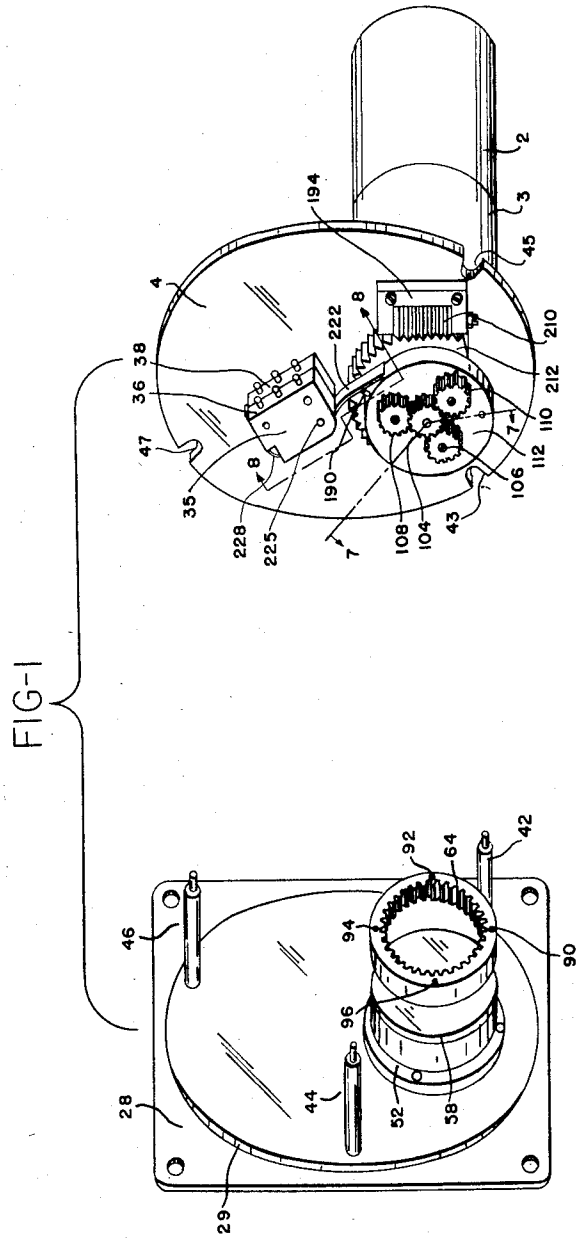
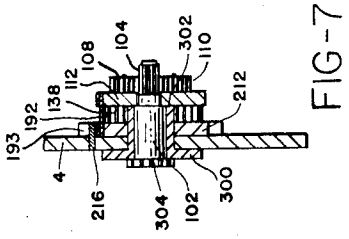
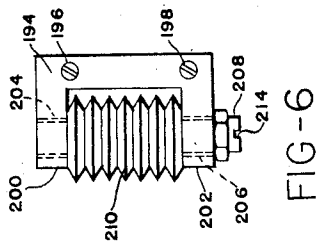
Nov. 17, 1959 L. H. GODDARD 2,913,544

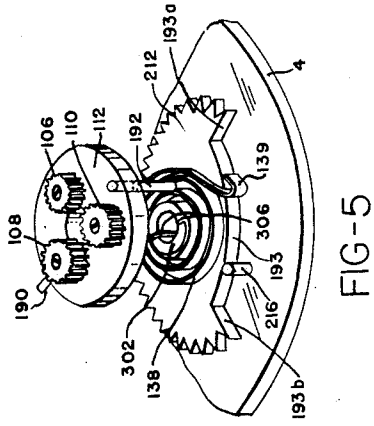
TIMER

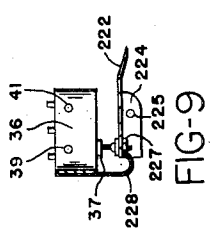
Filed Dec. 23, 1957 3 Sheets-Sheet 1

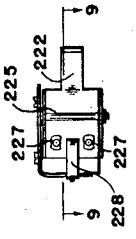












INVENTOR.
LOUIS H. GODDARD

BY Milton E. Gilbert

HIS ATTORNEY

Nov. 17, 1959 L. H. GODDARD 2,913,544

TIMER

Filed Dec. 23, 1957 3 Sheets-Sheet 2

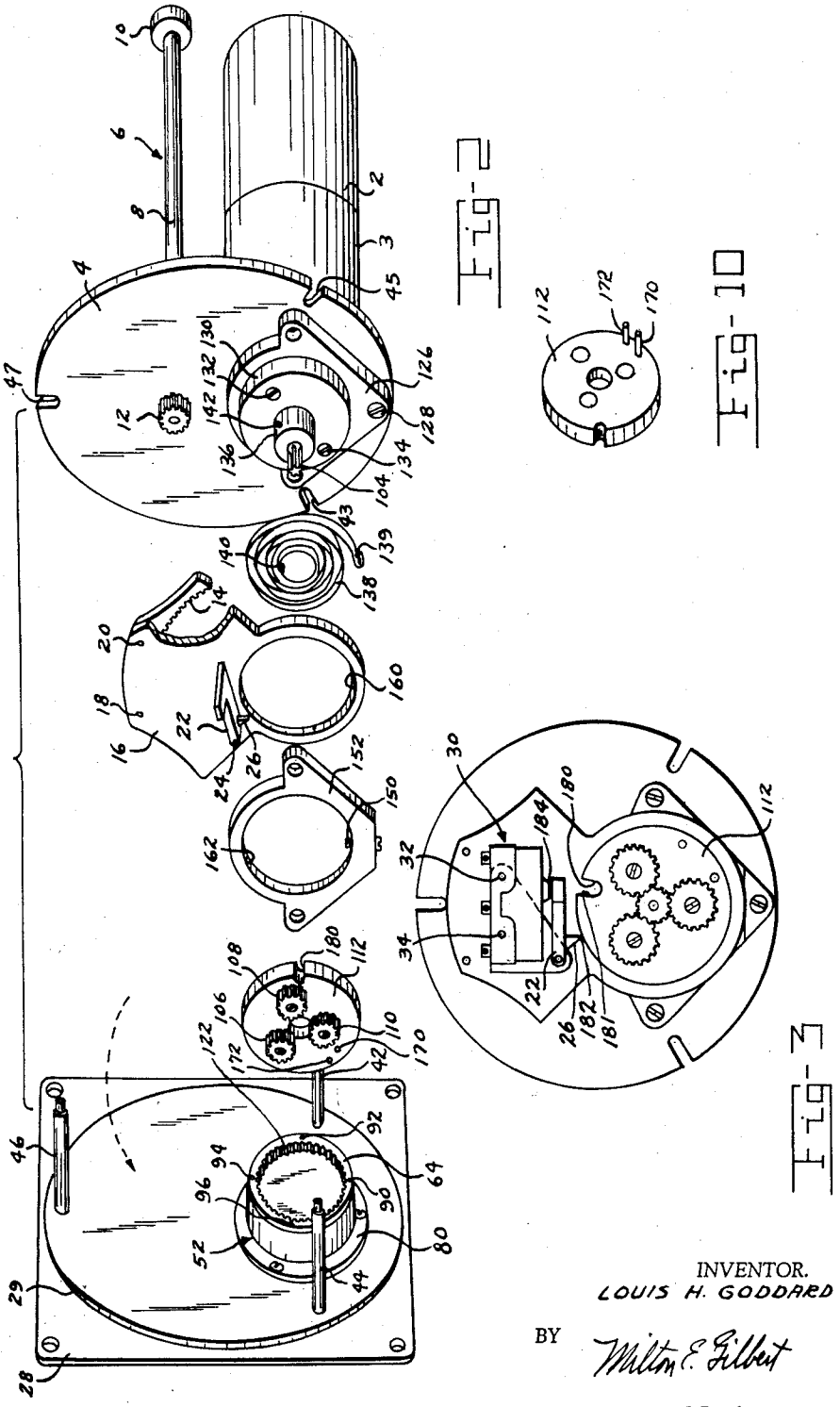


Fig-2

Fig-10

Fig-3

INVENTOR.
LOUIS H. GODDARD

BY Milton E. Gilbert

HIS ATTORNEY

Nov. 17, 1959 L. H. GODDARD 2,913,544

TIMER

Filed Dec. 23, 1957 3 Sheets-Sheet 3

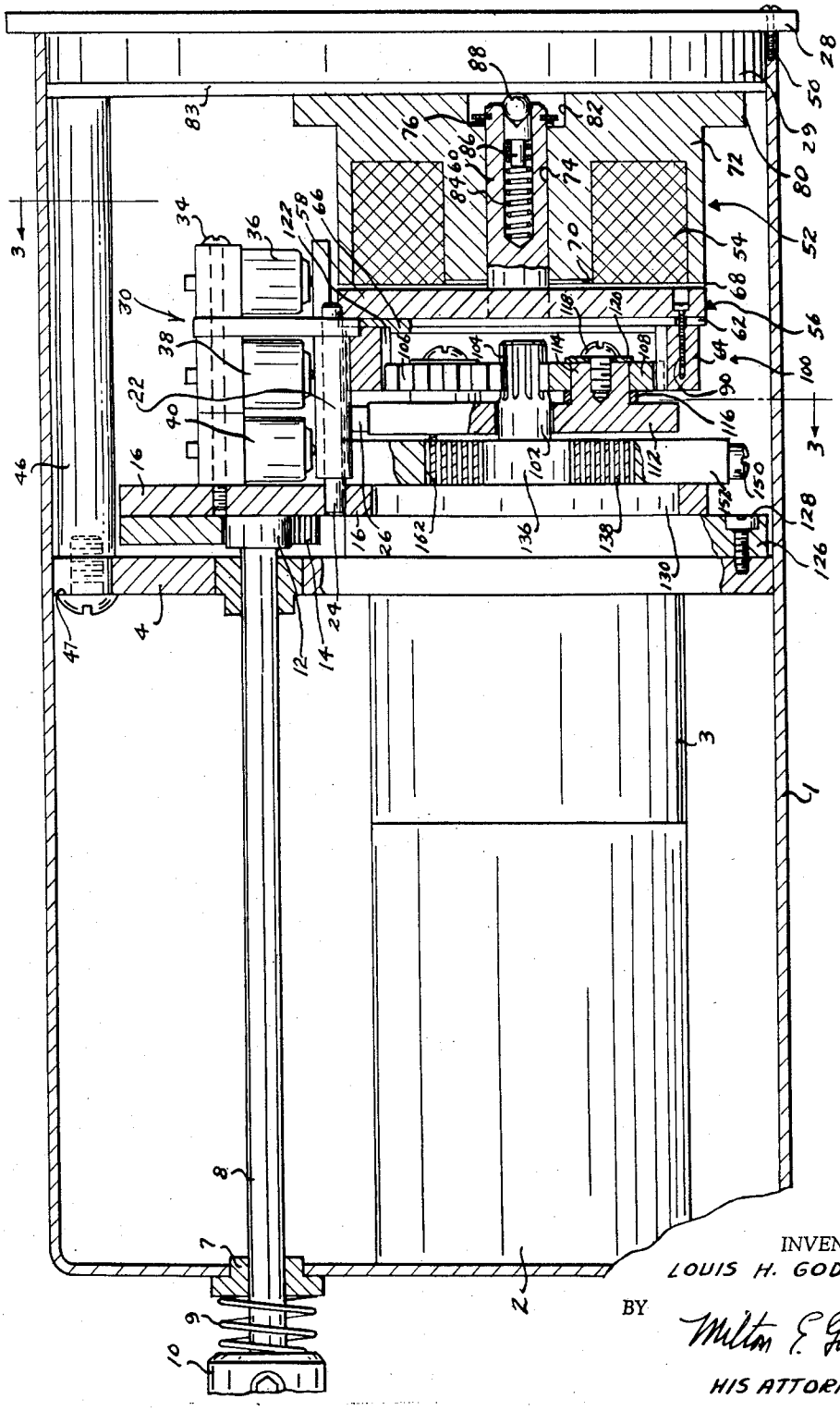


Fig-4

INVENTOR.
LOUIS H. GODDARD
BY
Milton E. Gilbert
HIS ATTORNEY

United States Patent Office 2,913,544
Patented Nov. 17, 1959

2,913,544

TIMER

Louis H. Goddard, Dayton, Ohio, assignor to Globe Industries, Inc., Dayton, Ohio, a corporation of Ohio

Application December 23, 1957, Serial No. 704,571

7 Claims. (Cl. 200—35)

This invention relates to an improvement in an adjustable delay timer. Such timers are self-resetting, so that when current is discontinued or fails, the timer will automatically be re-set to its initial position.

It is one object of the invention to provide a timer with means for instantaneously re-setting it when current is discontinued. It is another object of the invention to provide a timer in which the delay interval can be adjusted in a continuous manner over a pre-determined range. A still further object of the invention is to provide a timer in which the timing cycle is repeatable so that the precise timing interval will be attained for each cycle of operation.

These and further objects and advantages of the invention will become more readily apparent upon a reading of the description following hereinafter, and upon an examination of the drawings, in which:

Figure 1 is an exploded view in perspective showing the preferred embodiment of the timer of the invention,

Figure 2 is an exploded view similar to Figure 1 but of a modification of the timer,

Figure 3 is a plan view of a portion of the modification of Figure 2,

Figure 4 is a partial cross-sectional view through the assembled timer of the modification of Figure 2,

Figure 5 is a partial exploded view of a portion of the timer of Figure 1,

Figure 6 is a plan view of a portion of the adjustable interval means of the preferred embodiment of the invention,

Figure 7 is a cross-sectional view taken along line 7—7 of Figure 1,

Figure 8 is a view taken along line 8—8 of Figure 1,

Figure 9 is a sectional view taken along line 9—9 of Figure 8, and

Figure 10 is a perspective view of the carrier plate of the modification of Figure 2.

The timer of the invention comprises an electric motor running at steady speed and arranged for delivering to a driven device, such as an electric switch or switches, a cyclic or periodic repetition of brief actuations, after the lapse of a predetermined time interval. The timer of the invention employs a synchronous motor which drives the sun gear of a planetary system wherein the planet carrier for the planet gears serves as a portion of the actuating means for the switches; and the ring gear of the planetary system serves as one portion of a clutch or brake. Thus, when the clutch or brake is actuated to lock the ring gear, the planet carrier will planetate to actuate a switch or switches. The interval between the actuation of the clutch and the actuation of the switch is continuously adjustable over a pre-determined range by the employment of a gearing arrangement which positions the mechanical elements, which in turn determines the length of actuation interval. The timer also employs a spring to return the elements to normal or unactuated position when the clutch or brake is de-activated.

Devices of the type with which this invention is concerned have been known previously, however, in one such device the ring gear was locked by a pawl or detent element which engaged a series of teeth on the external surface of the ring gear, and was actuated by a solenoid. In such a device, after the switch was actuated, and when the return spring operated to reposition the cam element, the ring gear was moved, so that if the timing cycle were to be reinstituted, the teeth on the ring gear may be in such a position that the solenoid actuated pawl would strike against the crown of a tooth, thus delaying the start of the timing cycle, until the pawl engaged the flank of the tooth and preventing repeatability and accuracy of the timing cycle. In addition, in this old device, the length of the timing cycle could not be continuously adjusted over a predetermined range, but only selected fractions of a predetermined range could be used.

As shown in Figure 1, the timer includes a synchronous motor **2** the output of which is modified by a gear reduction **3**. At the end of the output shaft **102** of the motor-gear reducer is a sun gear **104**, which may be a separate gear mounted on the output shaft, or else a gear hobbed on this shaft.

As shown more clearly in Figures 5 and 7, the output shaft **102** from the gear box **3** has a gear **304** on its inner end, which is the last gear in the gear box. The output shaft **102** passes through the cover plate **300** for the gear box. This cover plate **300** is formed with an outwardly extending hub **302**, which serves as a bushing for the shaft **102**. The hub **302** is slotted at its outer extremity, for a purpose as will be explained more fully hereinafter. The gear **104** serves as the sun gear for a planetary system, and meshes with three planetary gears **106**, **108** and **110**, mounted upon studs affixed to a carrier plate **112**. On the underside of the carrier plate **112** is a projecting pin **192** which serves as an anchor for one end of the return spring **138**, i.e. the loop **139** of the spring **138** is wrapped around the pin **192**. The inner end of the spring **138** has a bent-over portion **140** which sits within the slot **306** in the hub **302**. The relative positions of the spring, carrier plate and planet gears is indicated clearly in Figure 7.

In the embodiment of Figure 1, the planet carrier plate **112** serves as a triggering or firing means for a switch or switches **36** and **38**. The switches are fired on the release of the switch actuator button since the release cycle is more accurate than the depress cycle. The carrier plate **112** has a pin **190** projecting from its peripheral surface, and this pin **190** cooperates with an actuator plate **222** to release the actuator buttons **37** on the switches **36** and **38** as clearly shown in Figure 9. The actuator plate **222** is slightly bent as shown in Figure 9 and is formed with a pair of opposing flanges **224** and **224*a*** (see Figure 8). A pin **225** holds the plate **222** in a fixed position to the flange **4** of the timer and also holds a mounting plate **35** to retain the switches **36** and **38** in position. Additional screws or fastening means **39** and **41** also serve to retain the switches **36** and **38** in position upon the plate **4**. The pin **225** serves as a pivot for the plate **222**. The inner end of the plate **222** carries a pair of adjustable actuator buttons **227** and **227*a*** which are adjusted to bear upon the actuator buttons **37** of the switches to normally retain them in depressed position. Actuator plate **222** is urged into the position shown in Figure 9 by the spring **228**. When the bent portion of the actuator plate **222** is contacted by the pin **190** mounted upon the disc **112**, then the plate **222** will pivot about its axis **225** and release the actuator buttons **37**.

The contacting means **227** and **227*a*** each comprise a screw and lock nut so that they are adjustable towards and away from the contact buttons **37** on the switches.

In the modification of Figure 1 the micro-switches are in fixed position and are not adjustable, so that the end of the time cycle is fixed. However, the beginning of the time cycle is adjustable. In order to adjust the beginning of the cycle in a very accurate manner, there is provided the worm **210** and worm wheel **212**. By using a worm gear arrangement there is obtained a very large multiplication factor, which means that the beginning of the time cycle can be very accurately located. Pin **192** is mounted on the planet carrier plate **112** and depends therefrom. This pin locates the starting point for the timing cycle. The pin **192** travels within the sector race **193** in the gear **212**. Actually, the pin **192**, at the beginning of the timing cycle, rests against the edge **193***a* of the race **193**. By adjusting the worm **210**, the relative position of the surface **193***a* is changed. An angle bracket **194** is fixedly mounted on the plate **4** by a pair of screws **196** and **198**. The worm **210** fits through the angle bracket **194** and rotates within bores **204** and **206** in each of the legs of the bracket **194**. One outer end of the shaft which bears the worm **210** has a slot **214** thereon so that the worm can be adjusted. A lock nut **208** is also mounted on the shaft of the worm **210** so that once the worm is adjusted into the desired position it can be locked therein by rotation of the nut **208** against the angle bracket **194**. The plate **212** is mounted on the hub **302** and is rotatable thereon. Stop pin **216** is fixedly mounted on the plate **4** and the sector gear **212** is positioned so that the stop pin **216** lies within the sector race **193**. The stop pin **216** provides an end point to the rotation of the sector gear when the surface **193***b* bears against the pin **216**, and in this manner limits the length of the timing cycle; however, if desired, this interval can be increased by increasing the length of race **193** or making it an arcuate slot. The pin **216** stops the rotation of the planet carrier **112** by means of pin **192** striking against the pin **216**. The longest timing interval will occur when the sector gear **212** is positioned so that the surface **193***b* bears against pin **216** while the pin **192** at the beginning of the timing cycle rests against the surface **193***a*. In order to shorten the timing cycle the sector gear is rotated so that the pin **192** is carried, by the repositioning of the surface **193***a* to any desired new starting position for the timing cycle, that is, the difference in distance between the surface **193***a* and the pin **216** is shortened. By vibrating sector gear **212** the worm **210** is not moved since the jam nut **208** locks it in position. This aids greatly in increasing the accuracy of the operation regardless of the degree of vibration to which the unit is subjected.

In the modification of Figure 2, a motor **2** and gear box **3** are mounted on a plate **4** with the output shaft of the gear box extending through the plate **4**. The adjustment of the time delay is accomplished by a means **6** which comprises a shaft **8** having a knob **10** mounted on the outer end thereof (see also Figure 4). The shaft **8** is spring loaded by spring **9** so that any end play is eliminated; the spring **9** bearing on one side against the knob **10** and on the other end against the bushing **7** in the housing **1**. The other end of the shaft **8** extends through a bushing similar to **7** and a gear **12** is mounted on the inner end of the shaft **8**. This gear **12** meshes with a sector gear **14**, which in turn is mounted upon a plate **16** by fastening means **18** and **20**. The sector plate **16** carries the actuator plate **22**, which is pivotally mounted on a post **24** fixed to the sector plate **16**. The plate **22** is provided with an actuator detent lug **26** which cooperates with the planet carrier plate **112** in a manner to be shortly described. The position of this lug **26** can be adjusted by rotating shaft **8** which then positions sector plate **16** to the extent of the teeth on the sector gear **14**. Also, the switches **30**, which are mounted upon sector plate **16** by two screws **32** and **34** are positioned together with the actuator lug **26**. The switches **30** comprise a bank of three switches **36**, **38** and **40** as shown in Figure 4. As shown in Figure 3, the actuator buttons **184** of the switches **30** are released when the detent lug **26** drops into the slot **180** in the carrier plate **112**.

The entire timer unit is mounted within a housing which consists of a cylindrical member **1**, which is mounted to a base member **28**, and affixed to this base plate by a series of mounting screws **50**. The base plate **28** is formed with an upstanding hub portion **29** which forms a pilot for mounting the cylinder **1**. Also, the mounting studs **42**, **44** and **46** serve to position the plate **4** with respect to hub **29**. The studs **42**, **44** and **46** mate with corresponding slots **43**, **45** and **47** in the plate **4**, respectively, to retain the assembly in position; and appropriate fasteners are used (see Figure 4) to fixedly mount plate **4** to the studs **42**, etc.

Mounted upon the hub **29** is a clutch or brake **52**. The clutch comprises a coil **54** which is embedded within a housing **72**. The housing **72** is also provided with an opening **74** into which an armature **56** may be piloted. The armature **56** is in the shape of a disc with a shaft mounted centrally thereof. In one method of fabrication, the armature **56** may consist of a disc mounted to a T-section shaft. The central portion of the armature **56** consists of the shaft **60** which pilots the disc **58** into the internal gear **64** of the planetary gearing **100**. The disc **58** is of ferro-magnetic material and the T-shaped shaft **60** may be of brass or other non-ferro-magnetic material. The top or T portion of the shaft **60** is indicated at **62** in Figure 4. The upper portion **62** of the T-shaped shaft **60** is formed with a piloting hub **66** which locates the external gear **64** upon the armature of the clutch. The armature **56** is so mounted in relation to the stationary part of the clutch that there are formed two air gaps **68** and **70**. Air gap **70** is larger than air gap **68** in order that the torque or the braking torque occur at the maximum radius (more torque will then be generated to lock the external gear **64** in position and prevent it from rotating when power is applied to coil **54**). The engagement of the disc **58** with the housing **72** is always on the outer edge with the arrangement of air gaps as shown in Figure 4. When current flows in coil **54** the plate **68** is attracted to the base **72** and held there until the power is turned off. Of course, the base **72** is also made of ferro-magnetic material and this serves as the return path for the flux. The bore **74** in the member **72** receives the shaft **60** and forms a pilot therefor. The ball **88** provides a friction-free pivot and bears against the surface of the hub **29**. The hub **29** is slightly beveled as at **83** at its outermost surface. The clutch housing **72** is affixed to the hub **29** by fasteners (not shown) extending through flange **80**. Centrally of the element **72** and extending from the bore **74** is a cavity **82**. The ball **88** is held within the cavity **82** by a spring follower assembly consisting of a spring **84** seated within a cavity of the shaft **60**, and a spring follower **86** which has an inwardly cone shaped lower portion to bear against the ball **88** in order to captivate the ball but still permit it to roll. The loading upon the spring **84** may be controlled by an appropriate shim assembly **76**. Also, the dimension of the air gaps **68** and **70** are controlled by the shim mounting **76**.

As indicated previously, the hub **66** serves as a pilot for the internal gear **64** of a planetary gear system. This gear **64** is fastened to the plunger **56** by a series of fasteners **90**, **92**, **94** and **96**. The heads of these fasteners are embedded in plate **58** as clearly shown in Figure 4. Thus, the internal gear **64**, the shaft **60** and the armature **56** are assembled together as an unitary member.

The planetary gear train consists of a sun gear **104** which is hobbed on the end of shaft **102** (which is the output shaft of the gear reducer **3**); a series of planetary gears **106**, **108** and **110** (which are mounted upon a planet carrier plate **112**) and the ring gear **64**. Carrier plate **112** also acts as a cam. Studs **114** are integrally

formed on the carrier plate **112**, and the planet gears are mounted on these studs and held in spaced relationship from the surface of plate **112** by a spacer **116**. The planetary gear is freely rotatable upon this hub **114** and is retained thereon by a screw **118**, which bears against a washer or spacer **120**. The ring gear **64** has teeth **122** only on the internal surface thereof.

Plate **126** is the flange of the gear box **3**, and it is affixed to plate **4** by fasteners **128**. Pilot hub **130** is integrally formed with the flange **126**. The pilot hub **130** will accept the sector gear **14**, that is, the circular portion **160** of the plate **16** is piloted on the hub **130**. The screws **132** and **134** go all the way through the plate **4** and connect the gear train to the motor. Hub **136** is also mounted upon the output shaft **102** and forms the mount for the spring **138**. The inner end **140** of the spring **138** is affixed to the hub **136** by a screw or other fastener extending into the bore **142**. The outer end of the spring **138** is formed into a loop **139** which is mounted to a pin on the back end of the planet carrier plate **112** (see Figure 10). Plate **152** is a retaining plate for the spring **138** and **150** is a stop pin. The spring fits within the opening **162** in the plate **152**.

The sector gear plate **16** has an opening **160** which fits around a pilot hub **130** and locates the switches with respect to the cam or flange. The hub **130** thus forms a base for the spring to retain it in place. The inner surface of the opening **162** in retainer plate **152** thus holds the spring in place upon the hub **130**.

As shown in Figure 10, on the backside of the planet carrier plate **112** there are two pins **170** and **172**. The loop **139** on the outer end of the spring **138** is dropped over stud **170**. The stud **172** contacts the stop pin **150**. Pin **170** is radially closer to the center of the planet carrier **112** than is the pin **172**. The purpose of the stop **172** is to give the spring something against which it can recoil and thereby establish the zero point. In other words, if there were no stop, the spring would unwind until it reached an equilibrium position and it would there locate itself. In order to have accuracy, the spring must recoil from the same point each time and it therefore recoils into the stop pin **150**. The reason for placing the pins **170** and **172** at different radial distances is to enable the location of stop pin **172** without touching the spring retaining pin **170**.

As indicated previously, the switches are released when the lug **26** falls into the slot **180** on the planet carrier plate **112**. The side **181** of the slot **180** is radially oriented. When the lug **26** drops into the slot **180** the buttons **184** on the micro-switches are released. Normally, the buttons **184** are all depressed and held in depressed position by the lug **26** riding on the outer peripheral surface of the plate **112**. The plate **22** being pivotally mounted can release or actuate the buttons **184** according to the relative position of the lug **26** and the plate **112**. The switches are wired so that they will be actuated upon the release of the button **184**.

Although certain modifications have been described hereinabove, it will be readily understood by those skilled in the art that various modifications may be made in the invention without departing from the scope thereof as defined in the appended claims.

What I claim is:

1. In a time delay relay, switch means having a switch contact actuator, an electric motor, planetary gearing drivingly connected to said motor and including a normally stationary planet carrier element and a ring gear, said planet carrier element providing means to engage said actuator, an electromagnetic brake, said ring gear being of paramagnetic material and constituting one element of said brake, means for energizing said motor, means for energizing said brake simultaneously with said motor, energization of said brake serving to instantaneously lock the normally rotating ring gear against rotation and cause the carrier element to planetate, said switch means including means for deenergizing said motor when the actuator engaging means contacts said actuator, enerby storage means operatively associated with said planet carrier element adapted to receive energy when said planet carrier element rotates and adapted to release its energy when said brake is deactivated, whereby the timing cycle will commence immediately upon energization of said brake and motor and will be repeated in exactly equal timing intervals upon each energization cycle.

2. In a time delay relay, switch means having a switch contact actuator, an electric motor, planetary gearing drivingly connected to said motor and including a normally stationary planet carrier element and a ring gear, said planet carrier element providing means to engage said actuator, means for holding stationary said ring gear whereby said planet carrier element is caused to rotate, means for energizing said motor simultaneously with said ring gear holding means, said switch means including means for deenergizing said motor when the actuator engaging means contacts said actuator, energy storage means operatively associated with said planet carrier element adapted to receive energy when said planet carrier element rotates and adapted to release its energy when said brake is deactivated, and means for fixedly adjusting the relative normal position between said actuator and said planet carrier element means in a continuous manner over a predetermined range.

3. In a time delay relay, switch means having a switch contact actuator mounted upon a movable plate member, an electric motor, planetary gearing drivingly connected to said motor and including a normally stationary planet carrier element and a ring gear, said planet carrier element providing means to engage said actuator, means for holding stationary said ring gear whereby said planet carrier element is caused to rotate, means for energizing said motor simultaneously with said ring gear holding means, said switch means including means for deenergizing said motor when the actuator engaging means contacts said actuator, energy storage means operatively associated with said planet carrier element adapted to receive energy when said planet carrier element rotates and adapted to release its energy when said brake is deactivated, and means for fixedly adjusting the relative normal position between said actuator and said planet carrier element means in a continuous manner over a predetermined range, said fixedly adjusting means including a rack affixed to said plate member, a pinion in engagement with said rack, and means for rotating said pinion to adjustably position the actuator with respect to said planet carrier element.

4. In a time delay relay, switch means having a switch actuator, an electric motor, planetary gearing drivingly connected to said motor and including a normally stationary planet carrier element and a ring gear, said planet carrier element providing means to engage said actuator, means for holding stationary said ring gear whereby said planet carrier element is caused to rotate, means for energizing said motor simultaneously with said ring gear holding means, said switch means including means for deenergizing said motor when the actuator engaging means contacts said actuator, energy storage means operatively associated with said planet carrier element adapted to receive energy when said planet carrier element rotates and adapted to release its energy when said brake is deactivated, said planet carrier element being provided with a depending stop means, a pair of abutments juxtaposed to said stop means for determining the rotational movement of said carrier element, and means for fixedly adjusting the relative normal position between said actuator and said planet carrier element means in a continuous manner over a predetermined range including means for fixedly adjusting the position of at least one of said abutments in a continuous manner.

5. In a time delay relay, switch means having a switch contact actuator, an electric motor, planetary gearing drivingly connected to said motor and including a normally stationary planet carrier element and a ring gear, said planet carrier element providing means to engage said actuator, an electromagnetic brake, said ring gear being of paramagnetic material and constituting one element of said brake, means for energizing said motor, means for energizing said brake simultaneously with said motor, energization of said brake serving to instantaneously lock the normally rotating ring gear against rotation and cause the carrier element to planetate, said switch means including means for deenergizing said motor when the actuator engaging means contacts said actuator, energy storage means operatively associated with said planet carrier element adapted to receive energy when said planet carrier element rotates and adapted to release its energy when said brake is deactivated and means for fixedly adjusting the relative normal position between said actuator and said planet carrier element means in a continuous manner over a predetermined range whereby the timing cycle will commence immediately upon energization of said brake and motor and will be repeated in exactly equal timing intervals upon each energization cycle.

6. The time delay relay of claim 5 wherein said switch contact actuator is mounted upon a movable plate member, and said fixedly adjusting means includes a rack affixed to said plate member, and a pinion in engagement with said rack, means for rotating said pinion to adjustably position the actuator with respect to said planet carrier element.

7. The time delay relay of claim 5 wherein said planet carrier element is provided with a depending stop means, a pair of abutments juxtaposed to said stop means for determining the rotational movement of said carrier element, means for fixedly adjusting the position of at least one of said abutments in a continuous manner.

References Cited in the file of this patent

UNITED STATES PATENTS

1,157,863	Ow	May 9, 1939
2,566,945	Laze	Sept. 4, 1951
2,631,664	Poole	Mar. 17, 1953
2,792,468	Kozikowski	May 14, 1957
2,820,859	Davies	Jan. 21, 1958
2,820,860	Kozikowski	Jan. 21, 1958