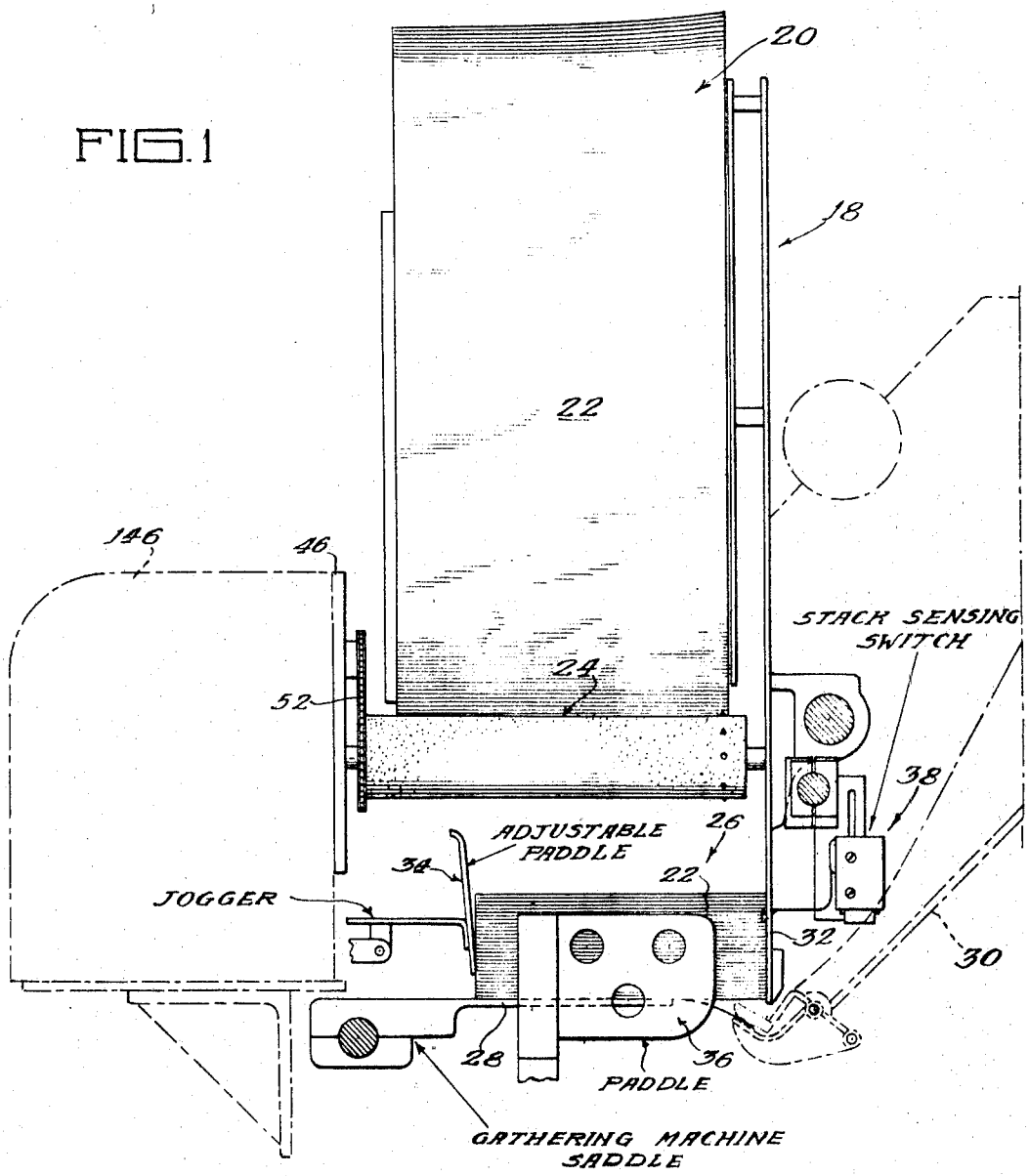
Sept. 9, 1969 K. E. SWANSON 3,466,030

ROTARY FEEDER FOR GATHERING MACHINES

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FIG. 1




Inventor:
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Attorneys

FIG. 10

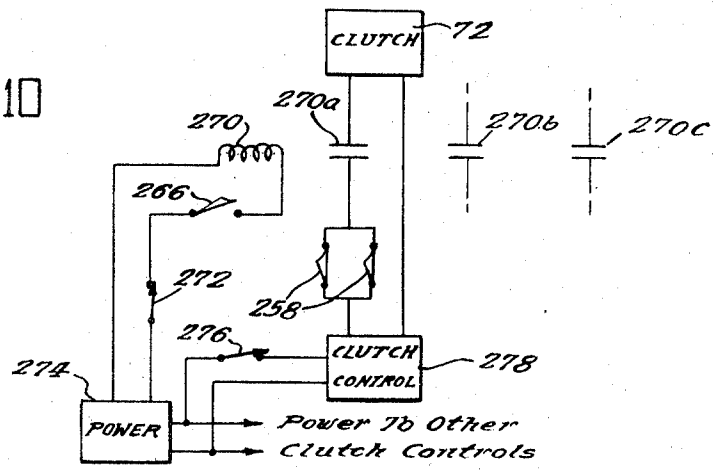
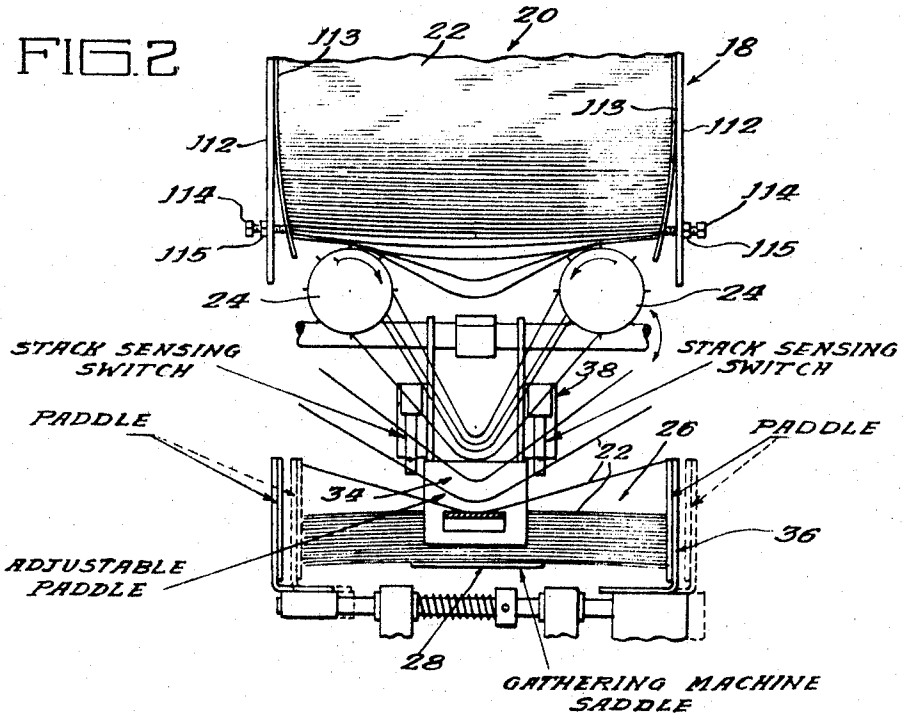

CLUTCH
72
270a
270b
270c
270
266
272
258
276
CLUTCH CONTROL
278
274
POWER
Power To Other Clutch Controls

FIG. 2

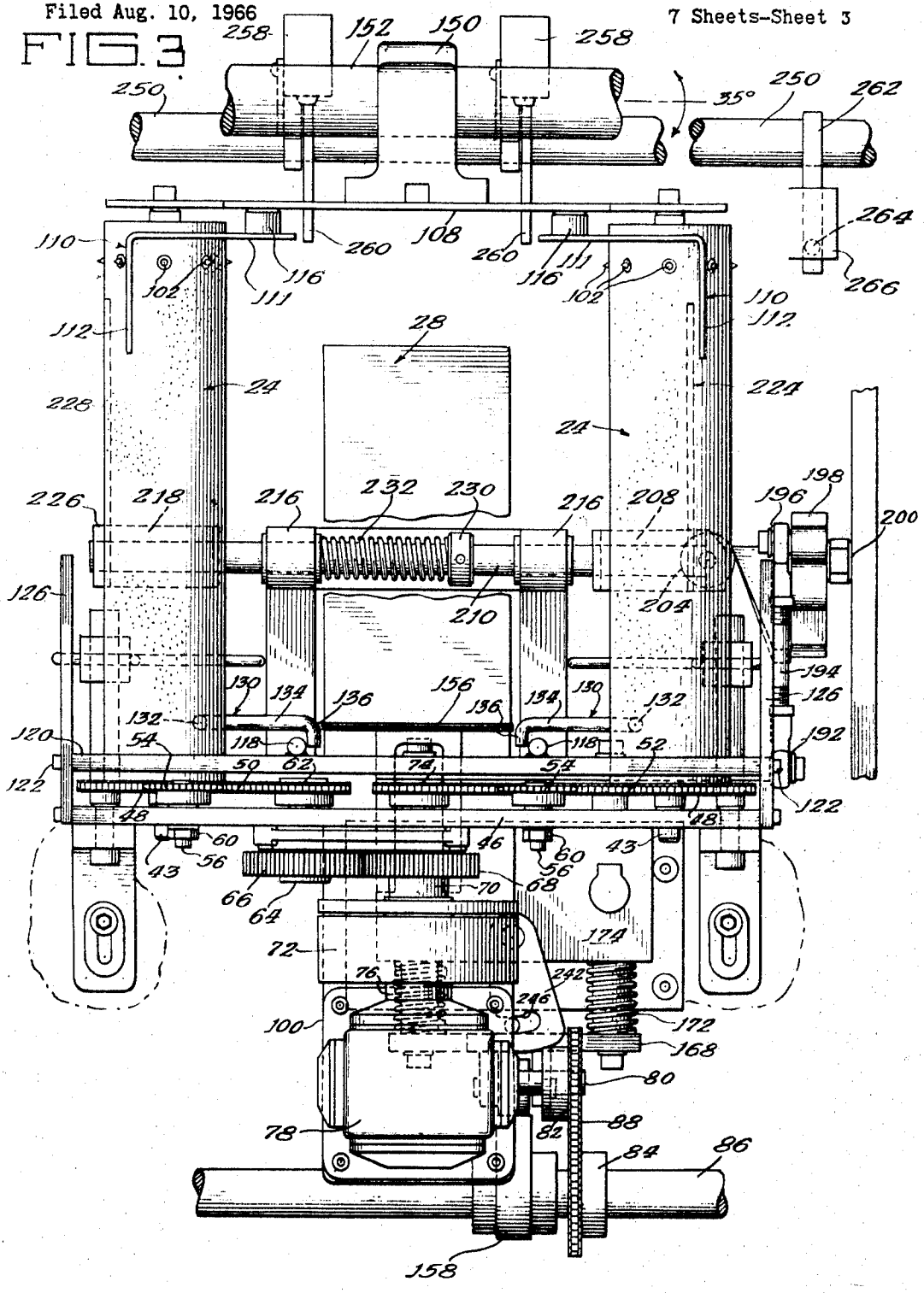

113
22
20
18
112
114
115
24
STACK SENSING SWITCH
38
PADDLE
26
22
34
36
ADJUSTABLE PADDLE
28
GATHERING MACHINE SADDLE

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FIG. 3



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FIG. 5

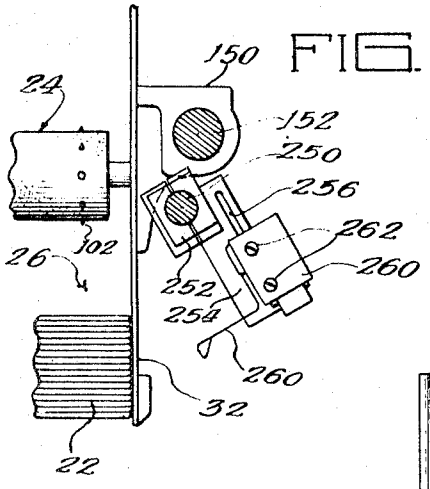
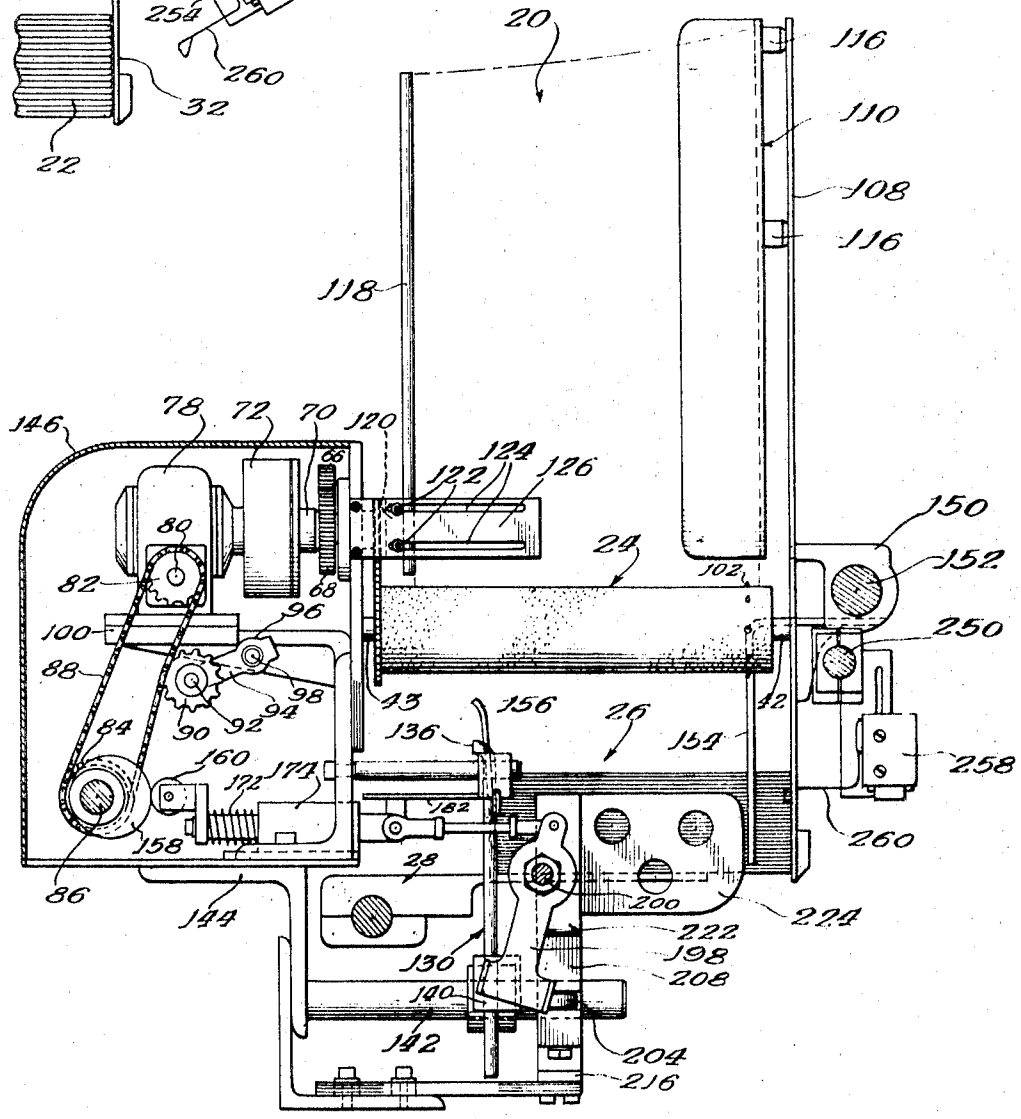



FIG. 4



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ROTARY FEEDER FOR GATHERING MACHINES

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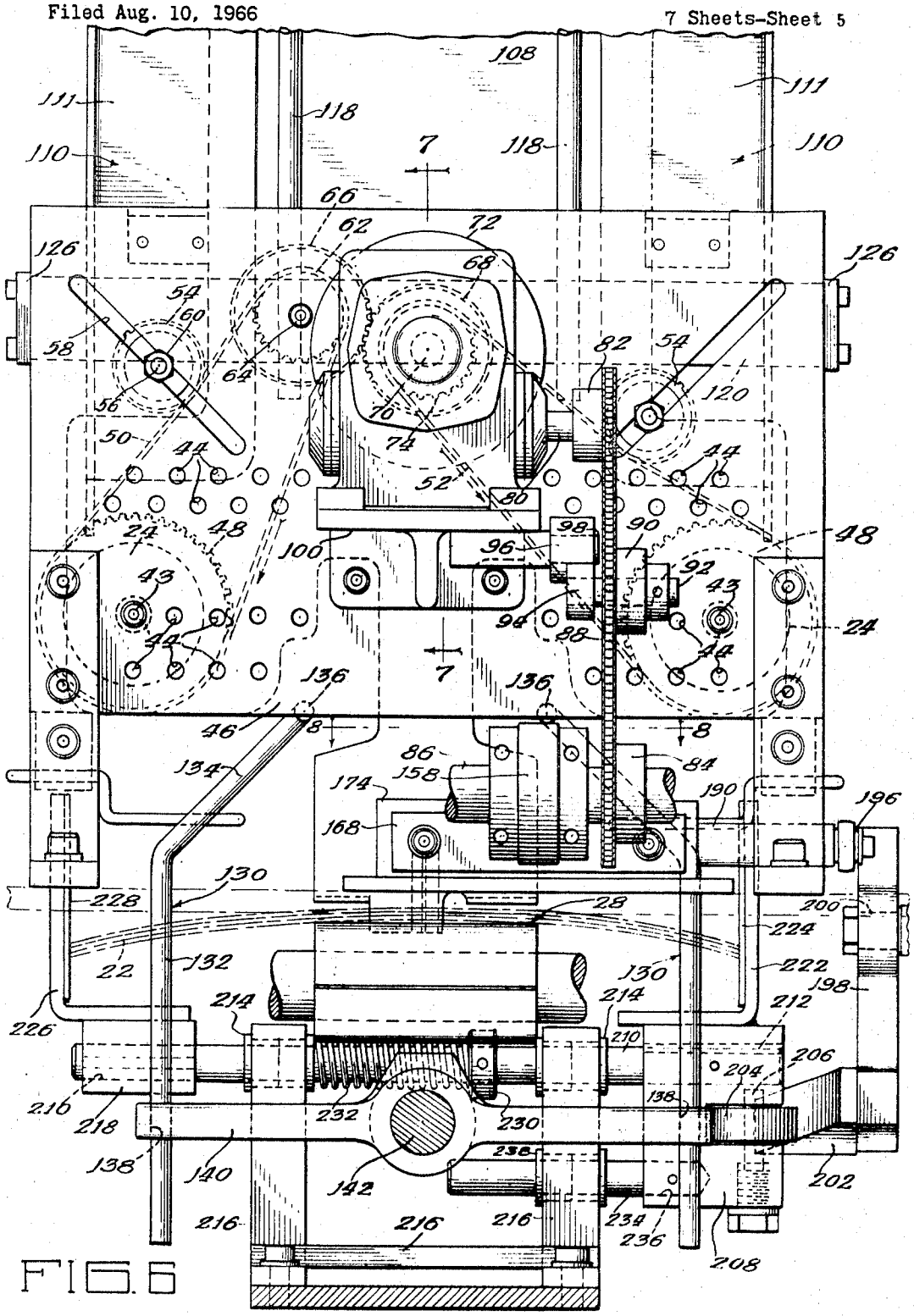


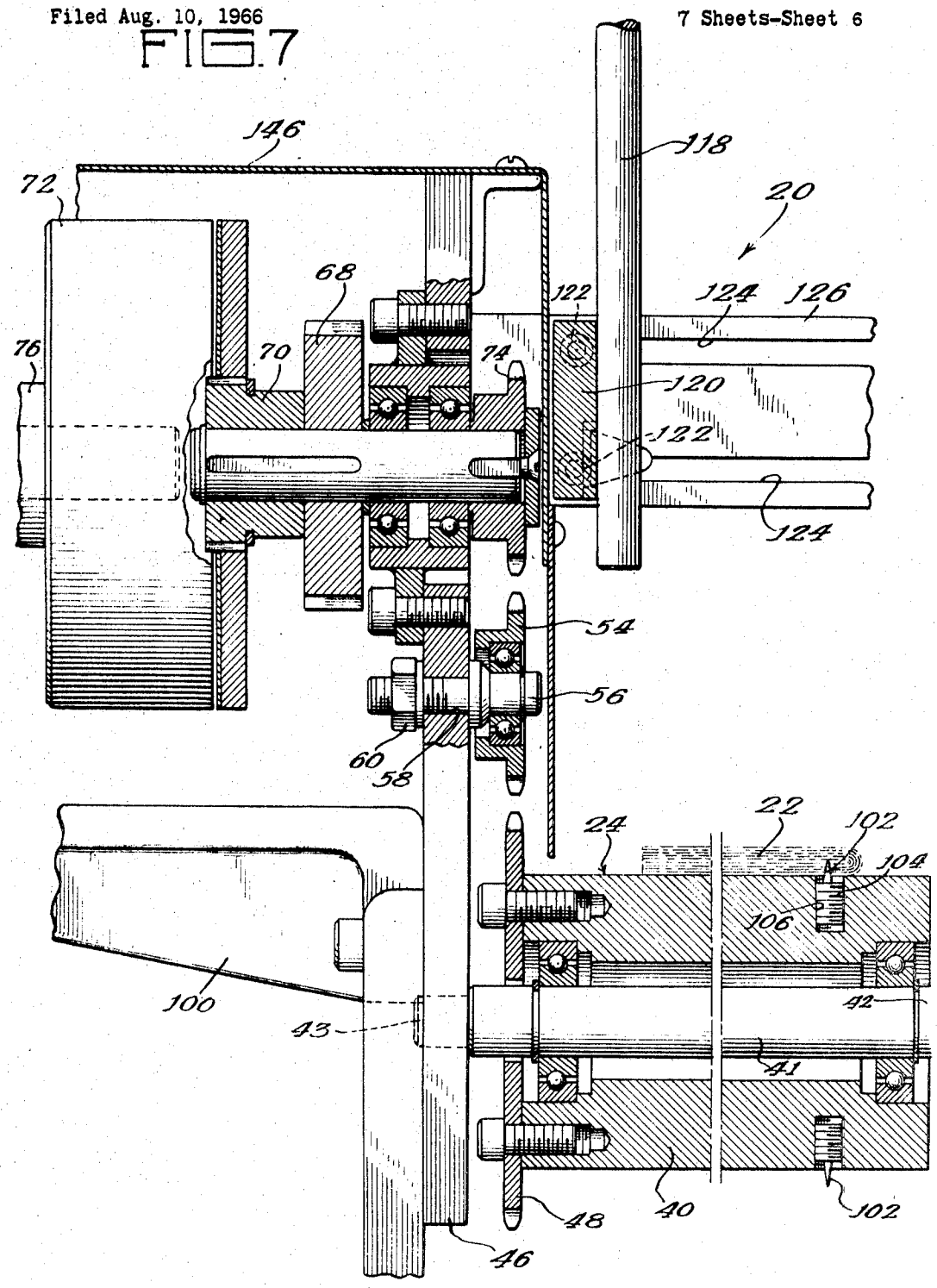

FIG. 6

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ROTARY FEEDER FOR GATHERING MACHINES

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FIG. 7

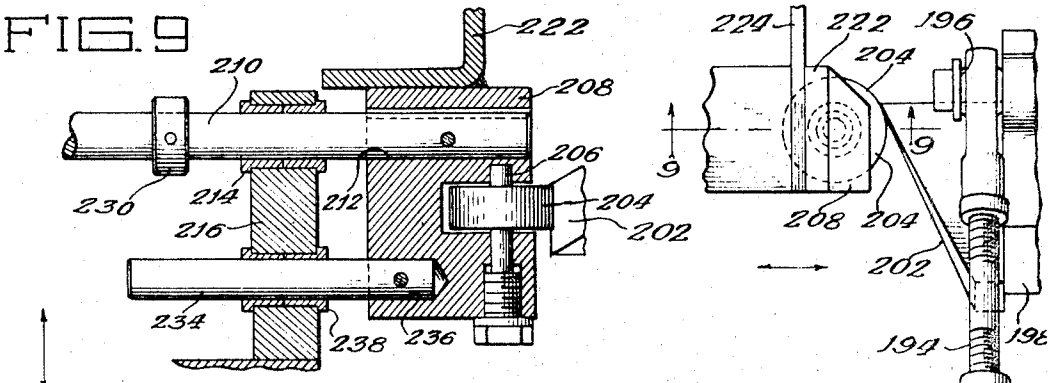


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ROTARY FEEDER FOR GATHERING MACHINES

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FIG. 9



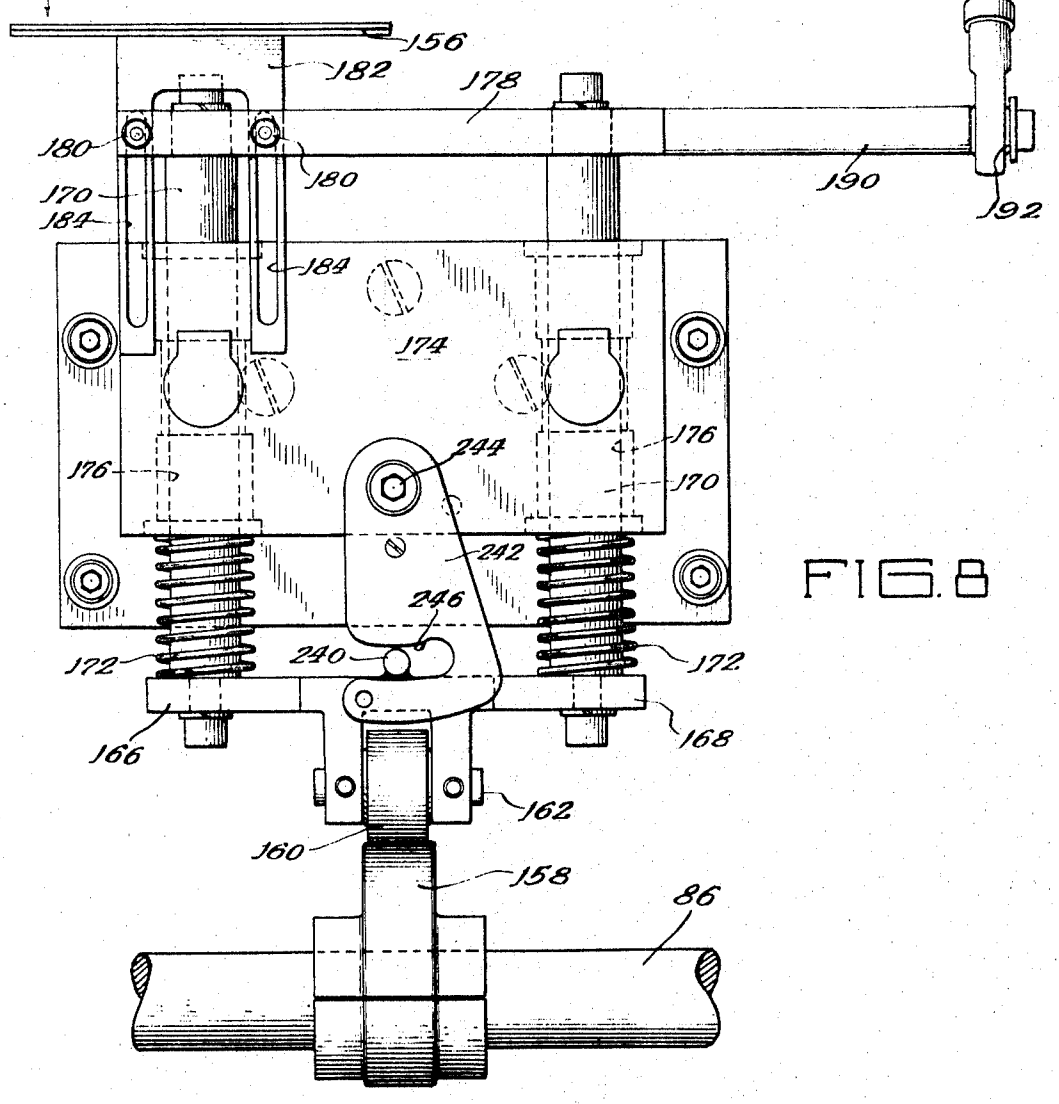




FIG. 8

United States Patent Office 3,466,030
Patented Sept. 9, 1969



3,466,030

# ROTARY FEEDER FOR GATHERING MACHINES

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Int. Cl. B65h 3/06, 7/02
U.S. Cl. 271—71 14 Claims

## ABSTRACT OF THE DISCLOSURE

Apparatus for intermittently feeding signatures into the signature supply box of a gathering machine, in which a large upper stack of signatures is supported upon a pair of spaced, driven rollers which may be rotated toward each other to collapse the bottom signatures in the upper stack in the supply box without creasing them. Means associated with the supply box senses whether the top of the lower stack is above a predetermined level, and interrupts rotation of the rollers when the top of the lower stack is above said level.

As is well known, in the bookmaking art, books, catalogues, etc., are commonly assembled by gathering machines in which signatures having the printed matter representing a plurality of pages in the finished book are gathered in the proper order for binding. Customarily, in a gathering machine a conveyor is provided which passes along a row of boxes each of which contains a plurality of signatures and a swinging jaw means is provided for withdrawing a single signature from the bottom of each box and placing it at a signature receiving station on the conveyor. Accordingly, the signatures in each box must be replenished from time to time.

As is well known in the art, it is necessary that the number of signatures in each box be limited so the total weight on the bottom signatures does not interfere with its proper feeding from the box to the conveyor by the swinging jaw. This factor requires that the boxes be refilled frequently; and this, in turn, requires the use of several laborers, each of whom is in charge of replenishing the signatures in as few as three or four boxes. It will be appreciated that the use of a great number of laborers in conjunction with the operation of a gathering machine is extremely expensive in terms of the cost of the labor and wasteful to the extent that the labor could be used elsewhere. The problem is aggravated for those commercial parties who produce such things as mail order catalogues, telephone directories, state statutes, and the like; because each is printed only once or twice a year, and each requires many more boxes of signatures than are needed for any other work in the shop.

It is, therefore, the principal object of the invention to provide a new and improved feeder for feeding signatures to a box of a gathering machine.

More specifically, it is an object of the invention to provide a feeder for feeding signatures to a position of a gathering machine including a hopper for receiving a stack of signatures, a pair of rollers located at the lower end of the hopper and supporting the stack of signatures therein, and a means for rotating the rollers toward each other to collapse the signatures in contact therewith so that the signatures are fed seriatim downwardly between the rollers to a subjacent gathering machine position without creasing the signatures.

Another object is to provide a feeder for a gathering machine such as that mentioned in the preceding paragraph further including a means for detecting the level of the stack of signatures within the gathering machine position and a means responsive to the detecting means for causing periodic rotation of the rollers whereby signatures will be fed to the position to replenish the supply of signatures therein.



Still another object is the provision of a feeder such as that mentioned above wherein the rollers have roughened surfaces that frictionally engage the signatures in the hopper to promote positive feeding thereof.

Still another object is to provide a feeder such as that mentioned in any of the preceding paragraphs wherein the hopper includes a front and a back and the signatures are adapted to be placed within the hopper with their fold ends at the front thereof, the rollers being constructed to rotate about axes which are perpendicular to the fold ends of the signatures.

Yet another object of the invention is to provide a feeder such as that mentioned in the preceding paragraph wherein the ends of the rollers adjacent the fold ends of the signatures are provided with pins projecting outwardly from the periphery of the rollers to further insure positive feeding of the signatures by penetrating the signatures.

Yet another object of the invention is to provide a feeder for gathering machines including a storage hopper; a pair of spaced rollers adjacent the lower end of the hopper for supporting a stack of signatures within the hopper; means for rotating the rollers toward each other to collapse and feed the signatures in contact therewith to a subjacent gathering machine box, the roller rotating means including a continuously rotatable drive shaft, a clutch, and power transmission means interconnecting the clutch and the rollers to rotate the same when the clutch is engaged; detecting means for determining the level of signatures within the box of the gathering machine; and a means responsive to the detecting means for engaging the clutch to rotate the rollers and feed signatures to the box when the detecting means determines a need for signatures at the box.

Other objects and advantages will become apparent from the following specification taken in conjunction with the accompanying drawings in which:

FIG. 1 is a schematic side elevational view of a rotary feeder embodying the invention for replenishing signatures in a gathering machine box;

FIG. 2 is a schematic front elevational view of a rotary feeder and box;

FIG. 3 is a plan view of the feeder;

FIG. 4 is a side elevational view of the feeder with parts shown in section;

FIG. 5 is a fragmentary side elevational view of a part of FIG. 4, on an enlarged scale, showing details of a level sensing device used in conjunction with the feeder;

FIG. 6 is a front elevational view of the feeder on an enlarged scale;

FIG. 7 is a fragmentary vertical section taken substantially as indicated along the line 7—7 of FIG. 6;

FIG. 8 is a fragmentary plan view of a signature jogging device and additionally illustrates a portion of a shaker operating mechanism;

FIG. 9 is a fragmentary vertical section taken substantially as indicated along the line 9—9 of FIG. 8; and

FIG. 10 is a schematic of a control circuit for the feeder.

Turning now to FIGS. 1 and 2, a preferred embodiment of the feeding device **18** of the invention is seen to include a hopper generally designated **20** in which a plurality of signatures **22** are placed. As best illustrated in FIG. 2, the signatures **22** rest upon a pair of spaced rollers **24** which are disposed in a single plane with their rotational axes generally parallel just above a box, generally designated **26**, of a gathering machine. The length of the rollers **24** may be varied in accordance with the length of various sized signatures.

Signatures **22** are fed by the rollers **24** into the box **26** where they are ultimately supported by a gathering ma-

chine saddle 28. Any conventional means such as an arm and jaw 30 may be used to extract signatures 22 from the box 26 by successively withdrawing the lowermost signature 22 and depositing it on a gathering machine conveyor (not shown).

The box 26 additionally includes a front plate 32; and a jogger, generally designated 34, is used to align the fold edges of the signatures against the front plate 32. Additionally, there is provided a shaker, generally designated 36, which aligns the heads and toes of the signatures within the box 26.

Finally, there is provided an adjustable sensing mechanism, generally designated 38, which is arranged to detect when the supply of signatures 22 within the box 26 falls below a predetermined level so as to actuate a mechanism including the rollers 24 for feeding additional signatures 22 from the hopper 20 to the box 26.

It is to be understood that a separate feeding device 18 is provided for each box 26 of a gathering machine.

As may be seen in FIG. 2, the rollers 24 support the stack of signatures 22 within the hopper by supporting the head end and foot end portions of the stack of signatures. When the rollers 24 are rotated in a direction toward the center of the stack of signatures 22, the signature directly in contact with the rollers 24 is collapsed and its central area is urged downwardly toward the box 26. When the signatures 22 are collapsed sufficiently to lose contact with the rollers 24, they fall to the subjacent box 26. The inherent resiliency of the signatures 22 causes them to return to a substantially flat condition, and they are properly arranged within the box 26 by the jogger 34 and the shaker 36 so that they may be withdrawn by the arm 30 and fed to the conveyor of the gathering machine.

The mechanism for operating the rollers 24 is best seen in FIGS. 3, 6 and 7. Each roller 24 consists of a hollow cylinder 40 rotatably mounted on a shaft 41 (FIG. 7) by means of antifriction bearings. In the preferred embodiment of the invention, the outside diameter of the cylinder 40 is approximately 2½ inches. One end 42 of the shaft 41 is received in a corresponding aperture (not shown) in the front plate 32 while the opposite end 43 of the shaft 41 is received in a corresponding aperture 44 (FIG. 6) in a vetrically disposed back plate 46 arranged near the rear of the box 26. In actuality, a plurality of the apertures 44 are provided in the back plate 46 for receiving the ends 43 of the shafts 41 supporting the corresponding rollers 24. A plurality of corresponding, aligned apertures (not shown) are also provided in the front plate 32 for receiving the respective shaft ends 42. As will be explained in greater detail hereinafter, the apertures 44 in the back plate 46 for receiving the shaft ends 43 and the apertures in the front plate 32 for receiving the shaft ends 42 are utilized to facilitate adjustment of the position of the rollers with respect to each other and with respect to the hopper 20.

Sprockets 48 are secured to the cylinders 40 adjacent the shaft ends 43, and respective drive chains 50 and 52 are trained about the sprockets 48, and into tensioning contact with respective idler sprockets 54. Each idler sprocket 54 is rotatably mounted on a stub shaft 56 which is received in an elongated slot 58 arranged diagonally in the back plate 46 in a direction generally transverse to the run of the respective cahins 50 and 52. Any conventional means such as a nut 60 may be used to retain the stub shaft 56 at a desired position within the slot 58 so that the positions of the idler sprockets 52 may be adjusted to take up slack in the drive chains 50 and 52 as required.

The drive chain 50 is also trained about a drive sprocket 62 which is mounted on a rotatable shaft 64 on which a drive gear 66 is journalled, the latter being in mesh with a second drive gear 68 keyed to the output shaft 70 of a magnetic clutch 72. The output shaft 70 additionally mounts a drive sprocket 74 for the chain 52 and is rotatably journalled in bearings secured to the back plate 46.



The magnetic clutch 72 additionally includes an input shaft 76 which is suitably connected to the output shaft of a reduction gear box 78 which also have an input shaft 80 with a sprocket 82 mounted thereon, while a second sprocket 84 is mounted on a power shaft 86. It will be appreciated that the power shaft 86 may be common to all of the feeding devices 18 associated with the several boxes of the gathering machine and may be driven by any driven shaft in the gathering machine mechanism. A drive chain 88 is trained about the sprockets 82 and 84 so that rotation of the power shaft 86, together with the engagement of the magnetic clutch 72 causes the roller 24 to be rotated in a clockwise direction by the chain 50 while the roller 24 is rotated in a counterclockwise direction by the chain 52. As described previously in conjunction with the description of FIG. 2, this action causes the signatures in contact with the rollers 24 to be collapsed and fed to the subjacent box 26.

As best seen in FIG. 4, an idler sprocket 90 may be placed in engagement with the drive chain 88. The idler sprocket 90 is rotatably mounted on a shaft 92 which, in turn, is mounted on an arm 94. The arm 94 includes at the end thereof opposite the idler sprocket 92, a yoke-like member 96 which surrounds a stationary shaft 98. The stationary shaft 98 is mounted on a support 100 which may additionally support the reduction gear box 78. The yoke-like member 96 includes a releasable securing means such as a screw, so the arm 94 may be secured against rotation relative to the shaft 98 in any of a plurality of positions whereby the idler sprocket 90 takes up slack in the drive chain 88 as required.

FIG. 4 additionally illustrates the surface characteristics of the rollers 24. Specifically, each roller 24 is formed with a roughened signature engaging surface to insure a good frictional contact with the signatures 22. Typically, the desired surface characteristics of the rollers 24 may be provided by a conventional metal spraying process or by knurling, although some care must be taken to insure that the surfaces are not so rough as to damage the signature.

In the event it is desired that a more positive gripping contact be made between the rollers 24 and the signatures 22, each roller 24 may have a plurality of pins 102 arranged about its periphery adjacent the shaft ends 42 for partially penetrating and gripping the signatures 22 adjacent their fold ends. Of course, the pins 102 can only be used where the signature is of the type where such perforations will be hidden or will be cut off in the finished product. Turning to FIG. 7, the manner in which the pins 102 are mounted on the rollers 24 may be seen. Specifically, each pin 102 is mounted on a threaded member 104 which may be received in a threaded bore 106 in the cylinder 40 comprising the roller 24. By rotating the member 104 within the bore 106, the degree of projection of the pin 102 beyond the periphery of the roller 24 may be regulated to suit the thickness of the particular signatures being fed.

The details of the hopper 20 will now be described. As seen in FIG. 1, the face plate 32 of the box 26 may be extended a substantial distance upwardly as indicated at 108. Guide means 110 are spaced somewhat rearwardly from the extension 108 so as to guide the fold end of the signature 22 in a proper path with respect to the pins 102 on the rollers 24. As best seen in FIG. 3, the guide means 110 comprise a pair of generally L-shaped members providing signature fold end engaging plates 111 and signature head or foot end engaging plates 112.

Turning now to FIG. 2, the details of a spring mechanism associated with the signature engaging plates 112 may be seen. Specifically, a leaf spring 113 is vertically arranged on the inner face of the signature engaging plate 112. At the lower end of the signature engaging plate 112 there is provided a set screw 114 which is threaded in a nut 115 welded to the outer face of the plate 112. By suitable manipulation of the set screw 114 within its

corresponding nut **115**, the lower end of the corresponding leaf spring **113** may be urged inwardly in varying degrees against the head or toe end of the signatures. The action of the spring **113** against the signature **22** is such as to aid the collapsing of the latter for feeding purposes as illustrated in FIG. 2. Thus, the spring **113** provides a preliminary collapsing effect before the signature is more completely collapsed by the action of the rollers **24**.

Returning to FIGS. 3 and 4, securing means **116** which may be of any conventional nature are used to interconnect the guide means **110** and the extension **108** of the face plate **32**. Preferably, the securing means **116** provide for an adjustment of the distance between opposing ones of the signature engaging plates **112**. The spacing between the signature engaging plates **111** and the extension **108** of the front plate **32** is such that the signatures **22** will be guided into contact with the pins **102** at a position just inside the margin defined by the fold ends of the signatures **22**.

The hopper **20** additionally includes a pair of vertically arranged guide rods **118** for engaging the lap ends of the signatures **22**. As best seen in FIGS. 3 and 7, the guide rods **118** are suitably secured as by welding to a horizontal bar **120** and have their lower ends terminating just above the upper surfaces of the rollers **24** (FIG. 7). Since the positions of the signature engaging plates **111** remain relatively fixed with regard to the rollers **24** and the front plate **32**, it is necessary to provide a means for adjusting the position of the vertical guide rods **118** with respect to the front plate **32**. Accordingly, the bar **120** receives a pair of set screws **122** in bores at its ends, the set screws **122** being passed through corresponding slots **124** in side plates **126**. As best seen in FIG. 3, the side plates **126** are fixedly secured to the back plate **46** so the bar **120** and thus the guide rods **118** may be adjusted to and secured in any one of a plurality of positions at differing distances from the front plate **32** by manipulation of the set screws **122**, so the guide rods **118** will engage the lap ends of the signatures.

As will be appreciated by those skilled in the art, when signatures are loaded in the box **26**, it is necessary that they be in abutment with the front plate **32**. Additionally, because the fold end of a signature is generally stiffer than the lap end thereof, the latter tends to descend into the box **26** more rapidly than does the fold end when the rollers **24** operate to replenish the supply of signatures within the box **26**. This characteristic of a descending signature may on occasion cause a signature to "bridge" within the box **26** so that its fold edge cannot descend properly to be engaged by the arm and jaw **30** for extraction from the box **26**.

Accordingly, means are provided for guiding the fold edge of a descending signature into substantial abutment with the front plate **32** and for retarding the descent of the lap end of the signature so that its rate of descent substantially matches that of the fold end of the signature. Specifically, as seen in FIGS. 3, 4 and 6, a pair of guide rods **130** are disposed below the rollers **24** adjacent the rear of the box **26**. As best seen in FIG. 6, each guide rod **130** comprises a lower, vertical section **132** and an upper inwardly extending, diagonal section **134** terminating in a rearwardly directed, substantially horizontal stub **136**. The lower ends of the vertically extending sections **132** are adjustably secured in apertures **138** of an elongated bar **140** by any suitable means. The bar **140** is, in turn, mounted on a shaft **142** which, as best seen in FIG. 4, is cantilevered from the downwardly extending portion of an angle iron **144** secured to the underside of a housing **146** for various parts of the mechanism including the clutch **72**, the reduction gear box **78**, the power shaft **86**, etc.

Means (not shown) are provided for fixing the bar **140** to the shaft **142** at any position along the length of the latter. Thus, the position of the guide rods **130** with respect to the front plate **32** and the height of the guide rods **130** with regard to the rollers **24** may be adjusted in accordance with the requirement of a particular size signature.

In operation, the lap end of a signature descending from the hopper **20** by means of the feeding action of the rollers **24** encounters the stubs **136** and the upper diagonally arranged sections **134** of the guide rods **130** and has its descent retarded so that the fold end of the signature comes to rest on the stack of signatures **22** within the box **26** at about the same time, or perhaps just before, the lap end of the signature contacts the stack of signatures within the box **26**. Additionally, when the rods **130** are adjusted properly, the portions of said rods which face the front plate **32** abut the lap edges of the signatures **22** and cause the fold edges of the latter to be in substantial abutment with the front plate **32**.

To aid in maintaining the orientation of the signatures **22** within the box, there is also provided a pair of side guidcs, (only one of which is shown) one for each side of the signature. Referring to FIG. 4, a block **150** is adjustably mounted on a shaft **152** which may extend the length of the gathering machine. From the lower end of the block **150**, a side guide rod **154** extends inwardly through the front plate and downwardly to engage the head end or the toe end portions, as the case may be, of the signatures **22** within the box **26**. The block **150** may be so positioned along the length of the shaft **152** as to orient the side guide rod **154** to abut the sides of the signatures within the box **26**.

While the various guide means disposed within the box **26** perform an orienting function on the signatures **22** within the box **26**, those skilled in the art will recognize that the effect of such guide means may not be sufficient to insure proper orientation. Accordingly, in order to insure that the fold end portion of each signature is in direct abutment with the front plate **32**, the jogger **34**, mentioned previously in conjunction with the description of FIG. 1, is provided. As best seen in FIGS. 4 and 9, the jogger **34** includes a substantially vertical paddle **156** which is driven in an oscillatory manner against the central area of the lap end portions of the signatures **22** to drive the fold end portions against the front plate **32**. Oscillation of the paddle **156** is caused by an eccentric cam **158** mounted on the power shaft **86** and engaging a cam follower **160** disposed upon a shaft **162** journalled within a U-shaped yoke **164**. The bight of the yoke **164** is extended to either side of the legs thereof as indicated at **166** and **168**, the extensions **166** and **168** in turn mounting a pair of push rods **170**. Compression springs **172** are mounted on the push rods **170** and are interposed between the respective ones of the extensions **166** and **168** and a surface of a stationary member **174** having bores **176** in which the push rods **170** are received. The ends of the push rods **170** opposite the extensions **166** and **168** are secured to a bar **178** which, adjacent one end thereof and on its upper side, mounts a pair of set screws **180**. Depending from the rear of the paddle **156**, is a U-shaped member **182** having legs bearing elongated slots **184** which are impaled by the set screws **180**. The purpose of the just described construction is to allow for adjustment of the distance between the paddle **156** and the bar **178** to accommodate signatures of varying sizes and which may be accomplished by loosening the set screws **180** and moving the paddle **156** to the desired position and then tightening the set screws **180**.

It will be apparent from the above description that rotation of the shaft **86** and the associated cam **158** will cause oscillation of the cam follower **160** and thus of the push rods **170**. The connection of the paddle member **156** to the bar **178** causes transmission of the oscillation of the push rods **170** to the paddle member **156**. The springs **172** act to maintain the cam follower **160** in engagement with the cam **158** at all times.

The just described construction including the cam **158** and the push rods **170** is also used to impart an oscillatory motion to the shaker **36** which, it will be recalled, aligns the heads and toes of the signatures within the box **26**. As seen in FIG. 8, the bar **178** includes an extension **190** terminating in a ball and socket joint **192** that connects with one end of an adjustable link **194**, the other end of which is connected through a similar ball and socket joint **196** to an arm **198**. As best seen in FIG. 6, the arm **198** is pivotally mounted intermediate its ends on a stub shaft **200** and bears at its end opposite the ball and socket joint **196** an inwardly extending diagonal cam surface **202**. A cam follower **204** is disposed adjacent the cam surface **202** and is rotatably mounted on a shaft **206** between the legs of a U-shaped block member **208**.

A first, upper shaft **210** is adjustably secured to the block member **208** within a bore **212** in the latter and extends through bushing **214** disposed in the upper ends of U-shaped member **216** which is secured to the frame of the gathering machine. The left-most end of the shaft **210** also adjustably mounts a block **218** by means of a bore **220** through the latter. Mounted on the upper surface of the block member **208** is an L-shaped member **222** which in turn mounts a paddle **224**, while a similar L-shaped member **226** is disposed on the upper surface of the block **218** and mounts a similar paddle **228**.

The shaft **210**, at a point between the legs of the U-shaped member **216**, mounts a collar **230**, and a spring **232** is disposed about the shaft **210** and interposed between the left-most leg of the U-shaped member **216** and the collar **230** to urge the shaft **210** toward the right as seen in FIG. 6. Additionally, a second, lower shaft **234** is disposed within a bore **236** in the block member **208** and extends through a bushing **238** in the right-most leg of the U-shaped member **216** at a point somewhat below the bushing **214** to restrict movement of the block **208** to motion in a single plane.

Oscillatory motion is imparted to the paddles **224** and **228** in the following manner. Reciprocating motion of the push rods **170** in the manner previously described causes the adjustable link **194** to reciprocate, thereby oscillating the arm **198** about the pivot provided by the shaft **200**. As a result, the cam surface **202** on the arm **198** oscillates within a rotary path and in engagement with the cam follower **204**. The cam follower **204** is continuously urged against the cam surface **202** by action of the spring **232**. The diagonal orientation of the cam surface **202** causes a reciprocating motion to be imparted to the block **208** and thus to the shaft **210**. As a result, the paddles **224** and **228** will reciprocate, alternately engaging the head end portion of the signatures within the box **22** and then the toe end portions of the signatures **22** within the box **26**. As mentioned above, the blocks **208** and **220** which ultimately mount the paddles **224** and **226** are adjustably secured to the shaft **210** such that the distance between the two paddles **224** and **228** may be varied to suit the dimensions of the particular signatures being used in the gathering machine.

In the event it is desirable to use the feeder while disabling the jogger **34** and the shaker **36**, a latch means is provided for holding the cam follower **160** in a position out of engagement with the cam **158**. As best seen in FIG. 8, a generally vertical stub shaft **240** is secured to the bight of the U-shaped yoke **164**. A latch member **242** is pivotally mounted as at **244** to the stationary member **170** and includes a slot **246** for receiving the stub shaft **240**. When the latch member **242** is swung into the position illustrated in FIG. 8, the entry of the shaft **240** into the slot **246** precludes reciprocation of the U-shaped yoke **164**; and the arrangement is such that the cam follower **160** is spaced a distance from the axis of rotation of the shaft **86** a distance equal to or greater than the greatest radial dimension of the cam **158**, thereby precluding movement of the follower **160** in accordance with the contour of the cam **158**.

As previously mentioned, means are provided for sensing the level of the signatures **22** within the box **26** for controlling operation of the feeder. Referring to FIGS. 3, 4 and 5, a lifter swing shaft **250** extends along the entire length of a gathering machine and is oscillated through an arc of about 35° during the operation of the gathering machine.

Two sensing devices are provided for each feeder; and since the construction of each is identical to the other, only one will be described. A block **252** is fixed on the shaft **250** for rotation therewith. Depending from the block **252** is an elongated plate **254** having a slot **256**; and a pair of microswitches **258** each having an actuator arm **260** is adjustably secured to the plate **254** by means of bolts **262** extending through the slot **256**. Since the lifter swing shaft **250** is in a fixed position relative to the box **26**, it will be apparent that the just described construction permits vertical adjustment of the microswitches **258** with respect to the box **26** so that each switch **258** may be positioned to sense any desired signature stack height within the box **26**.

The nature of the oscillation of the lifter swing shaft **250** is such that when it is in its extreme clockwise position, the microswitches **258** are disposed in substantially the position illustrated in FIG. 4, while rotation of the lifter swing shaft to its extreme counterclockwise position locates the microswitches **258** substantially in the position illustrated in FIG. 5. It will be apparent that when the microswitches **258** are in the FIG. 4 position, the actuator arms **260** thereof may extend into the confines of the box **26** to contact the fold ends of signatures therewithin. If the level of signatures within the box **26** is below the level of the actuators **260**, the positions of the actuator **260** to the microswitch **258** will not change. However, if the level of signatures **22** within the box **26** is above the level of the actuators, actuation of the microswitch **258** will take place.

The shaft **250** additionally mounts a control cam **262** which is oscillated with the shaft **250** to engage an actuator **264** of a microswitch **266** when the shaft **250** is in its extreme clockwise position.

The control circuit utilizing the switches **258** and the switch **266** will now be described. As seen in FIG. 10, a relay coil **270** is connected in series with the switch **266** and a switch **272** across a source of power **274**. The switch **266** is normally open and therefore will only be closed when, as described above, the cam **262** on the shaft **250** rotates into contact with the actuator **264** of the switch **266**. The switch **272** is an off-on switch for controlling the operation of a plurality of feeding units spaced along the gathering machine in that the relay coil **270** may include a plurality of contacts for operating a plurality of the clutch circuits, each clutch circuit being associated with a single feeder for a single box **26**.

Power is also fed from the source **274** through a unit off-on switch **276** to a conventional magnetic clutch control unit **278**. One of the outputs of the latter is connected directly to the magnetic clutch **72** while the other output is connected to the clutch **72** through the series combination of normally open contacts **270***a* operated by the relay coil **270** and the parallel combination of the switches **258** which are normally closed.

Power from the source **274** may also be fed to additional clutch control circuits (not shown) that are identical to that just described. In this respect, it is to be noted that but a single relay coil **270** is required and may operate contacts **270***b*, **270***c*, etc., in such additional clutch control circuits as may be required. The function of the switch **276** is to provide off-on control of but a single unit as opposed to the plural unit off-on control provided by the switch **272**.

The operation of the circuitry just described is as follows. As will be appreciated by those skilled in the art, each time a signature is withdrawn from the box **26**, the lifter swing shaft **250** will go through a complete period

of oscillation. During this period of oscillation, the actuators **260** of the switches **258** will be swung into the box **26**; and if the level of signatures within the box **26** is such as to block movement of the actuators **260** into the confines of the box, the switches **258** will be opened. The cam **262** is positioned on the lifter swing shaft **250** such that it will engage the actuator **264** of the switch **266** to close the same only during the period after the actuators **260** of the switches **258** have been swung into the box **26** and before they have been swung out of the box **26**. Accordingly, when the switch **266** is closed by action of the cam **262** and the relay **270** energized to close the normally open contacts **270***a*, the clutch **72** will not be energized by the clutch control unit **278** because the switches **258** are open at this time. Thus, when the level of signatures **22** within the box **26** is above the level where replenishment is necessary, the clutch **72** will remain deenergized, and thus disengaged, and preclude operation of the rollers **24** to feed additional signatures **22** into the box **26**.

If the level of signatures within the box **26** is sufficiently low that additional signatures should be fed to the box **26**, when the actuators **260** of the switches **258** are swung into the box, they will not encounter the fold edge of signatures therein and accordingly will remain closed. Thus, when the switch **266** subsequently closes to actuate the relay **270** and close the contacts **270***a*, the magnetic clutch **272** will be engaged and rotary power will be transmitted to the rollers **24** to feed additional signatures into the box **26**. Since the switch **266** is closed only momentarily during each period of oscillation of the lifter swing shaft **250**, it will be appreciated that the relay contacts **270***a* will only be closed momentarily thereby precluding the closed position of the switches **258** from continuously energizing the clutch **72** when the switches **258** are swung away from the box **26** by the lifter swing shaft **250**.

It is to be noted that two of the switches **258** are preferably provided and are arranged in parallel with respect to one another. Thus, if either one of the siwtches **258** remains closed when its actuator **260** is swung into the box **26**, feeding will take place. This feature is desirable in that each switch **258** acts as a back-up on the other switch **258**.

From the foregoing, it will be appreciated that a feeder made according to the invention will properly replenish the signatures in a box of a gathering machine as required and may be suitably adjusted to suit any particlar signature size. In this respect, as a generalization, the roller axes may be located at a point approximately ⅔ of the distance from the vertical median plane of the signatures to the side edge of the signatures although the orientation may differ somewhat due to such factors as signature thickness, type of stock, etc. It will also be apparent that because of the large capacity of the hopper **20**, a significant amount of manual labor may be eliminated because the automatic replenishing of the supply of signatures in the box by the apparatus is such as to meet the requirements of signature level control within the box while the number of signatures that may be loaded into the hopper **20** is independent of the maximum level of signatures permitted in the box **26**. Accordingly, an extremely large number of signatures may be initially placed in the hopper **20** of the feeder and the feeder may operate in conjunction with the gathering machine substantially unattended as contrasted to the frequent manual replenishing of signatures in the boxes as required in prior art devices.

Having described a preferred embodiment of my invention as required by 35 U.S.C. 112, I do not wish to be limited to the construction set forth, but rather, to have my invention construed broadly according to its true spirit as set forth in the following claims.

I claim:

**1.** Apparatus for feeding signatures from the bottom of a stack downwardly onto a pile of signatures in a gathering machine box, said apparatus comprising, in combination: a signature storage hopper having sides, a front and a back, and receiving a stack of signatures, a pair of spaced rollers at the bottom of the hopper, said rollers being adjacent the sides of the hopper and supporting the head portion and foot portion of a stack of signatures in the hopper; means for rotating said rollers toward each other to collapse the signatures that are in contact with the rollers and feed them seriatim downwardly toward a pile of signatures in the gathering machine box; means for detecting the position of the top of the pile of signatures in the box; and means responsive to said detecting means for periodically rotating the rollers to add signatures to the pile.

**2.** The apparatus of claim **1** wherein said detecting means include a signature level sensing means and a means for periodically moving said sensing means between a nondetecting position away from the gathering machine box and a detecting position within the gathering machine box.

**3.** The apparatus of claim **2** further including means for rendering said roller rotating means inoperative whenever said sensing means are not in said detecting position.

**4.** The apparatus of claim **3** wherein said roller rotating means includes an electrically operable clutch, said sensing means comprises at least one switch in series with said clutch, and said means for rendering said roller rotating means inoperative includes electrical contacts in series with said switch and said clutch.

**5.** The apparatus of claim **1** including means for mounting said detecting means in a plurality of differing positions adjacent the gathering machine box whereby the detecting means may be selectively positioned to detect any desired level of the pile of signatures within the gathering machine box.

**6.** Apparatus for feeding signatures to the box of a gathering machine comprising, in combination: a storage hopper for receiving a stack of signatures and adapted to be positioned over the box of a gathering machine; a pair of spaced rollers adjacent the lower end of the hopper and adapted to support the stack of signatures within the hopper, said rollers having a surface promoting a substantial frictional contact with the signatures; means for rotating said rollers towards each other to collapse the signatures in contact with the rollers to feed the signatures downwardly, said roller rotating means comprising a continuously rotatable drive shaft, a clutch operatively associated with said shaft, and rotary motion transmitting means interconnecting said clutch and said rollers; detecting means adapted to be associated with the gathering machine box for sensing the level of signatures therein to determine when signatures should be fed from said hopper by said rollers to the gathering machine box; and means responsive to a determination by said detecting means that signatures should be fed to said box for engaging said clutch to cause said rollers to be rotated.

**7.** The apparatus of claim **6** wherein said detecting means comprise switch means mounted on an oscillatory shaft for movement toward and away from the gathering machine box, said switch means having an actuator for contacting signatures within the gathering machine box; and said clutch engaging means includes circuit means including said switch means and energizable to engage said clutch.

**8.** The apparatus of claim **6** wherein said detecting means include switch means adapted to be associated with the gathering machine box and actuatable in response to the presence or absence of signatures therein; and said clutch engaging means comprises circuit means including said switch means and energizable to engage said clutch.

**9.** Apparatus for forming from an upper vertical signature stack a lower vertical signature stack spaced from and aligned with said upper stack, said apparatus comprising: means for laterally supporting said upper stack; a pair of spaced parallel rollers for supporting the bottom of said upper stack; means for supporting the bottom of

said lower stack; and means for rotating said rollers toward each other to collapse the bottom signatures in said upper stack contacting said rollers and feed said bottom signatures seriatim downwardly between the rollers, without creasing them, onto said lower stack.

**10.** Apparatus according to claim **9** additionally comprising guides forming part of said lateral support means for said upper stack having converging end portions adjacent said rollers for preliminarily bowing said bottom signatures of said upper stack ahead of said rollers.

**11.** Apparatus according to claim **9** in which said signatures are disposed with their folds extending transversely of said rollers, said apparatus additionally comprising means beneath said rollers for retarding the downward displacement of the lap sides of the signatures as the latter are fed onto said lower stack.

**12.** Apparatus according to claim **9** additionally comprising jogging means for vertically aligning the signatures in said lower stack.

**13.** Apparatus according to claim **9** additionally comprising means for sensing the height of said lower stack



operative to interrupt the rotation of said rollers whenever said height exceeds a predetermined level.

**14.** Apparatus according to claim **13** in which the supporting means for said lower stack is a gathering machine box.


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