connected to the sleeve 56a. Also, the valve mechanism 39 is connected to be driven by the sleeve 56a. Accordingly, all of these mechanisms may be driven at either the same rotational speed as the drum so as to operate to present to the drum one signature for each revolution of the gripper drum, or may operate at twice the speed of the gripper drum and present two signatures to the gripper drum per each revolution thereof.

From the above, it should be apparent that upon operation of the machine, signatures are removed from the various hoppers at the feed stations 12-15 and are transferred therefrom by rotation of drum 28 at each of the feed stations. The grippers release the signatures in the direction of movement of the signature conveyor 11 for a further movement by the signature conveyor 11 past the various signature feed stations. The signature conveyor 11 is provided with a plurality of pins,

each of which is designated 65. Two adjacent pins define a pocket on the signature conveyor. The grippers 30, 31 at each of the feed stations are constructed so as to release the signatures so as to drop into the pockets defined between adjacent pins. The adjacent pins are spaced two-thirds the distance between centers of the adjacent drums 28 of two adjacent hoppers in the illustrated example.

Moreover, while the mechanisms 18 at each hopper are substantially identical, the location of the grippers on adjacent drums 28 are located differently at any instant of time. As should be apparent in FIG. 1, the grippers 30, 31 at feeding station 12 are 90° out of phase with the grippers 30, 31 at feeding station 13, and that the grippers at any given feeding station are 90° out of phase with the grippers at the two adjacent feeding stations. By 90° out of phase, what is meant is that the drums 28 at alternate stations 12-15 are rotated 90° with respect to the drums 28 at the other stations.

The gatherer machine 10 at each feeding station 12-15 also has a caliper or sensor mechanism 69. Each caliper or sensor mechanism 69 is constructed so as to sense if no signature is fed or whether a double signature is fed and, if such is the case, to provide a machine control function, namely, which may be lighting a warning light for the operator and/or stopping the machine. In addition, each caliper senses whether a defective signature is fed, i.e., one which may have too many or too few pages. Each caliper mechanism 69 includes a roller or sensing roll 70 which is adapted to run on the drum 28 and engage a signature which is transmitted from the gripper. The sensing roll 70 is carried on the end of an arm 70a (See FIG. 5). Arm 70a cooperates with a pair of switches, designated schematically 71 and 72 in FIG. 5. The switches 71 and 72 are in a circuit with a switch 73 (See FIG. 2). The switch 73 is normally open and is closed at the appropriate time in the cycle of operation of the machine by a cam member 76 which rotates with sleeve 56a. The cam 76 is drivably connected with the sleeve 56a so as to trip the switch 73 twice for each revolution of the shaft 56, or once for each revolution of the shaft 56 depending on the setting of gearbox 60.

The switch 71 is closed when the arm 70a is in the position shown in FIG. 5 with no signature or a signature missing page present on the drum 28. If a proper signature is on the drum 28, the roll 70 and arm 70a are moved to a position where switch 71 opens. The switch 73 which is in series with the switch 71 is closed at the time when a signature should be sensed by the caliper 69. If there is no signature or a defective signature on the drum and the switch 73 is closed by the cam 76, a circuit is completed through the switches 71 and 73 to effect the control functions desired. If a double signature or defectively thick signature is carried past the caliper 70 at the time the switch 73 is closed, then switch 72 (normally open) is closed by movement of the caliper roll 70 sufficiently to effect such and then a circuit is completed through the switch 72 and closed switch 73 to effect a control function. In the event, however, that one proper signature is fed when the switch 73 is closed by the cam 76, the switch 71 is in an open position due to the movement of the roller 70 by the one signature. However, that movement is not sufficient enough to close switch 72.

During an operation of the machine in which both grippers 30 and 31 are carrying signatures around the

drum, it is necessary, of course, for the cam 76 to trip the switch 73 twice for each revolution of the drum 28. However, in a mode of operation of the machine (to be described hereinbelow) in which only one gripper 30 or 31 carries signatures around the drum, it is necessary for the caliper 69 to sense only once per revolution of the drum. By driving the cam 76 from the sleeve 56a, it should be apparent that such is accomplished.

From the above, it should be apparent that the machine which embodies the present invention can be operated in two different modes of operation, both of which can provide a substantial number of books per hour and highly increased production capability as compared to prior art machines, or, alternatively, can provide the same production capability of books per hour but enable the machine to be operated at a slower rate of speed than the conventional machine, so as to provide for a better control of the signatures and less wear and tear on the parts of the machine itself.

The modes of operation of the present invention as an improvement over the prior art is best illustrated in FIGS. 7-9. FIG. 7 is a schematic representation of a prior art machine in which the pin spacing on the signature conveyor is equal to the spacing between the axes of rotation of the drums carrying the grippers at each hopper.

The distance that the conveyor moves for 180° of rotation of the gripper drums is thus equal to the distance between hoppers. As shown in FIG. 7, the grippers release the sheet or signature at a speed which is approximately equal to the speed of movement of the signature conveyor. In addition, each of the hoppers delivers a signature to each pocket on the signature conveyor. The grippers are in a position, as shown in FIG. 7, where the grippers at each hopper simultaneously release a signature for deposit in the signature receiving pockets on the signature conveyor. As shown in FIG. 7, the spacing between the pins on the conveyor is equal to the spacing between the hoppers and the grippers are in the same position at each hopper at a given instant of time, i.e., the grippers are not dephased.

As shown in FIG. 7, the gripper 30a at the feeding station 12 has released a signature 90 which will be guided into the pocket which is generally designated A. At the same time, a gripper 30b at hopper 13 has released a signature 91 which will be guided into the pocket which is generally designated B. In 90° of rotation of the drum grippers thereafter, the signatures 90, 91 have settled into their respective pockets, as shown in FIG. 7. After 180° of rotation, the signature 90 which was dropped in the pocket A is now in a position for receiving a signature from gripper 31b at hopper 13 and gripper 31b will release a signature 91a which will be guided on top of signature 90. Of course, at a 180° of rotation another signature designated 90a is dropped in the next succeeding hopper pocket designated C. The operation, as is known, continues in the prior art with a signature being delivered from each hopper in turn to each pocket on the conveyor 11 as it moves in order to prepare completed books and deliver same from the end of the conveyor.

In accordance with the present invention, the spacing between various pins 65 on the conveyor 11 is reduced to, for example, two-thirds of that shown in FIG. 7 and the grippers in adjacent hopper feeding stations 12 and 13 are dephased, for example, by 90°. In addition, the signature conveyor 11 is reduced in speed to two-thirds

of that as shown in FIG. 7. The machine of the present invention is capable of a variety of different modes of operation.

In one mode of operation of the machine, each gripper 30, 31 at each feed station operates to extract signatures from the hoppers and feed those signatures to the pins or signature receiving pockets on the signature conveyor 11. A signature at each hopper is fed into the signature pocket defined between each adjacent set of pins so that a signature from each hopper is received in each signature conveyor pocket. In this mode of operation of the machine, the separator disc 22 must rotate so that the gap 22a in the separator disc 22 is appropriately positioned for the sucker members 24 to operate to present the signatures for gripping by both the grippers 30, 31. Moreover, the sleeve 56a must be driven at twice the speed of rotation of the drum 28. Accordingly, the cam 76 trips the switch 73 twice per revolution of the shaft 56 and at the proper time. In addition, cam 25 actuates suckers 24 twice for each revolution of the gripper drum and valve mechanism 39 controls the vacuum to the suckers twice per each revolution of the gripper drum. Also, the conveyor 11 moves at two-thirds the speed of the grippers 30, 31.

As shown at the zero degree position of the grippers in FIG. 8, the gripper 30a has released a signature 100 for deposit in pocket K of the conveyor. In 90° of rotation of the grippers, the pocket L has reached the position for receipt of a signature 101 from gripper 30b at feeding station 13. In the next 90° of rotation of the grippers, at 180° of rotation from the initial position, gripper 31a is now in position for dropping a signature 100a in pocket M on the signature conveyor 11. At 270° of rotation of the grippers, gripper 31b at feeding station 13 is in a position to drop a signature 101a on top of the signature 100 which was dropped in pocket K by feeding station 12. At 360° of rotation, gripper 30a is back to its position at 0° and releases a signature 100b for receipt in pocket P.

It should be apparent, of course, that in view of the fact that the pin spacing in the setup of the machine as shown in FIG. 8 is two-thirds of the pin spacing of that of FIG. 7, if the speed of the conveyor 11 would remain the same, a 50 percent increase in the number of books assembled by the machine is achieved. On the other hand, the same number of books per hour can be produced by the machine of FIG. 8 with the conveyor of FIG. 8 operating at two-thirds the speed of the conveyor shown in FIG. 7.

As shown schematically in FIG. 9, a different operation of the machine 10 can be achieved by modifying the machine in order to have only one gripper per drum 28 operative, but yet maintain the pins 65 spaced as shown in FIG. 8. In the mode of operation illustrated in FIG. 9, the signature conveyor 11 operates at a speed which is substantially two-thirds the speed of the gripper drum, as in the FIG. 8 mode of operation.

As shown in FIG. 9, the gripper 30a at feeding station 12 drops a signature 200 into conveyor pocket S, and at 360° of rotation thereafter drops a signature 200a into pocket X. After 90° of rotation the gripper 30b at feeding station 13 drops a signature 201 in conveyor pocket T. On the next 90° of rotation of the drums, the gripper 31a is located in a position to drop signatures in signature conveyor pocket U. However, since the gripper 31a has been deactivated, no such signatures were gripped thereby. Accordingly, signature pocket U

passes feeding station 12 without receiving a signature therein. The deactivation of the gripper 31a can be accomplished in a number of ways. In the present embodiment, the cam 25, as well as the vacuum valve mechanism, is operated so that the suckers 24 extract only one signature per revolution of the drum 28, due to operation of the gearbox 60 to a position where these mechanisms operate only once per revolution of drum 28. Also, the gripper can be mechanically locked in a deactivated position.

A signature is not received in signature pocket U until gripper 30b at station 13, which is the only active gripper on the transfer drum 28 thereat, again achieves a position as shown at 90° which occurs at 450° of rotation of the gripper 30b. At that point, the gripper 30b drops a signature designated 105 in the signature pocket U.

Accordingly, while signature pocket U has passed signature station 12 without receiving a signature therein, it does receive a signature from signature feeding station 13. This occurs at approximately, as shown in the drawings, 450° of rotation after beginning of the operation of the machine. Accordingly, it should be apparent that signature stations 12, 13 each feed to alternate pockets on the signature conveyor. By feeding to the signature conveyor, the same signature from each of the pockets 12, 13, each pocket on the conveyor receives the same signatures.

In the setup of the machine 10 to operate as shown schematically in FIG. 9, it should be apparent that the machine is modified in order to have the separator disc 22 rotate slower than in the FIG. 8 mode. This is accomplished by actuation of the two-speed gearbox 60, as noted. This has the great advantage of providing for slow separation disc speeds, so that good control can be maintained over hard to feed signatures. In addition, the cam 76 actuates the switch 73 only once per revolution of the drum 28 rather than twice per revolution of the gripper drum 28. It should be apparent also, however, that in the operation of the machine, as shown in FIG. 9, the grippers 30, 31 release signatures for alternate conveyor pockets. Accordingly, each hopper may feed the same signature, in which case all books are identical or each hopper may feed different signatures to produce different books.

Furthermore, it should be apparent that the operation of the machine, as set up to operate as shown in FIGS. 8 and 9, also provides for a higher per hour output of the machine in terms of number of books per hour, since the conveyor speed will provide approximately one-third greater number of books per hour than the operation of the machine shown in FIG. 7 with the signature conveyors operating at the same speed. On the other hand, if it is desired to maintain the same output of books per hour, such can be achieved in the operation of the machine as schematically illustrated in FIGS. 8 and 9 with the signature conveyor operating at a much slower speed than that of FIG. 7.

From the above, it should be apparent that applicant has provided a substantial improvement in the signature gatherer art in that either a greater output of books can be achieved per hour by operating the machine at the same speed as the prior art machines, or, alternatively, the machine can operate at a much slower speed with less wear and tear on the parts and still maintain the same level of productivity as the prior art.

What is claimed is:

1. A signature gatherer machine comprising a plurality of spaced hoppers for containing a stack of signatures,

a signature conveyor having a plurality of spaced pins which define signature receiving pockets, said pins being spaced apart less than the spacing of said hoppers,

sucker means at each hopper for engaging an edge of the lowermost signature and withdrawing it from the stack of signatures,

separator disc means for supporting the signatures above the lowermost signature while the lowermost signature is being removed from the hopper,

said separator disc means having a gap therein through which said sucker means withdraws the edge of the lowermost signature,

a gripper drum at each hopper rotatable about an axis transverse to the direction of movement of said signature conveyor,

a plurality of grippers on said gripper drum for gripping the withdrawn edge of the lowermost signature and for conveying the signature therewith to a release point for release of the signature into a signature receiving pocket,

said plurality of grippers on each gripper drum being spaced equidistantly around said gripper drum,

said plurality of grippers on one gripper drum being dephased with respect to the grippers on the adjacent gripper drum so that the grippers on the adjacent drum are at different phases in their operation at a given instant of time than the grippers on said one gripper drum,

sensor means for sensing whether no signature is conveyed or whether a double signature or faulty signature is conveyed by a gripper, and

means for driving said signature conveyor at a speed less than the speed of said grippers.

2. A signature gatherer machine as defined in claim 1 wherein said pins are spaced apart a distance equal to two-thirds the distance between the axes of rotation of adjacent gripper drums.

3. A signature gatherer machine as defined in claim 1 further including drive means for said separator disc including adjustable means for rotating said separator disc once per revolution of said gripper drum or twice per revolution of said gripper drum so that either one signature or two signatures may be fed per revolution of said gripper drum.

4. A signature gatherer machine as defined in claim 2 further including means for driving said signature conveyor at a speed two-thirds the speed of said grippers.

5. A signature gatherer machine as defined in claim 1 wherein said sensor means includes means selectively providing an output control signal either once or twice per revolution of the gripper drum.

6. A signature gatherer machine comprising, a plurality of spaced hoppers for containing signatures,

a signature conveyor having a plurality of spaced pins which define signature receiving pockets,

the spacing of the pins on said signature conveyor being two-thirds the spacing between hoppers,

means associated with each of said hoppers for removing signatures therefrom and for conveying the signatures and depositing them in said signature receiving pockets including,

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a gripper drum rotatable about an axis transverse to the direction of movement of the signature conveyor,
 gripper means carried by said gripper drum for gripping a signature in a hopper and for releasing it for deposit in a signature receiving pocket with the signature moving generally in the direction of movement of the signature conveyor,
 said gripper means on the gripper drum associated with one hopper being 90° out of phase with the gripper means associated with the adjacent hopper, and
 means for driving said signature conveyor at a speed two-thirds the speed of said gripper means.
 7. A signature gatherer machine as defined in claim 6 further including a separator disc associated with each hopper for at least assisting in separating an edge of each signature from the remaining signatures for gripping by said gripper means and drive means for rotating said separator disc including a two-speed gearbox so that said separator disc may rotate either once or twice per revolution of said gripper drum.
 8. A signature gatherer machine as defined in claim 6 wherein said gripper means on each drum comprises a pair of grippers spaced 180° apart.
 9. A signature gatherer machine as defined in claim 8 further including,
 sucker means at each hopper for engaging the lowermost signature and withdrawing a portion from the stack of signatures,

separator disc means for supporting the signatures above the lowermost signature while the lowermost signature is being removed from the hopper,
 said separator disc means having a gap therein through which said sucker means withdraws the edge of the lowermost signature and for conveying the signature therewith to a release point for release of the signature into a signature receiving pocket,
 said pair of grippers on one gripper drum being 90° dephased with respect to the pair of grippers on the adjacent gripper drum so that the grippers on one drum are at different phases in their operation at a given instant of time, and
 sensor means for sensing whether no signature is conveyed or whether a double signature is conveyed by a gripper.
 10. A signature gatherer machine as defined in claim 8 further including drive means for said separator disc including adjustable means for rotating said separator disc once per revolution of said gripper drum or twice per revolution of said gripper drum so that either one signature or two signatures may be fed per revolution of said gripper drum.
 11. A signature gatherer machine as defined in claim 10 wherein said sensor means includes means selectively providing an output control signal either once or twice per revolution of the gripper drum.

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