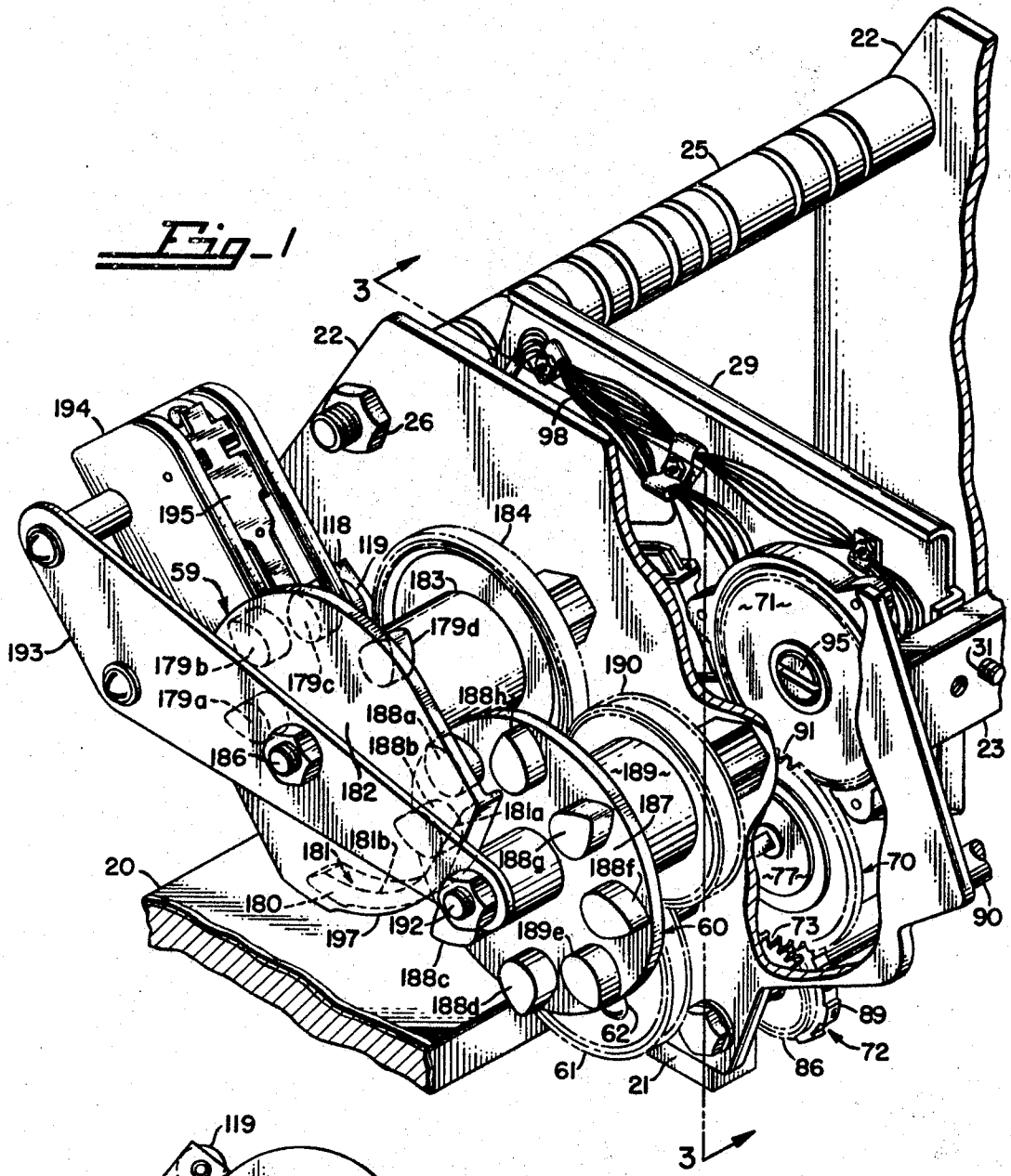
June 10, 1969 C. E. ADLER 3,448,639

INDICATING APPARATUS

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Fig. 1



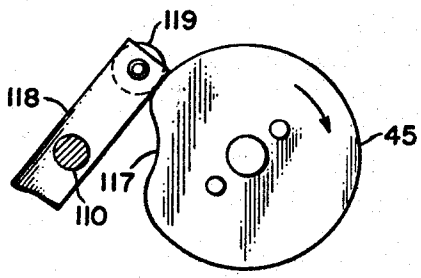


Fig. 2

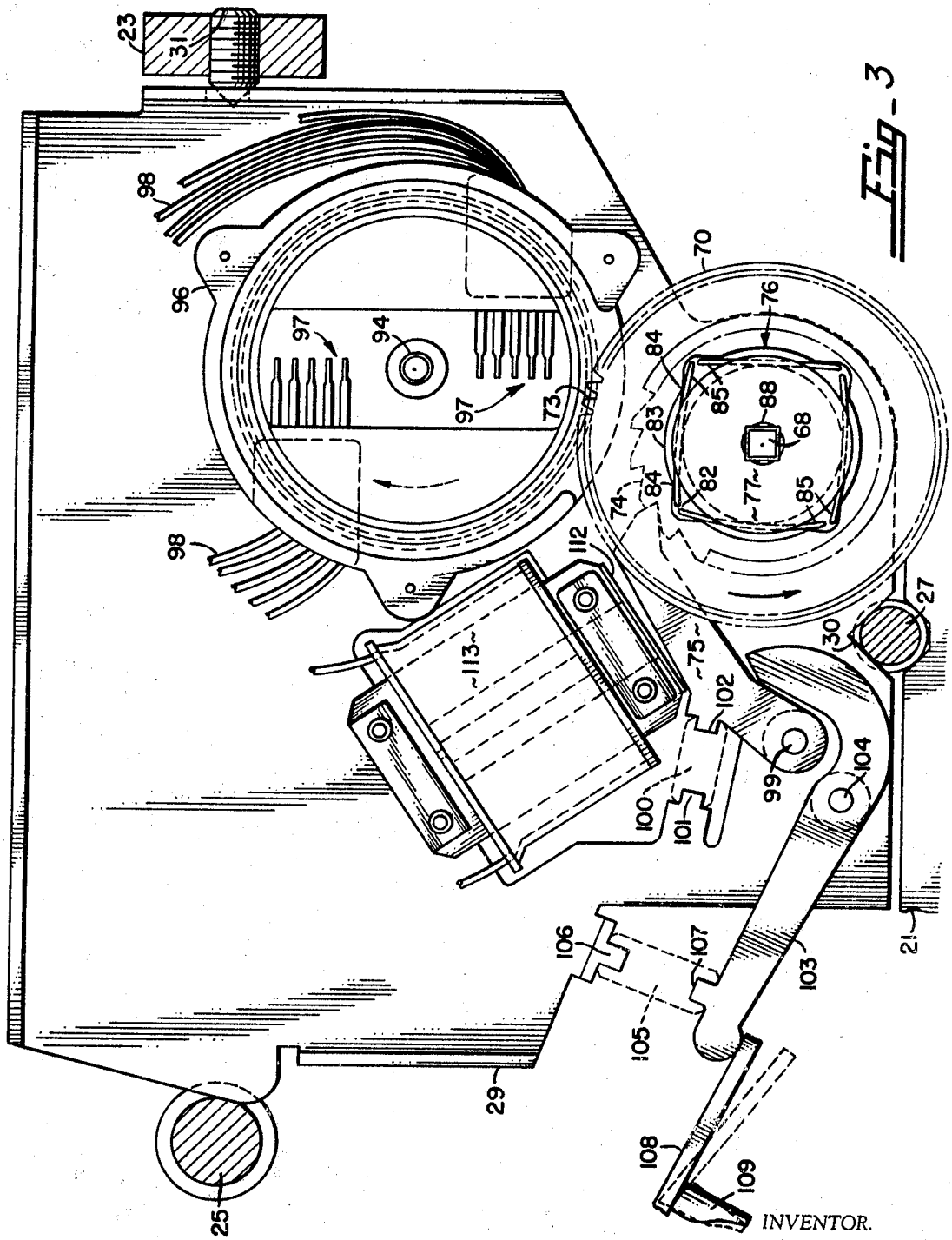
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Fig. 3



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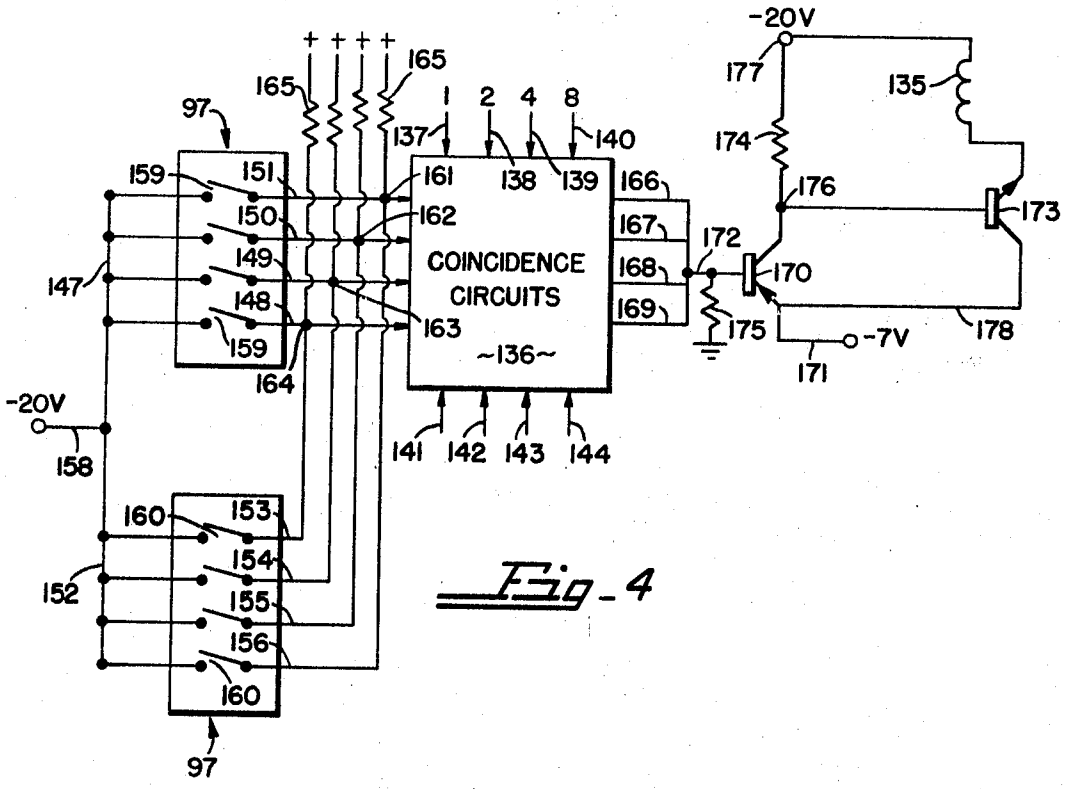


Fig_4

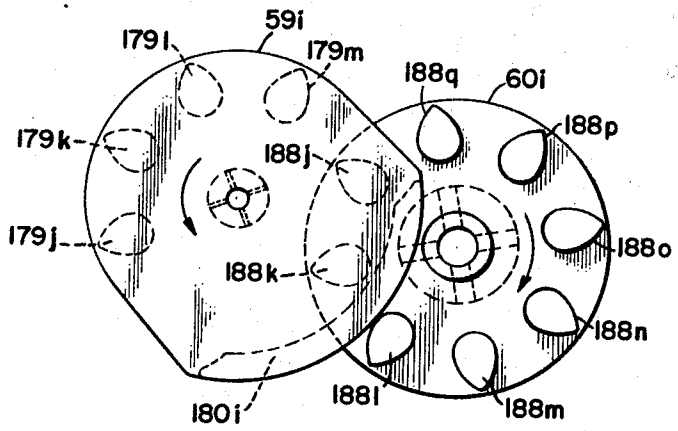


Fig_7

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INDICATING APPARATUS

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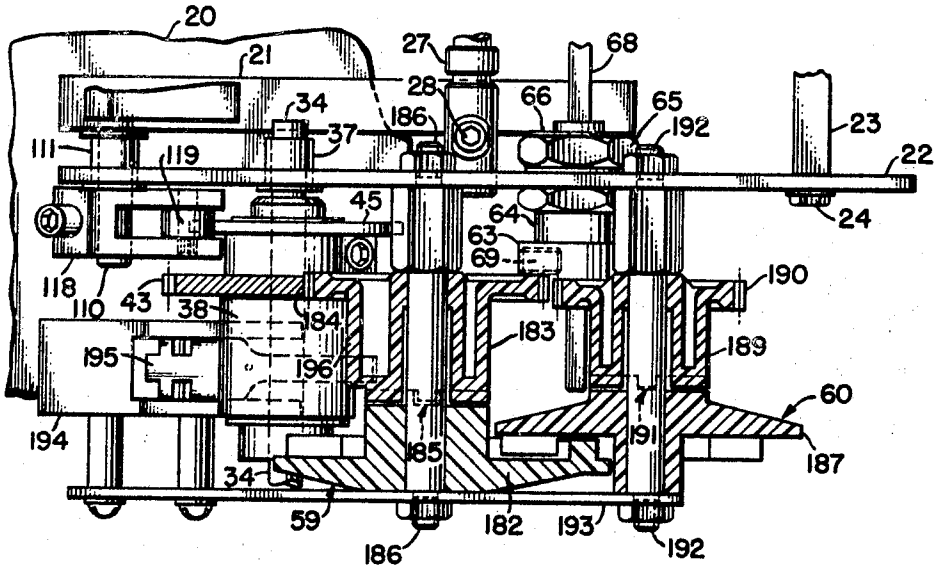


Fig_5

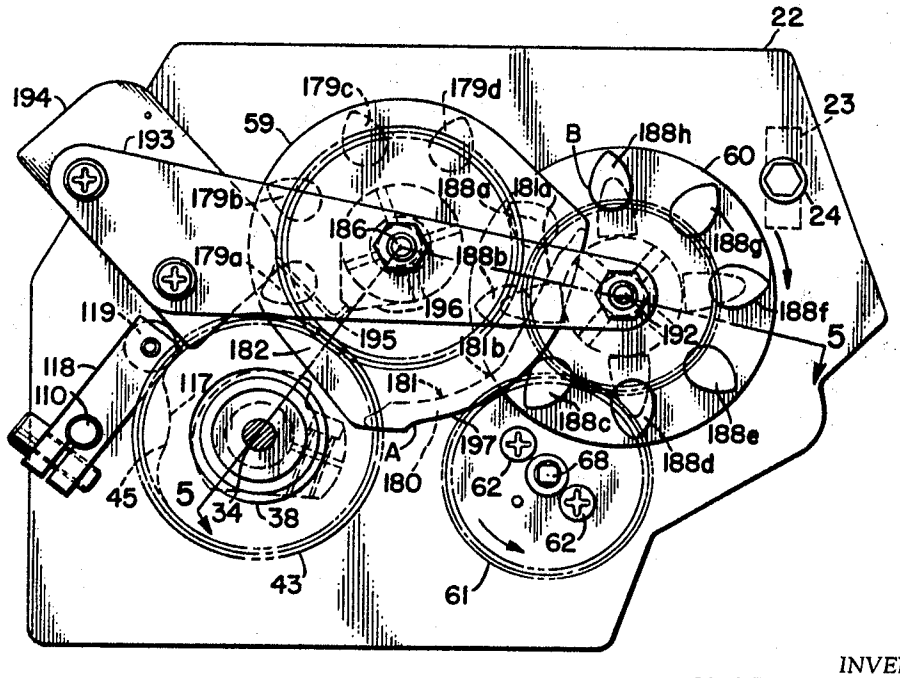


Fig_6

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INDICATING APPARATUS

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Filed June 22, 1967, Ser. No. 648,130
Int. Cl. F16h 27/04
U.S. Cl. 74—822 11 Claims

ABSTRACT OF THE DISCLOSURE

A numerical display device comprising a rotatable member to be rotated to a readout position corresponding to information in an electrical circuit, drive means (intermittent gearing) for locking the member in a dwell position and later for rotating the member, and stopping means operable during the dwell to disengage from and reengage with the member when successive readout positions are alike, and operable when successive readout positions are unlike and after the dwell for stopping the member in the readout position.

The basic readout device is disclosed in U.S. application Ser. No. 416,526, filed Dec. 7, 1964, in the name of Clarence E. Adler and includes a series of modules each comprising a detent wheel which is directly gear-connected to a rotatably mounted commutator and to a print wheel. Each module indicates the digits of a particular denominational order. When the turning print wheel approaches the correct indicating position, a stopping pawl intercepts the correct one of the teeth of the detent wheel to arrest the detent wheel and thus the print wheel. In the prior basic device, in order to prevent the stopping pawls from catching on the tips of the teeth and causing damage, electrical phasing circuitry is employed as disclosed in U.S. Patent No. 3,147,470 issued Sept. 1, 1964, to R. E. Bell and R. C. Loshbough.

In the prior basic device, the stopping pawls move back under the stopping impact and when lifted up off the detent wheels, they move slightly as driven by their drive springs. The detent wheels also move slightly, but in a direction opposite to the direction in which the pawls move, because they are connected to their drive shaft through spring clutches. Hence, the pawls cannot be dropped into the same tooth pockets without catching on the tips of the teeth. To accommodate this, the detent wheels in the prior device are driven ahead after the pawls are lifted up at least two digit positions.

In the improved readout of the invention, in one embodiment, a pair of intermittent gears reverses the detent wheels ten degrees at the start of a readout cycle to compensate for the slight movement of the pawls and of the detent wheels when the pawls are lifted up off the detent wheels, then locks the detent wheels during a dwell period, and then drives the detent wheels ahead when successive readout signals are unlike. The readout signal is applied before the intermittent gear pair drives the detent wheels ahead. If the readout signal is the same as the preceding one, the pawls drop squarely into their tooth pockets. If the readout signal is different from the preceding one, the readout wheels rotate until coincidence is reached between the information in an electrical circuit and the positions of the readout wheels.

The intermittent gear pair includes a rotatably mounted driver face gear and a rotatably mounted driven face gear each including a plurality of peg teeth and the driver gear further including a locking ring, the locking ring engaging peg teeth on the driven gear to lock the driven gear during part of a rotative cycle of the driver gear and the peg teeth on the driver gear engaging peg teeth on

the driven gear to drive the driven gear during another part of the rotative cycle. The locking ring also includes a cam surface for reverse driving the driven gear during still another part of the rotative cycle.

In the improved readout of the invention, in a second embodiment, the locking ring does not include the cam surface for reverse driving. The intermittent gears lock the detent wheels at the beginning of each cycle to provide a dwell during which the pawls are lifted up off the detent wheels and replaced when successive readouts are alike.

The intermittent gear pair with or without the cam surface can be used in devices other than numerical display devices to provide timing and driving functions, e.g., in printers.

This invention relates to intermittent gearing and to readout devices which are phased mechanically in contrast to the electrical phasing disclosed in the above U.S. Patent No. 3,147,470.

The objects of this invention are to improve numerical display devices, to provide means in the nature of a mechanical supervisory control for phasing the events in mechanical drive numerical display devices, to provide mechanical means for timing and driving the working parts in such devices, and to provide improved intermittent gearing.

The above and other objects and features of this invention will be appreciated more fully from the following detailed description when read with reference to the accompanying drawings wherein:

FIG. 1 is a fragmentary isometric view of the numerical display device showing one readout module in place which indicates the digits of a particular denominational order and the intermittent gear pair of the invention which provide timing and driving functions;

FIG. 2 is a side elevational view of a cam and its follower, the follower being shown fragmentarily in FIG. 1 indicating the general position of the cam and its follower in the display device;

FIG. 3 is an enlarged, vertical sectional view taken along the line 3—3 of FIG. 1;

FIG. 4 is a schematic diagram of the circuit controlling the indication of a count;

FIG. 5 is a horizontal sectional view taken generally along the line 5—5 of FIG. 6;

FIG. 6 is a fragmentary side elevational view showing the intermittent face gears illustrated in FIG. 1; and

FIG. 7 is a modified intermittent face gear pair in which the locking ring on the driver gear does not have a cam surface for reverse driving.

Referring to the drawings, the numerical display or readout device is constructed on a base **20** supporting two spaced-apart, elongated blocks **21** (only one shown in FIG. 1) and two side plates **22**. The side plates **22** are joined together by means including a flat block **23** at the upper front end of the device, screws **24** (one shown in FIG. 5) extending through the plates **22** and threaded into the block **23** holding the plates and the block together, a circumferentially grooved upper rod **25** at the upper rear end of the device, nuts **26** on shouldered, threaded ends of the rod holding the plates and the rod together, and a circumferentially grooved lower rod **27** at the bottom end of the device, screws **28** (one shown in FIG. 5) extending through the rod and threaded into the blocks **21** securing the rod to such blocks. The complete device comprises a plurality of duplicate sub-assemblies of unit construction, one for each place in the number to be indicated. Each module has all of its working parts mounted on a module plate **29** which is connected in the display device by moving it vertically, downwardly until a notch **30** (FIG. 3) in the plate **29** is received in one of the circum-

ferential grooves in the lower rod **27** and until the back end of the plate **29** is received in one of the circumferential grooves in the upper rod **25**. A set screw **31** threaded through the block **23** holds the module plate **29** in place.

The numerical display device is driven by a continuously moving belt as shown in the above U.S. application Ser. No. 416,526 that drives a shaft **34** which is journaled in bearings **37**, one shown in that one of the side plates **22** illustrated in FIG. 5. The shaft **34** drives a one-revolution clutch **38** which rotates a gear **43** and a cam **45** on the shaft **34** one revolution per readout cycle as shown and described in the above U.S. application Serial No. 416,526, gear **43** and cam **45** corresponding to gear **43** and cam **45** shown in such application.

The gear disclosed in the above U.S. application Serial No. 416,526 which corresponds to the gear **43** meshes with a gear which corresponds to a gear **61** (FIG. 6). In the readout device of the invention, intermittent gearing comprising a rotatably mounted driver face gear **59** and a rotatably mounted driven face gear **60** operatively connects the gears **43** and **61**. However, the function of the gear **61** is the same as that of the corresponding gear disclosed in the above U.S. application Serial No. 416,526. The gear **61** is attached by means of screws **62** to a hub **63** which is rotatable in a bearing **64** that is held on the side plate **22** by means of a nut **65**, a C-clip **66** retaining the hub **63** in the bearing **64**. The hub **63** defines a square hole which receives a square shaft **68** that is fixed in the hub **63** for rotation therewith by means of a set screw **69**. The square shaft **68** functions to drive the working parts on the module plates **29**. The gear **61** turns 190 degrees for every 360 degree turn of the gear **43**.

The modules or duplicate subassemblies each includes a detent wheel or toothed-member **70** which is directly gear connected to a dual commutator **71** (FIG. 1) and to a print wheel **72** (FIG. 1). The detent wheel **70** is formed of one molded piece having a gear portion **73** and twenty-four teeth **74** which cooperate with a stopping latch pawl **75**. The detent wheel **70** is driven by the square shaft **68** through a clutch **76**. The clutch **76** is a slip clutch having a drum **77** on the square shaft **68**. The square shaft **68** is received in a generally square hole **88** in the drum **77** so that the shaft **68** and the drum **77** turn together as one. A generally square opening **82** in the detent wheel **70** is provided with partially curved sides **83** forming two sharp edges **84** in each side of the generally square opening **82**. The clutch **76** also includes four flexure spring plates **85** one along each of the four sides of the generally square opening **82**. In operation, when the stopping latch pawl **75** is withdrawn from the teeth **74**, the square shaft **68** drives the detent wheel **70** through the clutch **76**, there being enough friction between the flexure plates **85** and the drum **77** to make the drum **77** and the detent wheel **70** turn together as one. However, when the stopping latch pawl **75** engages a tooth **74** of the detent wheel **70**, the flexure plates **85** slip on the drum and the detent wheel **70** is stationary while the drum turns. The print wheel **72** is a rotatable element to be positioned according to information in an electrical circuit, and the detent wheel **70** is a slip-clutch driven toothed-member directly gear connected to the rotatable element **72** and to the commutator **71** for driving them. The latch pawl **75** is part of stopping means and is engageable with the teeth on the toothed-member for stopping the print wheel **72** in the position corresponding to the information.

The module is removed from the readout device as a unit assembly by loosening the set screw **69** (FIG. 5), withdrawing the square shaft **68** from the generally square opening **88** (FIG. 3) in the drum **77**, loosening the set screw **31** (FIGS. 1 and 3) and lifting the module plate **29** out of the readout device.

The gear portion **73** of the detent wheel **70** meshes with a gear **86** (FIG. 1) on the side of the print wheel **72**, bearing printing type **89**, mounted for rotation on a stationary shaft **90** extending between the blocks **21**. The print wheel **72** turns twice for each turn of the detent wheel **70** (2:1 ratio) and has twelve printing positions.

The gear portion **73** of the detent wheel **70** also meshes with a gear **91** on the dual commutator **71**, the commutator consisting of a single flat metal plate having the double function of being formed with gear teeth on its periphery and having the commutator electrical pattern shown in the above U.S. application Serial No. 416,526, the pattern being separated from the metal plate by a layer or coating of epoxy resin. The commutator **71** (FIG. 1) is shown removed from the module in FIG. 3 to reveal the structure behind it. The commutator electrical pattern as viewed in FIG. 1 is on the back of the commutator **71** concealed from view. The commutator flat plate is rotatable on an internally threaded stationary stud **94** (FIG. 3) in the module plate **29**, there being a screw **95** (FIG. 1) received in the internally threaded stud holding the commutator in place. The commutator **71** is located in a housing **96** secured to the module plate **29** which functions to support a double set of brushes **97** which are molded for support in the housing **96**. Leads **98** for the brushes are shown in FIGS. 1 and 3. When the commutator is in place, the brushes **97** contact the electrical pattern.

The modules or duplicate subassemblies also each includes the stopping latch pawl **75** which is pivoted to the module plate **29** at **99** and is urged about the axis of such pivot by a coil spring **100**, extending between a projection **101** on the plate **29** and a projection **102** on the pawl **75**, clockwise toward the detent wheel teeth **74**. A reset finger **103** is pivoted at **104** to the module plate **29** and is urged about the axis of such pivot by a coil spring **105**, extending between a projection **106** on the plate **29** and a projection **107** on the finger **103**, counterclockwise toward the latch pawl **75**. A reset lever **108**, which is carried on a square portion **109** of a shaft **110** (FIG. 5) having round ends journaled in bearings **111** (one shown in FIG. 5) in the side plates **22**, moves from its solid line position shown in FIG. 3 down to its broken line position shown in FIG. 3 and then immediately back up to such solid line position at the beginning of each cycle to reset the latch pawls **75** on all of the duplicate subassemblies. When the reset level **108** is in its down position, the spring **105** pivots the reset finger **103** counterclockwise into engagement with the latch pawl **75**, overcomes the force of the spring **100**, and pivots the latch pawl **75** counterclockwise in opposition to its spring **100** into engagement with the core **112** of a solenoid **113** carried by the module plate **29**. The solenoid **113** when energized holds the latch pawl **75** up out of engagement with the detent wheel teeth **74** when the reset lever **108** moves back to its solid line position shown in FIG. 3 moving the reset finger **103** clockwise in opposition to its spring **105** out of engagement with the latch pawl **75**. When the detent wheel **70** approaches the position at which it is to stop, the solenoid **113** is deenergized and the spring **100** pivots the latch pawl **75** clockwise about its pivot **99** into stopping engagement with one of the twenty-four teeth **74**.

The reset lever **108** is driven by the cam **45** which as indicated by the curved arrow in FIG. 2 is rotated clockwise one revolution per readout cycle. The cam **45** is round except for a depression **117**. The shaft **110** carries a bifurcated member **118** which carries in turn a cam-following roller **119** between its bifurcations. The roller **119** follows the cam **45**. The cam **45** is shown in its home position in FIG. 2. An instant after the cam **45** starts rotating, the roller **119** moves down into the cam depression **117** causing the reset lever **108** to move from its solid line position to its broken line position shown in FIG. 3 and then soon moves back into its original position as the cam depression **117** passes by to return the reset lever **108** to its solid line position, i.e., the reset lever **108** as viewed in FIG. 3 quickly moves down and

then back up at the beginning of every readout cycle, and the stopping latch pawls **75** are moved away from the detent wheel teeth **74** and up against the solenoid cores **112**. Spring **105** holds the roller **119** on the cam **45**.

The signal controlling the indication of a count in an electronic counter is produced by the circuitry shown in FIG. 4, the counter being connected to the coincidence circuits **136**. However, the inputs applied to the coincidence circuits **136** can be supplied by other electrical circuits, such as flip-flops operated by photocell pulses. An example of a suitable counter is shown in U.S. Patent No. 3,029,352 issued April 10, 1962, to C. E. Marshall. The patent discloses four transistor binary flip-flop stages connected in cascade with added circuits to convert to a count of ten to fill and return to the initial condition (adapted to count according to the decimal system). The four flip-flops flip at counts of 1, 2, 4, and 8, respectively, i.e., a modified binary 1-2-4-8 counter. The counter is so connected to the coincidence circuits **136** that, when the four flip-flops flip, positive inputs are applied to leads **137–140**, i.e., there is one lead **137–140** for each output of the flip-flops. Combinations of positive and negative leads **137–140** permit counting in the decimal system 0–9. Auxiliary flip-flop circuits similarly provide the required combinations of positive and negative leads **141–144** to correspond to blank and extra segments of the dual commutator **71**.

The following table (Table No. 1) shows the positive or negative condition of the leads **137–140** according to the count:

Count	Lead 137	Lead 138	Lead 139	Lead 140
0	−	−	−	−
1	+	−	−	−
2	−	+	−	−
3	+	+	−	−
4	−	−	+	−
5	+	−	+	−
6	−	+	+	−
7	+	+	+	−
8	−	−	−	+
9	+	−	−	+

In addition, leads **141–144** are − − + + for blank (B), respectively, and are + + + + for extra (E), respectively.

The function of the readout device is to position the print wheel **72** in a printing station according to the count in the counter or to B or E (twelve printing positions).

The dual commutator pattern and the cooperation of the brushes **97** (FIG. 3) is shown in the above U.S. application Serial No. 416,526. The commutator **71** needs only one-half a revolution or less to produce a readout. One set of the stationary brushes **97** is connected to leads **147–151** (FIG. 4) and the other set is connected to leads **152–156** (FIG. 4), both sets being arranged to pick up the same 1-2-4-8 binary coded decimal signals as shown in the table above.

The leads **147–156** are shown connected to the coincidence circuits **136** in FIG. 4. Common commutator leads **147** and **152** are joined at the end of a lead **158** which is connected to a minus 20 volts power supply. Leads **148–151** are connected to the common lead **147** through contacts **159** and leads **153–156** are connected to the common lead **152** through contacts **160**. Actually, contacts **159** and **160** do not exist but are shown only to illustrate how the commutator electrically connects and disconnects the respective leads. Leads **151** and **156** are joined at terminal **161**; leads **150** and **155** are joined at terminal **162**; leads **149** and **154** are joined at terminal **163**; and leads **148** and **153** are joined at terminal **164**. Resistors **165** are connected to such terminals **161–164** to provide positive inputs to the coincidence circuits **136** which correspond to the positive inputs provided by the counter leads **137–140**.

Opening of contacts **159** in leads **148–151** applies positive inputs from the resistors **165** through the leads **148–151** to the coincidence circuits **136**. Opening of contacts **160** in leads **153–156** also applies positive inputs from the resistors **165** through the leads **148–151** to the coincidence circuits **136**, because leads **148–151** are joined to leads **156–153**, respectively. Closing of contacts **159** in leads **148–151** applies negative inputs from the minus 20 volts power supply (lead **158**) through the leads **148–151** to the coincidence circuits **136**. Closing of contacts **160** in leads **148–151** applies negative inputs from the minus 20 volts power supply (lead **158**) through the leads **148–151** to the coincidence circuits **136**, because leads **148–151** are joined to leads **156–153**, respectively.

The following table (Table No. 2) shows the positive or negative condition of the leads **148–151** (positive or negative inputs to coincidence circuits) according to which of the commutator segments are at the brushes **97**.

Segments	Lead 151	Lead 150	Lead 149	Lead 148
0	+	+	+	+
1	−	+	+	+
2	+	−	+	+
3	−	−	+	+
4	+	+	−	+
5	−	+	−	+
6	+	−	−	+
7	−	−	−	+
8	+	+	+	−
9	−	+	+	−
B	+	+	−	−
E	−	−	−	−

Table No. 1 (counts 0–9) and Table No. 2 (segments 0–9) are alike, except the positive and negative input conditions are opposite. Also, the positive and negative input conditions in Table No. 2 for B and E are like such conditions or leads **141–144**. For the sake of simplicity, the following description will ignore readout positions B and E, since an understanding of the invention can be had by an understanding of how the print wheel **72** is positioned according to the count in the counter, i.e., counts 0–9.

Any coincidence circuit which matches plus and minus inputs and produces current flow in output leads can be used. When the input on commutator lead **151** is plus and the input on counter lead **137** is minus or vice versa, current flow stops in output lead **166**, when the input on commutator lead **150** is plus and the input on counter lead **138** is minus or vice versa, current flow stops in output lead **167**, when the input on commutator lead **149** is plus and the input on counter lead **139** is minus or vice versa, current flow stops in output lead **168**, and when the input on commutator lead **148** is plus and the input on counter lead **140** is minus or vice versa, current flow stops in output lead **169**. Stoppage of current flow in all of the output leads **166–169** indicates coincidence. If there is current flow in any one of the output leads **166–169**, coincidence does not exist. This means, for example, that if the count in the counter is three (+ + − − inputs, see Table No. 1) coincidence occurs when the commutator segments to produce a 3 are at the brushes **97** (− − + + inputs, see Table No. 2).

If there is current flow in output lead **166** or **167** or **168** or **169** (not at coincidence), then there is current flow in a PNP transistor **170** which has its emitter connected to a minus 7 volts power supply through a lead **171**, its base connected to the leads **166–169** through a lead **172**, and its collector connected to the base of an

NPN transistor **173** and to a resistor **174**. A resistor **175** is connected between the lead **172** and ground. When the PNP transistor **170** is on, terminal **176** connected to the collector of the transistor comes to minus 7 volts, the same as that of the power supply on the lead **171**. The resistor **174** and a coil **135** of the solenoid **113** (FIG. 3) are connected to a minus 20 volts power supply connected to a terminal **177**, the coil **135** also being connected to the emitter of the NPN transistor **173**, and the collector of the NPN transistor **173** is connected through a lead **178** to the emitter of the PNP transistor **170**. When the PNP transistor **170** is on, the NPN transistor **173** also is on because the base of the transistor **173** (connected to minus 7 volts terminal **176**) is more positive than the emitter of the transistor **173** (connected to minus 20 volts terminal **177**) and current flows through the coil **135**, i.e., the solenoid **113** (FIG. 3) is energized. Thus, the solenoid **113** is energized when coincidence does not exist and is deenergized when coincidence exists (no current flow in any of output leads **166–169**—transistors **170** and **173** off—no current flow in coil **135**).

In operation, to make a new reading, the gear **43** and the cam **45** are turned through one revolution. Gear **43** drives gear **61** through the intermittent face gears **59** and **60**. An instant after the cam **45** starts rotating, the cam following roller **119** moves down into the cam depression **117** causing the reset lever **108** to move down and then back up as shown in FIG. 3 and the latch pawls **75** are driven away from the detent wheel teeth **74** and up against the solenoid cores **112**, the solenoids **113** being denergized at this time when successive readouts are alike and being energized at this time when successive readouts are not alike as described hereinafter. The deenergized solenoids **113** (successive readouts alike) permit the springs **100** to return the pawls **75** to the same tooth pockets from which they were removed. The energized solenoids **113** (successive readouts not alike) hold the pawls **75** up out of engagement with the detent wheel teeth **74**.

The rotation of the gear **61** rotates the square shaft **68**, which drives the detent wheel clutch **76**, an equal amount. The gear ratio between the gears **73** and **91** of the detent wheel **70** and of the commutator **71**, respectively, is 1:1. However, the gear ratio between such gear **73** and the gear **86** on the print wheel **72** is 2:1. The direct gearing keeps the commutator **71** and the print wheel **72** synchronized, the printing type **89** on the print wheel corresponding exactly to the segments of the commutator **71** (twenty-four commutator segments and twenty-four detent wheel teeth **74**), i.e., for example, when the 2 commutator segments are at the brushes **97**, the 2 printing type is located in a printing station ready for printing to be accomplished. Because of the dual commutator pattern, only one-half revolution or less of the commutator **71** is required for a readout, but, because of the above 2:1 gear ratio, such one-half revolution of the commutator produces a full revolution of the print wheel **72**. Of course, less than one-half revolution of the commutator can produce a readout depending on how soon the count in the counter and the commutator segments agree. As the print wheel or rotatable member **72** which is to be positioned according to information in the counter approaches the position corresponding to the information, the coincidence circuits **136** detect coincidence between the commutator position and the count in the counter and all current flow stops in output leads **166–169** and thus in the transistors **170** and **173** and in the coil **135** to deenergize the solenoid **113**. Deenergization of the solenoid **113** permits the coil spring **100** to pivot the stopping latch pawl **75** into engagement with the proper one of the twenty-four teeth **74**, stopping the detent wheel **70** and thus the commutator **71** and the print wheel **72** in positions wherein the print wheel **72** is positioned in the printing station corresponding to the count in the counter. After the detent wheel **70** is stopped, its clutch drum **77** continues to turn until the square shaft **68** and its gear **61** stop. The readout device includes a series of modules each having a print wheel that indicates the digits of a particular denominational order.

The driver face gear **59** includes a first portion **182** having four peg teeth **179***a–d* and a locking ring **180** with a cam surface **181** and a second portion **183** having a gear **184** meshed with the gear **43**, the gear portions **182** and **183** being connected by means of four tongue and groove connections **185**. The driver face gear **59** is rotatably mounted on a stationary shaft **186** extending horizontally from that one of the side plates **22** shown in FIGS. 5 and 6. The driven face gear **60** includes a first portion **187** having eight peg teeth **188***a–h* and a second portion **189** having a gear **190** meshed with the gear **61**, the gear portions **187** and **189** being connected by means of four tongue and groove connections **191**. The driven face gear **60** is rotatably mounted on a stationary shaft **192** extending horizontally from the side plate **22**. The shafts **186** and **192** carry a plate **193** which in turn carries a switch **194** having a switch operator **195** which is operated by an extension **196** on the second portion **183** of the driver face gear **59**. The switch **194** is normally closed but is held open in the home position of the readout device to indicate that the previous reading has been completed.

In operation, to make a new reading, the gear **43** and the cam **45** are turned through one revolution. The gear **43** drives the driver face gear **59** through 360 degrees per cycle. An instant after the cam **45** starts rotating, the cam following roller **119** moves down into the cam depression **117** causing the reset lever **108** to move down and then back up as shown in FIG. 3 and the latch pawl **75** is driven away from the detent wheel teeth **74** and up against the solenoid core **112**, the solenoid **113** being deenergized at this time when successive readouts are alike, because the commutator **71** has not been moved enough to produce a new electrical output, and being energized at this time when successive readouts are not alike, because the new count in the electronic counter does not agree with the rotary position of the commutator **71**.

The working parts are shown in their home position in FIG. 6. The driver face gear **59**, by engagement of the cam surface **181** of its locking ring **180** with the peg tooth **188***a*, reverses or drives the driven face gear **60** counterclockwise as viewed in FIG. 6 about ten degrees to compensate for the slight movements of the pawl **75**, as driven ahead by its spring **100**, and of the detent wheel **70**, as urged by its spring clutch toward the pawl, when the pawl **75** is lifted clear of the detent wheel **70** at the beginning of a readout cycle. This moves the detent wheel **70** slightly clockwise as viewed in FIG. 3 so that if the readout signal is the same as the preceding one the pawl **75** drops squarely back into the same tooth pocket without danger of catching on the tip of the tooth. When successive readouts are alike, the solenoid **113** remains deenergized to permit the pawl **75** to drop back into the same tooth pocket during a dwell period hereinafter described which follows the above reversal period.

If successive readouts are not alike, the solenoid **113** is energized to hold the pawl **75** out of engagement with the detent wheel **70**. At the end of the ten degree reversal, the peg tooth **188***a* is on a high part **181***a* of the cam surface **181** and the peg tooth **188***b* is on a low part **181***b* of the cam surface **181**. Continued counterclockwise rotation of the driver face gear **59** moves the locking ring **180** between the peg teeth **188***a* and *b* on the one side and the peg teeth **188***c* and *h* on the other side, a lock side **197** of the locking ring **180** holding the driven face gear **60** stationary for a dwell of about 125 degrees. After point A on the locking ring **180** meets point B on the peg tooth **188***h*, the driven gear **60** is driven clockwise in the direction of the curved arrow shown in FIG. 6 for 10 degrees to cancel the 10 degree reversal. This returns

the working parts to their positions shown in FIG. 6. Immediately thereafter, peg tooth **179***a* on the driver gear **59** engages peg tooth **188***c* on the driven gear **60** and tooth drive takes place to advance the driven gear **60** about 225 degrees, i.e., a net 225 degrees—10 degrees counterclockwise and 235 degrees clockwise. This drives the gear **61** counterclockwise as viewed in FIG. 6 about 190 degrees per cycle. As described above the commutator **71** needs only one-half a revolution or less to produce a readout. As the print wheel **72** approaches the position corresponding to the count in the counter, the solenoid **113** is deenergized and the pawl **75** moves into engagement with a tooth **74**, stopping the detent wheel and thus the commutator **71** and the print wheel **72** in readout position as described above.

The pair of intermittent gears **59** and **60** reverses the detent wheels 10 degrees at the start of a readout cycle and locks the detent wheels during a following dwell period. The readout signal is applied before the detent wheels are driven ahead. If the readout signal is the same as the preceding one, the pawls drop squarely into their tooth pockets. If the readout signal is different from the preceding one, the readout wheels rotate until coincidence is reached between the information in the electrical circuit and the positions of the readout wheels. The intermittent gear pair includes the driver face gear **59** and the driven face gear **60** each including a plurality of peg teeth and the driver gear further including a locking ring, the locking ring engaging peg teeth on the driven gear to lock the driven gear the above dwell part of the cycle and the peg teeth on the driver gear engaging peg teeth on the driven gear to drive the driven gear during the last part of the cycle. The locking ring also includes the cam surface for reverse driving the driven gear during the first part of the cycle. The intermittent gear pair with or without the cam surface can be used in devices other than numerical display devices to provide timing and driving functions, e.g., in printers.

If the numerical display device is constructed of high precision parts and assembled to have little play between working parts, the reversal part of the cycle may be omitted. In a second embodiment shown in FIG. 7, a locking ring **180***i* is smoothly curved on both sides so that, as the gear **59***i* is turned counterclockwise from its position shown in FIG. 7, the locking ring locks the driver gear **60***i* to provide a dwell period, in the same manner as the first embodiment provides a dwell period, with no reversal occurring. Thereafter, the driver gear peg teeth engage the driven gear peg teeth to rotate the driven gear in the same manner as the first embodiment provides peg teeth gear drive. Similar reference numbers in FIG. 7 refer to parts alike in structure and function to parts shown in FIGS. 1–6.

When the second embodiment (no reversal) of the intermittent gear pair is used in the readout device, the combination includes a rotatable member to be rotated to a readout position corresponding to information in an electrical circuit, i.e., any rotatable member not necessarily a toothed-member, means (intermittent gear pair) for locking the member in a dwell position and later rotating the member, and stopping means operable during said dwell to disengage from and reengage with the member when successive readout positions are alike, and operable when successive readout positions are unlike and after said dwell for stopping the member in the readout position. When the first embodiment (reversal) of the intermittent gear pair is used in the readout device, the combination includes a rotatable member to be rotated in a forward direction to a readout position corresponding to information in an electrical circuit, drive means for reversing the member slightly in a direction opposite to said forward direction and later rotating the member in said forward direction, and stopping means operable after said reversal to be engageable with the member for stopping the member in the readout position.

It is to be understood that the above description is illustrative of this invention and that various modifications thereof can be utilized without departing from its spirit and scope.

Having described the invention, I claim:

1. Intermittent gearing comprising, in combination, a rotatably mounted driver face gear and a rotatably mounted driven face gear each including a plurality of peg teeth and the driver gear further including a locking ring, the locking ring engaging peg teeth on the driven gear to lock the driven gear during part of a rotative cycle of the driver gear and the peg teeth on the driver gear engaging peg teeth on the driven gear to drive the driven gear during another part of said rotative cycle.

2. Intermittent gearing according to claim **1** wherein the locking ring includes a cam surface for reverse driving the driven gear during still another part of said rotative cycle.

3. A readout device comprising, in combination, a rotatable toothed-member to be rotated to a readout position corresponding to information in an electrical circuit, drive means for locking the toothed-member in a dwell position and later rotating the toothed-member, and stopping means operable during said dwell to disengage from and reengage with a tooth on the toothed-member when successive readout positions are alike, and operable when successive readout positions are unlike and after said dwell for stopping the toothed-member in the readout position.

4. A readout device according to claim **3** wherein the drive means includes driver and driven face gears.

5. A readout device according to claim **3** wherein each of the gears includes a plurality of peg teeth and the driver gear further includes a locking ring, the locking ring engaging peg teeth on the driven gear to lock the driven gear during said dwell and the peg teeth on the driver gear engaging peg teeth on the driven gear after said dwell to drive the driven gear to said readout position.

6. A readout device comprising, in combination, a rotatable toothed-member to be rotated in a forward direction to a readout position corresponding to information in an electrical circuit, drive means for reversing the toothed-member slightly in a direction opposite to said forward direction and later rotating the toothed-member in said forward direction, and stopping means operable after said reversal to be ingageable with a tooth on the toothed-member for stopping the toothed-member in the readout position.

7. A readout device according to claim **6** wherein the drive means includes driver and driven face gears.

8. A readout device according to claim **7** wherein each of the gears includes a plurality of peg teeth and the driver gear further includes a ring, the ring engaging peg teeth on the driven gear to drive the driven gear during said reversal and also in said forward direction enough to cancel said reversal and the peg teeth on the driver gear engaging peg teeth on the driven gear after said cancellation to continue driving the driven gear in said forward direction.

9. A readout device according to claim **8** wherein the ring passes between pairs of peg teeth on the driven gear and has a locking surface which prevents rotation of the driven gear during a dwell time which exists between the end of said reversal and the beginning of said cancellation.

10. A readout device comprising, in combination, a rotatable member to be rotated to a readout position corresponding to information in an electrical circuit, means for locking the member in a dwell position and later rotating the member, and stopping means operable during said dwell to disengage from and reengage with the member when successive readout positions are alike, and operable when successive readout positions are un-

like and after said dwell for stopping the member in the readout position.

11. A readout device comprising, in combination, a rotatable member to be rotated in a forward direction to a readout position corresponding to information in an electrical circuit, drive means for reversing the member slightly in a direction opposite to said forward direction and later rotating the member is said forward direction, and stopping means operable after said reversal to be engageable with the member for stopping the member in the readout position.

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