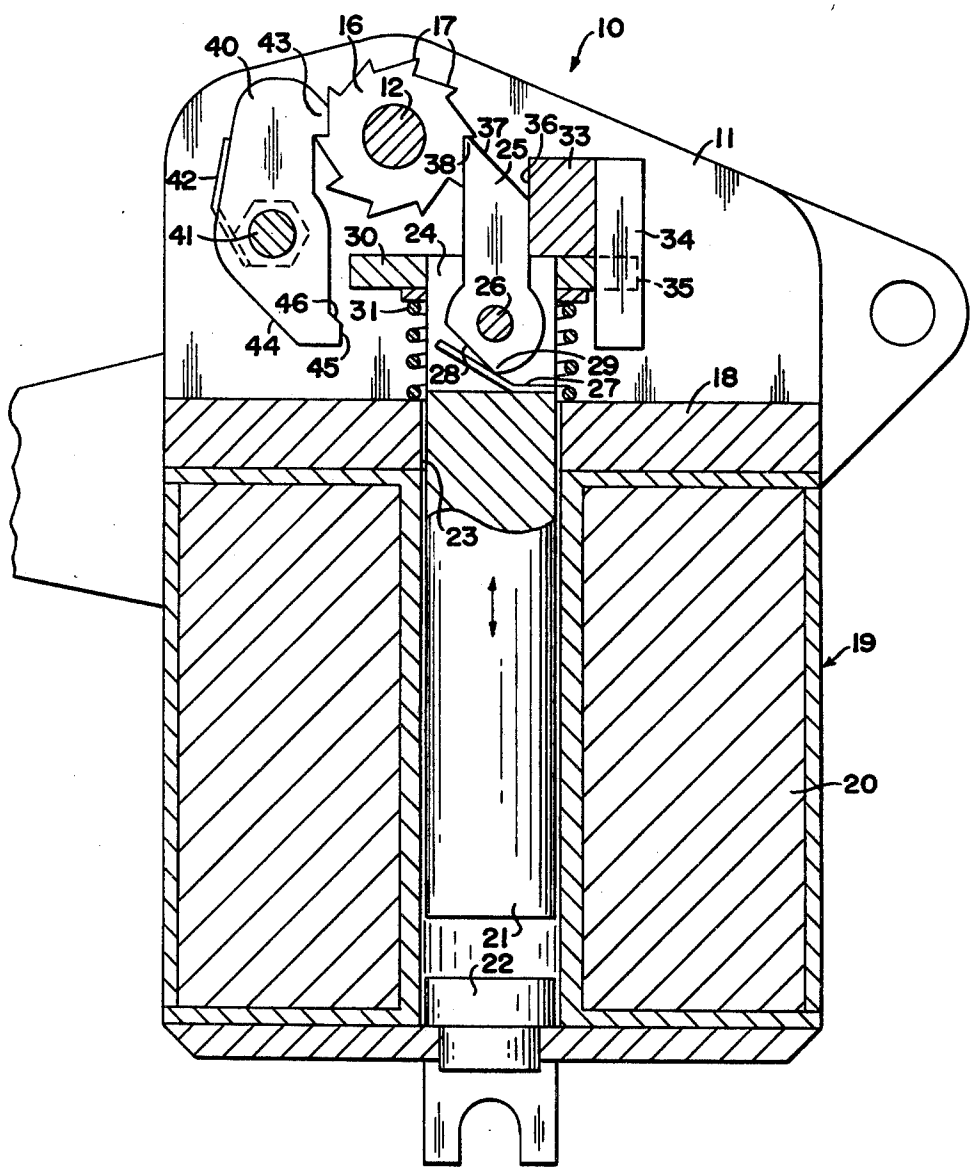
March 24, 1970 G. D. FREDELL 3,501,968

DRIVE MECHANISM

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FIG. 1



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DRIVE MECHANISM

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FIG. 2

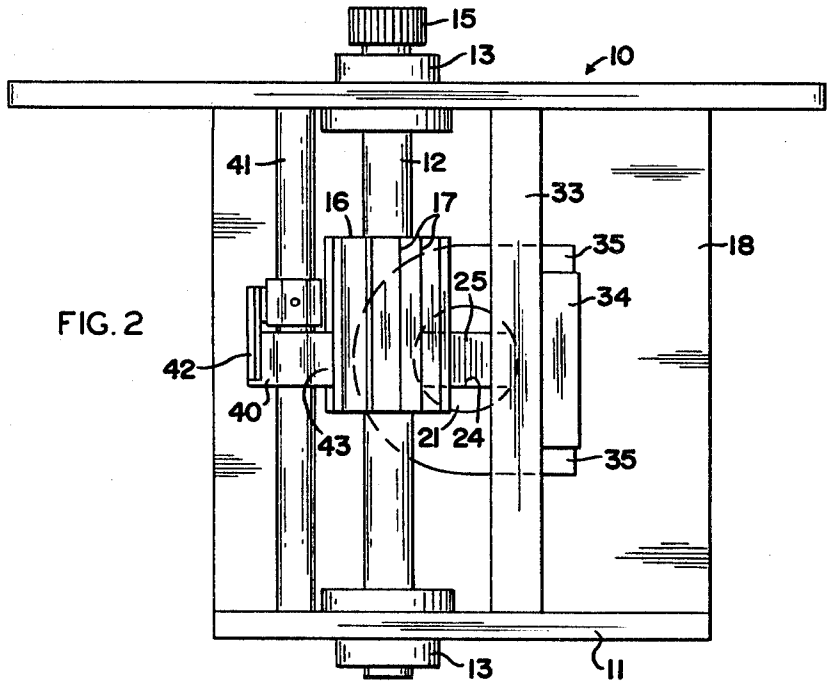
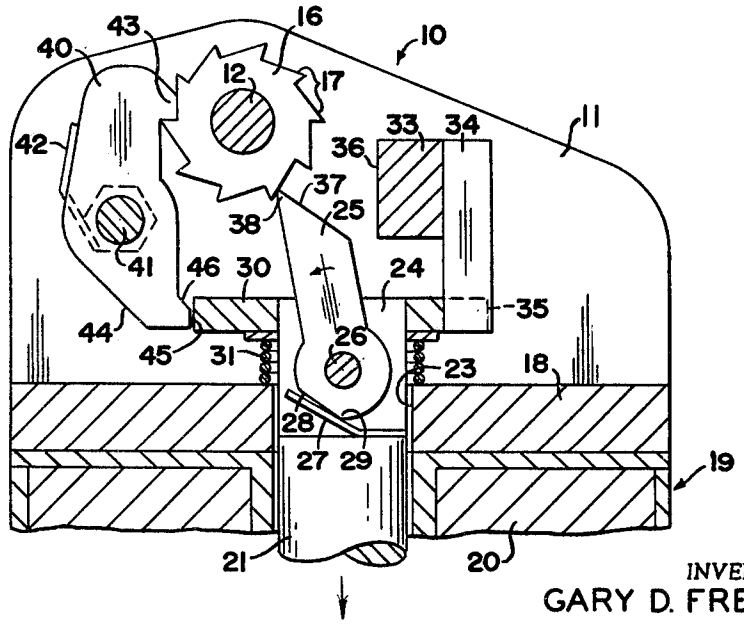


FIG. 3



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DRIVE MECHANISM

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FIG. 4

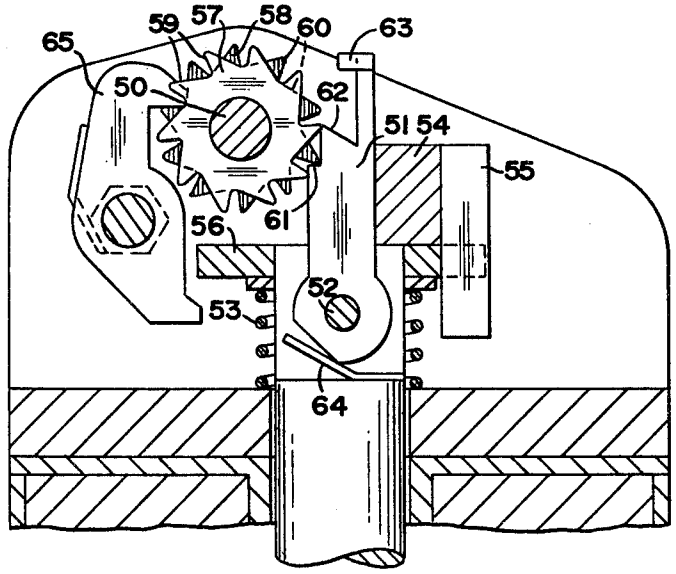
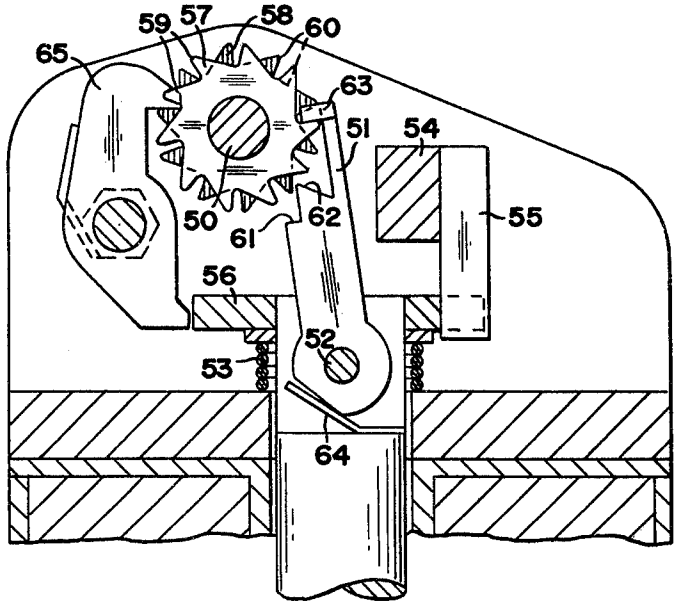


FIG. 5



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3,501,968

DRIVE MECHANISM

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Int. Cl. F16h 27/02
U.S. Cl. 74—128 9 Claims

ABSTRACT OF THE DISCLOSURE

A shaft supporting a ratchet wheel is rotatably supported in a frame with a pawl reciprocating into and out of engagement with the teeth of the ratchet, thereby to impart rotation to the shaft. Lock means cooperate with the pawl and the ratchet wheel to restrict rotation of the ratchet wheel with each actuation to a predetermined amount in a single direction with the ratchet wheel being otherwise restricted from any movement in either direction.

This invention is directed to a drive mechanism, and more particularly to a mechanism in which reciprocating linear motion is converted to rotary motion.

A great number of prior art mechanisms have been developed in which reciprocating linear motion is converted to rotary motion. One type of such prior art mechanisms employs a ratchet wheel on a shaft, a pawl which is adapted to engage the teeth on the ratchet wheel and some appropriate mechanism to reciprocate the pawl into and out of engagement with the ratchet teeth. The path of reciprocation of the pawl is normally tangential to the ratchet wheel and as the pawl approaches the ratchet wheel it engages a ratchet tooth and rotates the ratchet wheel a predetermined amount. One advantage of a mechanism such as this is that a predetermined incremental rotation may be imparted with a relatively simple mechanism.

The prior art has also devised means to prevent unwanted rotation of the ratchet wheel. Typically, the prior art approach has employed some form of a locking detent or pawl which engages the ratchet wheel to prevent reverse rotation of the wheel. These locking detents or first position generally beneath the feedboard to a second engagement with the teeth of the ratchet wheel but are permitted to ratchet over the teeth as the ratchet wheel is rotated by the drive pawl. As the drive pawl is returned to its normal position to pick up the next tooth on the ratchet wheel, the lock detent or pawl remains in engagement with the teeth of the ratchet wheel and precludes reverse rotation of the wheel.

Mechanisms such as those hereinabove described have some shortcomings. Thus, although the prior art has provided means for preventing reverse rotation of the ratchet wheel, the prior art has made no provision whatsoever for restraining rotation of the ratchet wheel in the drive direction. The locking detent or pawl is wholly ineffective to prevent additional rotation of the ratchet wheel in the drive direction since it is designed to ratchet over the teeth of the wheel when the wheel rotates in this direction. As a result, the ratchet wheel is normally free to rotate in the drive direction when the drive pawl is disengaged from the ratchet teeth. Indeed, in some such mechanisms even when the drive pawl is in engagement with the ratchet teeth, the drive pawl does not prevent additional rotation of the ratchet wheel in the drive direction. It will be appreciated that devices such as these are not satisfactory when a carefully controlled movement of the drive wheel is desired.

It is an object of this invention to provide a drive mechanism in which reciprocating linear motion is converted into rotary motion.

It is a further object of this invention to provide a drive mechanism in which the rotary motion of a shaft is controlled both in direction and amount of rotation.

It is a still further object of this invention to provide a drive mechanism in which a drive pawl is reciprocated into and out of engagement with the teeth of a ratchet wheel, and in which means are provided to prevent any rotation of the ratchet wheel when the drive pawl is disengaged from the ratchet teeth.

Another object of the invention is to provide a ratchet mechanism in which the ratchet wheel may not rotate more than a predetermined amount in one direction with each actuation of the mechanism.

It is another object of this invention to provide a drive mechanism which converts linear motion into rotary motion with the linearly moving mechanism serving to lock the rotary mechanism from movement during a portion of the linear cycle.

It is still another object of this invention to provide a drive mechanism in which linear motion is converted into rotary motion and in which the mechanism is failsafe in that it is impossible for the rotary mechanism to rotate in any direction without a prederminted linear movement.

More specifically, this invention broadly contemplates a shaft supporting a ratchet wheel with the shaft being rotatably supported in a frame. A pawl is provided to reciprocate into and out of engagement with the teeth of the ratchet, thereby, to impart rotation to the shaft. Lock means cooperate with the drive pawl to prevent rotation of the shaft beyond a predetermined movement for each reciprocation of the pawl, and lock means cooperate with the ratchet wheel to prevent rotation of the ratchet wheel in any direction when the drive pawl is disengaged from the ratchet wheel.

The preferred construction of the invention contemplates a frame supporting a shaft for rotation with a ratchet wheel secured to the shaft. A solenoid-operated reciprocating plunger is supported on the frame with a drive pawl carried by the plunger and which is adapted to be reciprocated into and out of engagement with the teeth on the ratchet wheel. A guide is positioned adjacent the pawl and serves to limit movement of the pawl in a direction radially away from the ratchet wheel. A lock pawl is pivotally supported on the frame and is biased into engagement with the wheel to prevent reverse rotation of the ratchet wheel. In addition, the plunger carries a lock bar which engages the lock pawl when the drive pawl is disengaged from the ratchet wheel. This lock bar cooperates with the lock pawl to prevent the lock pawl from being pivoted out of engagement with the ratchet wheel, thereby, preventing rotation of the ratchet wheel in any direction when the drive pawl is disengaged from the wheel.

Referring to the drawings wherein like reference numerals indicate like parts in the various views:

FIGURE 1 is a sectional view through the drive mechanism.

FIGURE 2 is a top plan view of the drive mechanism of FIGURE 1.

FIGURE 3 is a partial sectional view similar to FIGURE 1 showing the parts of the drive mechanism in a different portion of the operating cycle.

FIGURE 4 is a sectional view of a modified form of the invention.

FIGURE 5 is a sectional view of the modification of FIGURE 4 illustrating the parts in a different position of actuation.

Referring now to the drawings, and particularly the embodiment of FIGURE 1, the drive mechanism indicated generally by the reference numeral **10**, is supported on a frame **11** which may be mounted on any supporting structure. A shaft **12** is rotatably supported by bearings **13** in the frame **11**. The shaft **12** may carry on its one end an appropriate driving element such as a gear **15**. Secured to the shaft **12** is a ratchet wheel **16**, on the periphery of which there are formed a plurality of ratchet teeth **17**.

A plate **18** is supported on the frame **11** and the plate, in turn, supports a solenoid indicated generally by the reference numeral **19**. The solenoid includes a solenoid coil **20** and a solenoid plunger or armature **21**. A bottom stop **22** provides a bottom limit for the reciprocation of the plunger **21**. The plate **18** includes an aperture **23** through which the upper end of the plunger **21** projects.

An upwardly opening bore or slot **24** is provided in the upper end of the plunger **21** and receives therein a pawl **25**. A pin **26** pivotally supports the pawl **25** in the bore **24**. A leaf spring **27** is secured at the inner end of the bore and is adapted to engage a flat surface **28** formed on the inner end of the pawl. The flat surface defines a chord on the otherwise circular end of pawl **25** with one end **29** of the surface serving as a fulcrum point against which spring **27** abuts. A lock bar **30** encircles the upper end of plunger **21** and is secured thereto with a spring **31** received over the plunger **21** and interposed between the lock bar **30** and the upper surface of the plate **18** to bias the plunger **21** in a direction away from the bottom stop **22**.

As an upper stop for the plunger **21**, there is provided a stop bar and guide **33** which is supported by the frame **11**. A guide block **34** is secured to the guide **33** with the guide block extending between a bifurcated portion of lock bar **30** defining arms **35**.

The pawl **25** is defined by substantially parallel opposed sides with a beveled surface **37** formed on the outer extremity of the pawl **25** defining a nose **38** adapted to engage the ratchet teeth **17** in the manner shown in FIGURE 1. As will be understood by those in the art, reciprocation of the plunger **21** will cause the pawl **25** to be reciprocated therewith, and as the pawl engages the ratchet teeth **17** on the ratchet **16**, a rotary motion will be imparted to the shaft **12**.

In many applications it is desirable to prevent reverse rotation of the ratchet wheel **16**. Moreover, it is often desirable to assure that the ratchet wheel **16** is advanced but a predetermined amount with each actuation of the mechanism.

As a means to accomplish both of these purposes, there is provided a locking arrangement which includes a locking pawl or detent **40** which is pivotally mounted on a shaft **41** supported by the frame **11**. The pawl is normally biased by a spring **42** in a clockwise direction about the shaft **41**, as viewed in FIGURE 1. The pawl **40** includes a nose portion **43** which is adapted to cooperate with the ratchet teeth **17**. The pawl **40** further includes a tail portion **44** which includes a flat surface **45** and a tapered surface **46** adjacent surface **45**. The tail portion **44** is of such a configuration and so dimensioned that it is normally spaced from the path of reciprocation of lock bar **30** when pawl **40** is in engagement with ratchet wheel **16**.

The above-described mechanism operates in the following manner:

With the parts of the mechanism in the position shown in FIGURE 1, it will be appreciated that the shaft **12** is effectively restrained from any rotation. Thus, any tendency of the shaft **12** to rotate in the clockwise direction will be restrained by the engagement of the pawl **25** with the ratchet tooth **17**. Similarly, the engagement of the pawl **40** with ratchet teeth **17** also prevents counter-clockwise rotation of the shaft **12**. The spring **42** maintains engagement of the pawl **40** with the ratchet wheel, while pawl **25** is maintained in engagement with the ratchet wheel by the blocking engagement of surface **36** on guide **33** with pawl **25**.

When it is desired to impart rotation to the shaft **12**, the solenoid **19** is actuated which causes the plunger **21** to be drawn toward the bottom stop **22**. As the plunger **21** is displaced, the pawl **25** is disengaged from the ratchet wheel, and the action of the spring **27** against the fulcrum point **29** on the pawl causes the pawl **25** to pivot in a counter-clockwise direction around the pin **26**. However, though the pawl **25** is now disengaged from the ratchet wheel **16**, the shaft **12** is still restrained from rotating in the clockwise direction due to the continued engagement of the pawl **40** with the teeth **17**. Moreover, as the plunger **21** is moved downward, the lock bar **30** moves to a position in which it is directly opposed to the surface **45** on tail **44** of the pawl **40**. Thus, although pawl **40** normally ratchets over teeth **17** when wheel **16** rotates counter-clockwise, lock bar **30** blocks pawl **40** so that it can no longer pivot to accommodate the rotation of wheel **16**, thereby effectively locking the ratchet wheel against movement in any direction.

As the solenoid is de-energized, the spring **31** returns the plunger **21** to the position shown in FIGURE 1. As the plunger is returned to its original position, the pawl **25** picks up a different tooth of the ratchet wheel and imparts rotary movement to the shaft **12**. Because the lock bar **30** has now been displaced from a position of direct opposition to the tail portion **44** of the pawl **40**, the pawl is free to pivot about the shaft **41** without interfering with the rotation of wheel **16**.

It will be appreciated that this mechanism prevents any rotation of the shaft **12** from external sources and limits the rotation of the shaft to a single ratchet tooth with each actuation of the solenoid **19**. The mechanism is entirely failsafe in that all steps in the cycle the ratchet wheel **16** is positively controlled by either the pawl **25** or the pawl **40** or both. Moreover, the engagement of the guide **34** with the lock bar **30** and arms **35** prevents any tendency of the plunger **21** to tilt so that not only are the pawls locked in position, but also the plunger **21** is restrained from movement.

Referring now to FIGURES 4 and 5, there is illustrated an alternate embodiment which achieves the same desirable results as the mechanism of FIGURE 1. Essentially, the same basic arrangement of a frame, solenoid and plunger is employed. A shaft **50** is rotatably supported by the frame and a pawl **51** is pivotably supported by a pin **52** carried by the upper end of the plunger. A spring **53** biases the plunger to an extended position with a guide bar **54** functioning as an upper stop and a guide **55** cooperating with a bar **56** to prevent undesirable tilting of the plunger.

Rather than employing a single ratchet wheel as in the embodiment of FIGURE 1, the embodiment of FIGURE 4 employs two ratchet wheels. Thus, there are secured on the shaft **50** a ratchet wheel having ratchet teeth formed around the periphery thereof. However, the teeth **59** on the ratchet wheel **57** face in the direction opposite to the direction of the teeth **60** on ratchet wheel **58**.

The pawl **51** includes a stepped shoulder **61** which is adapted to engage the teeth **60** on the ratchet **58**. The pawl further includes a nose portion **62** which extends in a direction longitudinal of the pawl **51**. In addition, the pawl includes an arm or lock bar **63** which is formed at the outer extremity of the pawl with the arm **63** having a transverse dimension relative to the pawl **51**. The arm **63** is adapted to engage the teeth **59** on the ratchet wheel **57**. A spring **64** tends to bias pawl **51** in the same manner as in the embodiment of FIGURE 1. The embodiment of FIGURE 4 also includes a lock or check pawl **65** which cooperates with the teeth of ratchet wheel **58** to prevent reverse rotation.

The embodiment of FIGURE 4 functions in the following manner:

With the parts of the mechanism in the position illustrated in FIGURE 4, it will be appreciated that the shaft **50** is restrained from any movement whatsoever. Thus, the tooth **60** on the ratchet wheel **58** in engagement with the shoulder **61** of the pawl **51** is restrained from movement relative to the pawl. Should the wheel **58** tend to rotate in a clockwise direction, the check pawl **65** will restrain such tendency. In the event that the ratchet wheel should tend to rotate in the counterclockwise direction, the tooth **60** will engage the longitudinal surface of the shoulder **61**. Any tendency of the pawl **51** to be pivoted about the pin **52** is prevented through the inter-engagement of the pawl with the lock bar **54**. Similarly, any attempt to tilt the plunger is restrained through inter-engagement of the lock bar **56** with the guide **55**.

When it is desired to impart rotation to the shaft **50**, the solenoid is actuated and the plunger is retracted in the manner of the embodiment of FIGURE 1. As the plunger is retracted, the pawl **51** is disengaged from the teeth on the ratchet wheel **58**. As the plunger is retracted, the pawl **51** is permitted to pivot in a counterclockwise direction around the pin **52** under the bias of spring **64**. As the pawl **51** is pivoted in a counterclockwise direction, the arm **63** engages the teeth **59** on the ratchet wheel **57**. Any tendency of the shaft **50** to rotate in the counterclockwise direction when the arm **63** is in engagement with the ratchet wheel **57** will merely tend to move the plunger upward. However, since the plunger is electrically held energized, the shaft **50** is prevented from rotation. When the solenoid is de-energized, the plunger will be displaced under the bias of spring **53** and the shoulder **61** on the pawl **51** will engage the next tooth on the ratchet wheel **58** and impart a rotary movement to the shaft **50**.

It will be appreciated that this latter embodiment may utilize the engagement of member **56** with check pawl **65** in the same manner as in the embodiment of FIGURE 1. However, since arm **63** is effective to prevent rotation of shaft **50** in the counterclockwise direction when the solenoid is energized, member **56** need not be employed.

It is thus apparent that both embodiments employ the linearly reciprocating member as the means to lock the rotary mechanism when the drive pawl is disengaged from driving engagement with the ratchet wheel. Moreover, both embodiments employ the drive pawl as the means to limit the amount of rotary motion imparted to the ratchet wheel, thereafter locking the wheel from further rotation in the drive direction. Thus, rotation of the shaft is fully controlled in direction and amount at all times.

Having thus descried my invention, I claim:

1. An improved mechanism for converting linear motion to rotary motion in which the mechanism includes a shaft rotatably supported on a frame, a single ratchet wheel secured to the shaft, a drive pawl adapted to reciprocate into and out of driving engagement with said ratchet wheel means, reciprocating drive means connected to said drive pawl to rotate said wheel means in one direction and lock means cooperating with said ratchet wheel means to prevent rotation in the other direction, the improvement comprising:

additional lock means operative to prevent rotation of said wheel means in said one direction when said drive pawl is out of driving engagement with said wheel means.

2. The mechanism of claim **1** wherein said improvement further comprises guide means fixedly supported on said frame adjacent to the path of reciprocation of said drive means,

said guide means being operative to limit the rotation of said wheel means in said one direction when said drive pawl is in driving engagement with said wheel means.

3. An improved mechanism for converting linear motion to rotary motion in which the mechanism includes a shaft rotatably supported on a frame, ratchet wheel means secured to the shaft, a drive pawl adapted to reciprocate into and out of driving engagement with said ratchet wheel means, reciprocating drive means connected to said drive pawl to rotate said wheel means in one direction and lock means cooperating with said ratchet wheel means to prevent rotation in the other direction, the improvement comprising:

additional lock means operative to prevent rotation of said wheel means in said one direction when said drive pawl is out of driving engagement with said wheel means; said lock means comprises a lock pawl pivotally supported on said frame;

said additional lock means comprising a lock bar on said drive means,

said lock bar cooperating with said lock pawl to prevent pivoting movement of said lock pawl when said drive pawl is out of driving engagement with said wheel means.

4. An improved mechanism for converting linear motion to rotary motion in which the mechanism includes a shaft rotatably supported on a frame, ratchet wheel means secured to the shaft, a drive pawl adapted to reciprocate into and out of driving engagement with said ratchet wheel means, reciprocating drive means connected to said drive pawl to rotate said wheel means in one direction and lock means cooperating with said ratchet wheel means to prevent rotation in the other direction, the improvement comprising:

additional lock means operative to prevent rotation of said wheel means in said one direction when said drive pawl is out of driving engagement with said wheel means; said additional lock means includes an arm projecting from said drive pawl,

said arm being spaced from said ratchet wheel means when said drive pawl is in driving engagement with said wheel means and in engagement with said wheel means when said drive pawl is out of driving engagement with said wheel means.

5. The mechanism of claim **4** wherein said wheel means comprises a pair of ratchet wheels secured to said shaft,

said drive pawl being adapted to engage one of said wheels and said arm being adapted to engage the other of said wheels.

6. An improved mechanism for converting linear motion to rotary motion in which the mechanism includes a shaft rotatably supported on a frame, ratchet wheel means secured to the shaft, a drive pawl adapted to reciprocate into and out of driving engagement with said ratchet wheel means, reciprocating drive means connected to said drive pawl to rotate said wheel means in one direction and lock means cooperating with said ratchet wheel means to prevent rotation in the other direction, the improvement comprising:

additional lock means operative to prevent rotation of said wheel means in said one direction when said drive pawl is out of driving engagement with said wheel means; said drive means comprises a solenoid having a reciprocating armature,

a recess in the upper end of said armature,

said drive pawl being pivotally supported in said recess,

spring means in engagement with said drive pawl,

said spring means normally pivoting said pawl toward said ratchet wheel means, and

guide means fixedly supported on said frame adjacent the path of reciprocation of said drive pawl,

said guide means being operative to limit the pivoting movement of said pawl in a direction away from said ratchet wheel means.

7. An improved mechanism for converting linear motion to rotary motion in which the mechanism includes a shaft rotatably supported on a frame, ratchet wheel means secured to the shaft, a drive pawl adapted to reciprocate into and out of driving engagement with said

ratchet wheel means, reciprocating drive means connected to said drive pawl to rotate said wheel means in one direction and lock means cooperating with said ratchet wheel means to prevent rotation in the other direction, the improvement comprising:

additional lock means operative to prevent rotation of said wheel means in said one direction when said drive pawl is out of driving engagement with said wheel means; said drive pawl is pivotally supported on said drive means,

biasing means cooperating with said drive pawl to pivot said drive pawl toward said ratchet wheel means, and

stop means operative to limit the pivoting movement of said drive pawl away from said ratchet wheel means.

8. The mechanism of claim **7** wherein said stop means is radially spaced from the periphery of said wheel means a distance substantially equal to the width of said drive pawl.

9. The mechanism of claim **7** wherein said lock means comprises a lock pawl pivotally supported on said frame, said lock bar cooperating with said lock pawl to prevent pivoting movement of said lock pawl when said drive pawl is out of driving engagement with said wheel means.

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