

June 8, 1965

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3,188,408

INTERVAL TIMER WITH CONTROLLED TIME DELAY MEANS

Filed Aug. 31, 1961

3 Sheets-Sheet 1

Fig. 1

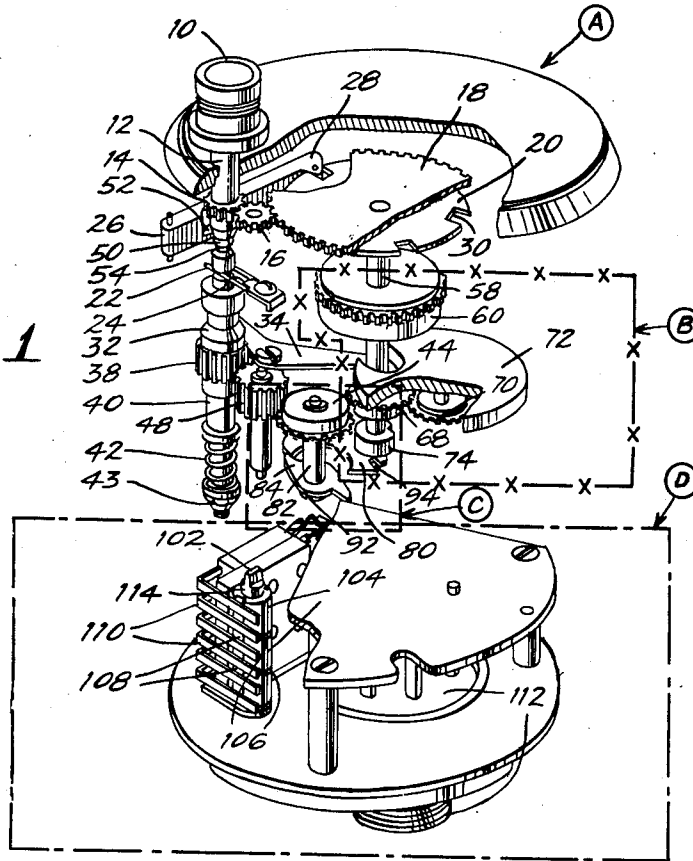
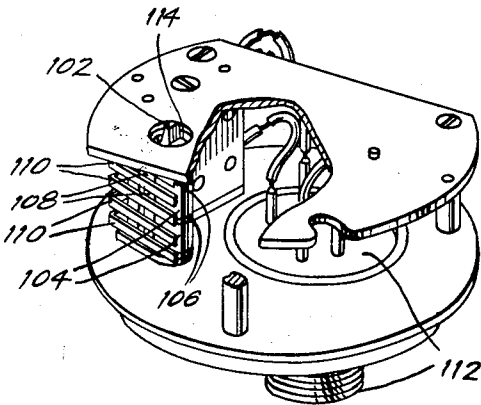


Fig. 7

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3 Sheets-Sheet 2

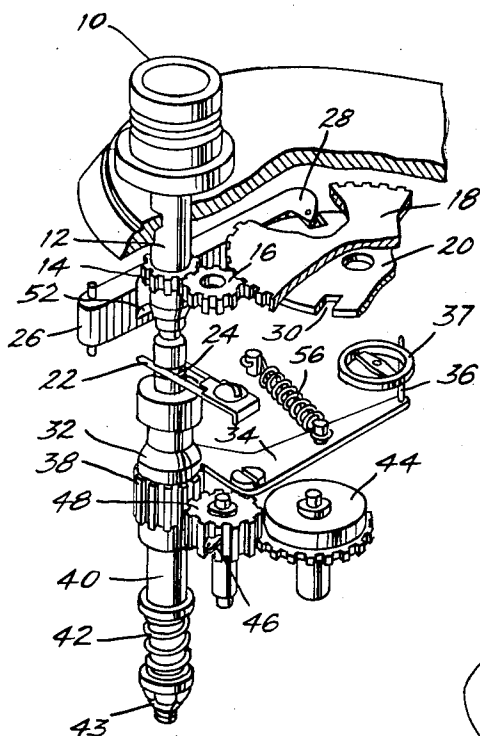
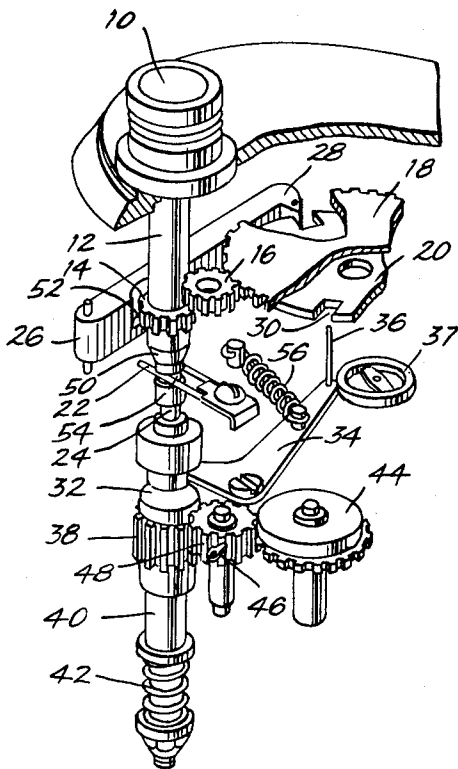


Fig. 2

Fig. 3



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3 Sheets-Sheet 3

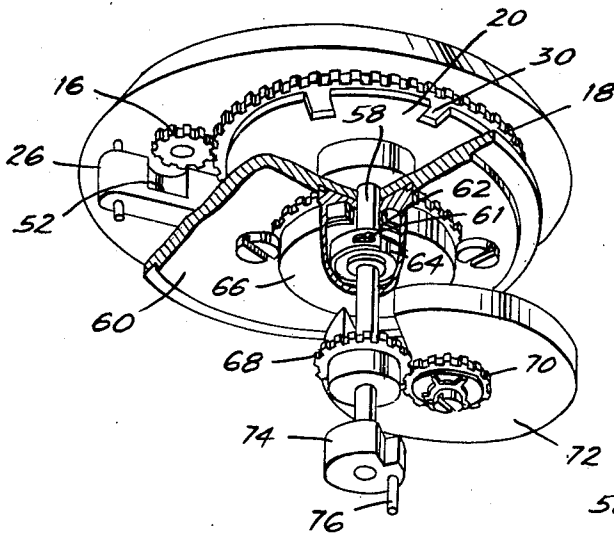


Fig. 4

Fig. 5

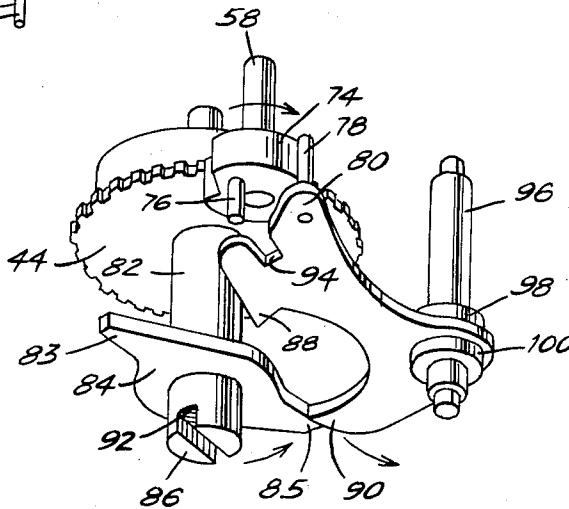
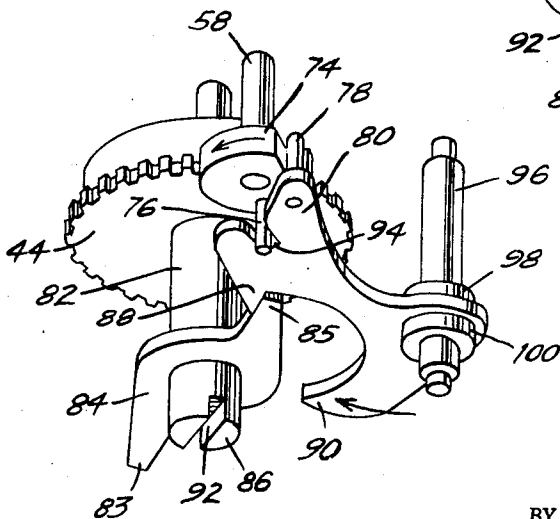


Fig. 6

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INTERVAL TIMER WITH CONTROLLED TIME DELAY MEANS

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19 Claims. (Cl. 200—38)

This invention relates to an interval timer for controlling switches and in particular to a timing mechanism which provides "snap-action" switch closure rather than the conventional "creep-up" switch closure.

Heretofore, attempts have been made to produce interval timers having extremely fast closure time. In most prior known clock-controlled switches, the contacting elements of the switching mechanism "creep up" on closure. Though switch mechanisms heretofore known were considerably fast regarding closure time, a quick, fast, "snap-action" clock-controlled switch having low interval resistance, discrete time-settings, shock and vibration resistance, and high-low temperature range has been sought.

According to the present invention, the interval timer is wound, set, started and stopped by manipulation of a control shaft system. After the interval timer is started, a time-delay is controlled by a timing system. At the end of the time delay of the timing system, a switch drive system is released by the timing system and operates a switch thereby transmitting the indexing motion to the switch from the switch drive system to periodically close a plurality of switches.

It is accordingly a primary object of the present invention to provide an improved interval timer having "snap-action" switch closure rather than "creep-up" switch closure.

It is a further primary object of the present invention to provide an improved interval timer which is capable of driving an output shaft a discrete angular distance whereby output responsive means are accurately controlled by the angular movement thereof.

It is another object of the present invention to provide an improved interval timer having a total internal resistance of less than 50 milli-ohms.

It is another object of the present invention to provide an improved interval timer having a high degree of shock and vibration resistance.

It is another object of the present invention to provide an interval timer of the foregoing type which accurately performs under extreme temperature conditions, such as, -65° F. to 165° F.

It is another object of the present invention to provide an improved interval timer of the foregoing type which is capable of discrete minute time settings, such as, 0-5-10-15, etc., or alternately, of continuous settings.

It is another object of the present invention to provide an interval timer of the foregoing type which is simple of construction, economical to manufacture, highly accurate in performance, and relatively "fool-proof" in operation.

These and further objects and advantages of the present invention shall become more apparent upon reference to the following specification and claims and appended drawing in which:

FIGURE 1 is a perspective view of the interval timer of the present invention; and

FIGURE 2 is a perspective view of the control-shaft system of the present invention in the "setting" position; and

FIGURE 3 is a perspective view of the control-shaft system of the present invention in "running" position; and

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FIGURE 4 is a perspective view of the timing system of the present invention; and

FIGURE 5 is a perspective view of the switch-drive system of the present invention with the switch open; and

FIGURE 6 is a perspective view of the switch-drive system of the present invention with the switch closed; and

FIGURE 7 is a perspective view of the switch system of the present invention.

Referring to FIGURE 1, there is shown in perspective view merely the essential systems which make up the improved interval timer of the present invention.

The area generally designated by the reference letter A is the control-shaft system whereby the improved interval timer of the present invention can be wound, set, started and stopped by manipulation thereof. The area generally designated by the reference letter B is the timing system of the improved interval timer of the present invention, which controls the time delay after the interval timer is started. The area generally designated by the reference letter C is the switch-drive system which is released by the timing system and operates the switch at the end of the time delay controlled by the timing system. The area generally designated by the reference letter D is the switch of the improved interval timer of the present invention which is controlled by the switch-drive system.

Referring now to FIGURE 2, there is shown the control-shaft system as indicated by the reference letter A in FIGURE 1, when in the "out," "up" or "setting" position which comprises a setting knob 10 connected to control shaft 12 which has a setting pinion 14 pinned thereto. The setting pinion 14 is engaged with an idler gear 16 which drives the dial gear 18 and the setting detent plate 20 which is attached in a conventional manner to the dial gear 18. A detent spring 22 resiliently engages with a turned groove 24 on the control shaft 12 thereby holding the control shaft 12 in the position shown. The setting detent lever 26 has a nose 28 at one end thereof which is biased against the detent plate 20 by an extension spring (not shown). The nose 28 of the setting detent lever 26 cooperates with the detent plate notches 30 to indicate 5-minute delay intervals. A conical cam 32, set screwed to control shaft 12, retains starter lever 34 in such a position that an elastic "whisker" pin 36 frictionally engages the balance wheel 37 of the timing movement, thus preventing operation of the timer. The conical cam 32 also positions winding gear 38, which has a running fit on control shaft 12. A sleeve 40 also has a running fit on control shaft 12 and transmits to the lower face of winding gear 38 the force developed by a compression spring 42 below it on the control shaft 12 as shown. The combination of compression spring 42, sleeve 40 and winding gear 38 is adjustable by means of threaded nut 43 so that the friction against winding gear 38 is sufficient to fully wind a spring contained in barrel 44 before slippage occurs. Barrel 44 cannot unwind so as to cause control shaft 12 to rotate counterclockwise because click-pawl 46, which is conventionally mounted in the timer, engages idler gear 48 and prevents rotation thereof, thereby locking idler gear 48 and barrel 44 while winding gear 38 slips on the control shaft 12.

Referring now to FIGURE 3, wherein identical elements therein which are shown and discussed with regard to FIGURE 2 are given like reference numerals, there is shown the control shaft system of the improved interval timer of the present invention, as indicated by reference letter A in FIGURE 1, when in a "running" position.

When the setting knob 10 is moved axially downward from the position as shown in FIGURE 2, the control shaft 12 is caused to move axially "in" or "down." The axial movement of control shaft 12 results in dis-

engagement of setting pinion 14 from the idler gear 16 and consequently from dial gear 18. The upper conical cam 50 formed on the lower portion of setting pinion 14 cooperates with a camming surface 52 of detent lever 26 to lift the lever nose 28 clear of detent plate 20. The upper turned groove 54 formed in control shaft 12 is engaged by detent spring 22 which holds the control shaft in the position shown. The downward displacement of conical cam 32 withdraws support of starter-lever 34, and spring 36 draws the starter-lever whisker pin 36 across the periphery of balance wheel 37 thus providing a starting impulse.

Referring now to FIGURE 4, wherein identical elements therein which are shown and discussed with regard to FIGURE 3 are given like reference numerals, there is shown the timing system of the improved interval timer of the present invention as indicated by reference letter B in FIGURE 1.

The entire timing system is tied together by the main shaft 53 which has pinned to its upper end the dial gear assembly including dial gear 18 and detent plate 20. A first structural plate 60 having a centrally located bore is located below the dial gear assembly. The shaft 19 passes through the centrally located bore of the structural plate 20. The shaft 53 has a hub 64 pinned to it which includes a hook 61 to engage the main spring 62. The main spring 62 is contained in the barrel 66 which is secured to the structural plate 60. A setting gear 68 is set screwed in a conventional manner to the main shaft 53. Through setting gear 68, main spring torque is transmitted to setting gear 70 which forms part of the friction clutch assembly. The friction clutch assembly is regulated so that it can be overridden during setting but supports the main spring torque required to drive the timing movement proper 72 (i.e., a modified watch). Roller 74 is set screwed in any conventional manner to the lower end of main shaft 53 and carries a pressed-in pin 76. It is the action of roller 74 which actuates the switch-drive system. During setting, the shaft 53 is driven by the control-shaft 12 through gears 14, 16 and 18 and, as the delay setting increases, the main spring 62 is correspondingly wound. Therefore, during running, the main spring 62 drives the shaft 53 whose rotation is controlled by the timing movement proper 72.

Referring now to FIGURE 5, wherein identical elements therein which are shown and discussed with regard to FIGURE 4 are given like reference numerals, there is shown the switch-drive system of the improved interval timer of the present invention, as indicated by reference letter C of FIGURE 1, when the switch is open.

In the switch drive system, the torque provided by the spring in the barrel 44 is applied to the lower end of shaft 82 which has a female drive key 86 formed therein. The escape wheel 84 is fixedly mounted to the shaft 82 and is the final element in the control system (escape-ment) which links the main shaft 53 to shaft 82. As above set forth regarding FIGURE 4, the pin 76 is friction-fitted or pressed-in to the roller 74 which is set-screwed in any conventional manner to the main shaft 53. As shaft 53 rotates as shown by the arrow when the interval timer is running, the pin 76 is driven into engagement with the slot 94 in pallet 80 which causes the pallet 80 to rotate. The pallet 80 is pivotally mounted on arbor 96 and is held thereon by spacer members 98 and 100. The arbor 96 is fixedly mounted in a conventional manner to the housing of the interval timer (not shown). The pallet 80 has at least two teeth members, 88 and 90, formed thereon. As main shaft 53 rotates, pin 76 engages slot 94 and causes pallet lever 80 to pivot on arbor 96, thereby driving the outer tooth 90 of the pallet lever 80 clear of tooth 85 of wheel 84. This unlocks the torque supported by the wheel 84, thereby permitting this force to rotate shaft 82 through a 90-degree angle until the rotation thereof is arrested by the inner tooth 88 of the pallet lever

80 (the incorporation of inner tooth 88 and tooth 85 will be discussed in detail regarding FIGURE 6).

Thus it will be seen that the indexing motion is transmitted to the switch system (FIGURE 7) through key 86. Further, the cooperation between the pin 76 of pallet lever 80 and the outside diameter of roller 74 frictionally prevents unlocking of the torque supported by wheel 84 as a result of shock or vibration to which the interval timer may be subjected.

Referring now to FIGURE 6, wherein identical elements which are shown and discussed with regard to FIGURES 4 and 5 are given like reference numerals, there is shown the switch-drive system of the improved interval timer of the present invention, as indicated by reference letter C of FIGURE 1, when the switch is closed.

The escape wheel 84 is locked against the inner tooth 88 of the pallet 80. During resetting of the interval timer, the main shaft 53 rotates counterclockwise, as shown by the arrow, and the pin 76 which is engaged in the slot 94 of pallet 80 causes the pallet 80 to pivot on the arbor 96, thereby driving the tooth 88 of the pallet lever 80 clear of the tooth 85 of the wheel 84. This again unlocks the torque supported by the wheel 84, thereby permitting this force to rotate shaft 82 through a second 90-degree angle until the rotation thereof is arrested by the outer tooth 90 of pallet 80, as shown in FIGURE 5.

It is to be understood that the indexing motion transmitted by the slot 92 of the shaft 53 of the switch-drive system may be utilized to control any means wherein intermittent or periodic operation thereof is desired.

Referring now to FIGURE 7, which shows the switch system of the improved interval timer of the present invention, as indicated by reference letter D of FIGURE 1, the indexing motion of the switch-drive system is transmitted to the switch system through female key 86 to male key 102. The male key 102 is formed on the upper end of a shaft 114 (see FIGURE 1). Permanently formed on the shaft 114 are shorting bars 108 which are located 180 degrees apart and are separated by grooves 106 and 104. When the female key 86 rotates and male key 102 is caused to rotate thereby, the commutator brushes 110 are engaged by either the insulators 104 or the shorting bars 108 relative to the angular position of the switch drive system (see FIGURES 5 and 6). The rotation of the drive key 102 is varied in 90-degree indexes caused by the intermittent rotary motion transmitted by the switch drive system (FIGURES 5 and 6) to the switch system. The insulators 104 are located between the shorting bars 108 and are also separated axially by grooves 106. Thus it can be seen that there are three sets of two each of the shorting bars 108 and insulators 104. Therefore, the switch intermittently closes three circuits which are coupled to the interval timer through the connector 112. That is to say, two commutator brushes 110 and one shorting bar 108 cooperate to complete each circuit. The specific circuitry and connectors which couple the connector 112 to the shorting bars 108 are not shown nor disclosed in detail since any well known method of electrically coupling these elements can be used without departing from the present invention.

A cycle of operation of the improved interval timer of the present invention follows. When it is desired to start the timer, the control knob 10 is pushed "in" or "down," thereby causing the control shaft 12 to move axially "in" or "down." The setting pinion 14 disengages from the idler gear 16 and consequently from the dial gear 18. The upper conical cam 50 of the lower portion of setting pinion 14 cooperates with a camming surface 52 of the detent lever 26 to lift the lever nose 28 "out" or "clear" of the notches in detent plate 20. Thus it will be seen that the upper turned groove 54 formed in control shaft 12 is now engaged by the detent spring 22 which holds the shaft in this position. The axial movement of control shaft 12 results in a downward displace-

ment of conical cam 32 which results in movement of starter lever 34 under the tension of spring 56 whereby the "whisker" pin 36 draws across the periphery of balance wheel 37, thereby providing a starting impulse.

Prior to starting the timer, the control knob 10 is rotated for the purpose of setting the specific time interval desired. During this setting of the control knob 10, the shaft 58 is caused to rotate as a result of the rotational movement of control shaft 12, setting pinion 14 mounted thereon, idler gear 16 and dial gear 18. As the control knob 10 is rotated, i.e., the delay setting increased, the main spring 62 is wound.

During running of the interval timer, the main spring 62 drives the shaft 58 whose rotation is controlled by the timing movement proper 72. The rotation of shaft 58 causes pin 76 to come into engagement with the slot 94 of pallet 80 and causes the pallet 80 to pivot on its arbor 96. When the pivoting of pallet lever 80 has progressed far enough, tooth 88 of the pallet lever 80 clears tooth 85 of the escapement wheel 84. Thus, the torque supported by the escapement wheel 84, as a result of cooperation between shaft 82 and torque-producing barrel 44, is released or unlocked. Shaft 82 is permitted to rotate through a 90-degree angle until its rotational movement is arrested by the inner tooth 88 of the pallet lever 80. This indexing motion is transmitted to the switch through female key 86. The female key 86 causes rotation of the male key 102 which causes the shorting bars 108 and insulators 104 to periodically engage the commutator brushes 110 thereby closing the circuits connected to the switch through the connector 112.

It is to be understood that the specific closing of the switches of the switch system by the indexing motion transmitted thereto by the switch-drive system is merely exemplary of one utility of the improved interval timer of the present invention. Clearly, the indexing motion may be utilized by other devices, such as, lights, electric apparatus, fuses, alarms, bells, time-safes, time-pieces or any device wherein intermittent or periodic operation thereof is desired.

When shaft 58 is rotated counterclockwise during setting, pin 76 which is cooperating or in engagement with slot 94 in pallet lever 80 causes the pallet 80 to rotate on its arbor 96 until inner tooth 88 of pallet 80 releases the escape wheel tooth 85. The escape tooth 83 is then driven under the torque supported by the wheel 84 until it locks against outer tooth 90 of the pallet 80.

Blocking pins (not shown) are provided so as to force the teeth of idler gear 16 so that the main shaft 58 is prevented from rotating beyond a few degrees below minimum time delay and a few degrees above maximum time delay. By way of example, blocking pins may be connected to the periphery of gear 18 so that rotation of gear 18 will be limited in both counterclockwise and clockwise directions. Thus it will be seen that the unit will operate accurately whenever a minimum delay, e.g., a five-minute time interval, is set by the control shaft since the main spring 62 is prevented from winding or unwinding beyond predetermined limits. Therefore, the re-winding of main spring 62 will be sufficient to compensate for any prior use thereof.

The cooperation between pin 78 and outside the diameter of roller 74 (see FIGURE 5) prevents unlocking of the switch drive system as a result of the shock or vibration to which the interval timer is subjected.

It will be apparent from the foregoing that the improved interval timer of the present invention provides "snap-action" switch closure rather than the heretofore conventionally known "crepe-up" closure and further provides discrete time settings as a result of the rotational movement of the control knob of the interval timer and the cooperation of the detent lever and dial plate.

Further, the unique combination of components of the improved interval timer of the present invention has re-

sulted in a considerable decrease in the resistance thereof to within less than 50 milli-ohms.

Still further, the frictional cooperation between the pressed-in pin 78 and the outside diameter of the rotating roller 74 provides a unique method for preventing unlocking of the interval timer as a result of shock or vibration to which the timer may be subjected.

Still further, the unique combination of the components of the present invention results in an interval timer which accurately performs within a wide temperature range such as -65° F. to 165° F.

Still further, the specific combination of the control system, timing system, switch drive system, and switch system, as above set forth, has resulted in a considerable reduction in cost, considerable increase in accuracy and ruggedness and a considerable reduction in maintenance.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

1. An interval timer for periodically causing a plurality of devices to operate at discrete time intervals comprising: a control shaft system; a timing system including timing means coupled to said control shaft system whereby operation of said control shaft system drives said timing means; a switch drive system having input and output means; means coupling said input means of said switch drive system to said control shaft system whereby operation of said control shaft system drives said switch drive system; escapement means coupled to said output means of said switch drive system for controlling the movement thereof; said escapement means being driven by said timing means whereby the movement of said escapement means causes a plurality of devices to periodically operate at discrete time intervals.

2. An interval timer for periodically causing a plurality of devices to operate at discrete time intervals comprising: a control shaft system for setting and indicating said time intervals and imparting a starting impulse to said interval timer; a timing system coupled to said control shaft system for imparting a torque to drive a timing movement proper and a switch drive system; a switch drive system coupled to said timing system and adapted to periodically impart a torque to a plurality of torque-responsive devices whereby said torque-responsive devices are caused to periodically operate at discrete time intervals.

3. An interval timer for periodically closing a plurality of switches at discrete time intervals comprising a setting stem, a timing system including a timing shaft and main-spring, means coupling said setting stem to said timing system whereby rotation of said setting stem winds said mainspring to power said timing shaft, a switch-drive system including a drive spring and output shaft, means coupling said setting stem to said switch-drive system whereby rotation of said setting stem winds said drive spring to power said output shaft, and escapement means coupled to said output shaft for controlling the movement thereof, said escapement means being actuated by rotation of said timing shaft.

4. An interval timer for periodically closing a plurality of switches at discrete time intervals comprising: a control shaft system for setting and indicating said time intervals, for imparting a starting impulse to said interval timer, and for controlling a torque-producing means; a timing system coupled to said control shaft system for imparting a torque to drive a timing movement proper and a switch-drive system; a switch-drive system coupled

to said timing system and adapted to periodically impart a torque to drive a switch system; and a switch system coupled to said switch-drive system and adapted to periodically close said plurality of switches at discrete time intervals.

5. An interval timer for closing a plurality of circuits at discrete time intervals comprising: means for setting and indicating said time intervals; means for imparting a starting impulse to said interval timer; means for controlling a first torque-producing means; timing means coupled to said means for setting and indicating said time intervals for imparting a second torque to drive a timing movement proper and a switch-drive means; said switch-drive means coupled to said timing means and including said first torque producing means and adapted to intermittently impart a first torque to drive a switch means; said switch means coupled to said switch-drive means and adapted to intermittently close said plurality of circuits at discrete time intervals.

6. An interval timer for closing a plurality of switches at discrete time intervals comprising: control shaft means having a setting pinion, a cam, and a winding gear connected thereto, said setting pinion drives an indicating and setting gear, said cam is engaged by a pivotally mounted starter-lever, said lever is adapted to impart the starting impulse to said interval timer, and said winding gear drives a torque-producing barrel; timing means having a timing-shaft coupled to said indicating and setting gear, said timing-shaft, having a second torque-producing means, a timing movement gear, and a rotating roller connected thereto, said second torque-producing means causes said timing-shaft to rotate, said timing movement gear drives a timing movement proper; switch drive means having a rotatable drive-shaft coupled to said torque-producing barrel and having an escapement wheel connected thereto and a female key formed therein, said switch-drive means further including a pivotally connected pallet lever, said pallet lever engages said escapement wheel and prevents rotation thereof, said rotating roller engages said pallet lever and causes said pallet lever to momentarily release said escapement wheel whereby said escapement wheel is permitted to rotate a predetermined angle and the further rotation of said rotating roller causes said pallet lever to again engage said escapement wheel and prevent further rotation thereof; a switch means having a rotatable switch-shaft coupled to said female key and rotatable therewith and having a male key formed thereon and a plurality of spaced conductors and insulators connected thereto, said switch means further including a plurality of fixedly mounted conductors which are connected to said plurality of switches whereby the rotation of said switch-shaft causes said spaced conductors to intermittently engage said fixedly mounted conductors thereby intermittently closing said plurality of switches.

7. An interval timer for closing a plurality of switches at discrete time intervals comprising: a control shaft system having a control shaft and including *first* means for setting discrete time intervals, *second* means for imparting a starting impulse to said interval timer, *third* means for winding a first torque-producing member of said interval timer and *fourth* means coupled to said *first* means for indicating said discrete time settings and for driving a timing system; said timing system being connected to said control shaft system and includes *fifth* means coupled to said *fourth* means for winding a second torque producing member and for imparting a torque to drive a timing movement proper, and *sixth* means coupled to said *fifth* means and responsive to the torque produced thereby for actuating a switch-drive system; said switch-drive system being connected to said timing system and includes *seventh* means coupled to said *third* means for producing a torque, *eighth* means coupled to said *seventh* means and responsive to the torque produced thereby, and *ninth*

means coupled to both of said *sixth* and *eighth* means for periodically releasing the torque produced by said *seventh* means; and a switch system connected to said switch-drive system including *tenth* means coupled to said

5 *eighth* means for closing said plurality of switches.

8. An interval timer in accordance with claim 7 wherein said *first* means comprises a setting pinion connected to said control shaft and coupled to a first idler gear which drives said *fourth* means; said *second* means comprises 10 a balance wheel, a first cam connected to said control shaft and a pivotally mounted starter-lever follower, said follower having a friction-member connected thereto for frictionally engaging the periphery of said balance wheel; said *third* means comprises a winding gear connected to said control shaft and coupled to a second idler gear which drives said first torque-producing member; and said *fourth* means comprises a dial gear connected to said first idler gear which drives a setting detent plate, said setting detent 15 plate having notches formed therein which engage a pivotally mounted lever, said lever pivotally follows a *second* cam which is connected said control shaft whereby the axial movement of said control shaft causes said lever to be disengaged by said notches thereby commencing said discrete time intervals and to cause said starter-lever fol- 20 lower to drive said "whisker" frictionally across the periphery of said balance wheel thereby imparting a starting impulse to said interval timer.

9. An interval timer in accordance with claim 7 wherein said *fifth* means comprises a main-shaft coupled to said *fourth* means and having a second torque-producing member and a setting gear mounted thereon, said second torque-producing member causes said main shaft rotate 25 whereby the rotation of said main shaft causes said setting gear to also rotate and to drive said timing movement proper; and said *sixth* means comprises a roller mounted on said main shaft and a transversely extending pin mounted in said roller whereby the rotation of said roller causes said pin to actuate said switch-drive system.

10. An interval timer in accordance with claim 7 wherein said *seventh* means comprises a rotatable drive-shaft having a spring barrel mounted thereon and a female key formed therein, said barrel being connected to said 30 *third* means whereby the actuation of said *third* means winds said barrel and produces a torque; said *eighth* means comprises an escapement wheel connected to and rotatable with said drive-shaft and having a plurality of teeth formed thereon; and said *ninth* means comprises a pivotally mounted pallet lever having a slot formed therein and at least two teeth formed thereon; said escapement wheel and said pallet lever are relatively positioned in said interval timer whereby one tooth of said pallet 35 lever engages one tooth of said escapement wheel thereby preventing said escapement wheel from rotating under the influence of said torque produced by the winding of said barrel; said *sixth* means engages said slot and causes said pallet lever to pivot; the pivoting of said pallet lever drives said one tooth thereof out of engagement with said one tooth of said escapement wheel thereby permitting said escapement wheel to rotate until said one tooth there- 40 of engages the other tooth of said pallet lever whereby the torque produced by the winding of said barrel is periodically released.

11. An interval timer in accordance with claim 7 wherein said *tenth* means comprises a rotatable switch-shaft having a male key formed thereon, a plurality of axially spaced conductors connected to said switch-shaft, a plurality of axially spaced insulators connected to said switch-shaft and positioned between said conductors, and a plurality of fixedly mounted brushes connected to a plu- 45 rality of circuits whereby the rotation of said switch-shaft causes said conductors to periodically engage said brushes

and thereby periodically close said plurality of circuits.

12. An interval timer in accordance with claim 7 wherein means for preventing unlocking thereof are connected to said switch-drive system.

13. An interval timer in accordance with claim 7 wherein a transversely extending pin is connected to said ninth means which is adapted to frictionally engage said sixth means for preventing unlocking of said interval timer as a result of shock or vibration experienced thereby.

14. An interval timer for closing a plurality of switches at discrete time intervals comprising: a control shaft system having an axially movable control-shaft, a setting pinion connected to said control shaft and coupled to a first idler gear, a balance wheel, a first conical cam connected to said control-shaft, a pivotally mounted starter-lever follower cooperating with said first cam, said follower having an elongated transversely connected pin thereon for frictionally engaging the periphery of said balance wheel, a winding gear frictionally connected to said control shaft and coupled to a second idler gear, said second idler gear drives a torque-producing barrel, a dial gear connected to said first idler gear, a setting detent plate, said first idler gear drives said dial gear which in turn drives said detent plate, said detent plate having a plurality of notches formed therein, a pivotally mounted detent-lever, a second conical cam connected on said control shaft, said detent lever engages said second cam, the axial movement of said control shaft and the second cam connected thereto causes said detent lever to disengage and engage said notches of said detent plate thereby starting and stopping said discrete time intervals and to cause said starter lever follower to drive said pin thereon frictionally across the periphery of said balance wheel thereby imparting a starting impulse to said interval timer, a rotatable main-shaft connected to said detent plate, a second torque-producing barrel mounted on said main-shaft, a setting gear mounted on and rotatable with said main-shaft, said second torque-producing barrel causes said main-shaft to rotate whereby said setting gear drives a timing movement proper, a roller mounted on and rotatable with said main-shaft, said roller having a transversely extending rod mounted therein, a rotatable drive-shaft connected to said second idler gear, said drive-shaft having said first torque-producing barrel mounted thereon and a female key formed therein, the rotation of said control shaft causes said second idler gear to rotate thereby rotating said first barrel and producing a torque thereby, an escapement wheel mounted on and rotatable with said drive-shaft, and having a plurality of teeth formed thereon, a pivotally mounted pallet lever having a slot formed therein and at least two teeth formed thereon, said escapement wheel and said pallet lever are relatively positioned whereby one tooth of said pallet lever engages one tooth of said escapement wheel thereby preventing said escapement wheel from rotating under the influence of said first torque producing barrel, said rod connected to said roller engages said slot and causes said pallet lever to pivot, the pivoting of said pallet lever drives said one tooth thereof out of engagement with said one tooth of said escapement wheel thereby permitting said escapement wheel to rotate until said one tooth thereof engages the other tooth of said pallet lever whereby the escapement wheel is permitted to intermittently rotate a predetermined

mined angle, a rotatable switch-shaft having a male key formed thereon, a plurality of axially spaced conductors connected to said switch-shaft, a plurality of axially spaced insulators connected to said switch-shaft and positioned between said conductors and a plurality of fixedly mounted brushes coupled to a plurality of switches, said female key engages said male key thereby causing said switch-shaft to intermittently rotate whereby said conductors intermittently engage said brushes and thereby intermittently close said plurality of switches at discrete time intervals.

15. An interval timer in accordance with claim 14 whereby said pallet lever further includes a transversely extending friction pin adapted to frictionally engage the periphery of said roller to prevent unlocking of said timer as a result of shock or vibration to which the timer may be subjected.

16. An interval timer comprising an output shaft, first spring means coupled thereto for rotating said output shaft, a timing system, second spring means coupled to said timing system for driving said timing system, escapement means coupling said timing system to said output shaft whereby the rotation of said output shaft is controlled by said timing system, a setting stem movable into setting and running positions respectively, means coupling said stem in said setting position to both said spring means whereby rotation of said setting stem winds both said first and second spring means, and means responsive to movement of said setting stem into said running position for decoupling said setting stem from both said spring means.

17. An interval timer according to claim 16 wherein said timing system includes a balance wheel and means responsive to movement of said setting stem into said running position for imparting a starting impulse to said balance wheel.

18. An interval timer according to claim 17 including a dial plate for indicating the amount said timing spring means is wound, and means coupling said setting stem in said setting position to said dial plate whereby the indication of said dial plate is proportional to the rotation of said setting stem.

19. An interval timer comprising an output shaft, first spring means coupled thereto for rotating said output shaft, a timing system, second spring means coupled to said timing system for driving said timing system, escapement means coupling said timing system to said output shaft whereby the rotation of said output shaft is controlled by said timing system, a setting shaft, and means coupling said setting shaft to both said first and second spring means whereby rotation of said setting shaft winds both said first and second spring means.

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**UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION**

Patent No. 3,188,408

June 8, 1966

James W. Farmer

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected, below.

Column 5, line 63, strike out "the"; line 70, for "crepe up" read -- "creep-up" --; column 8, line 22, after "connected" insert -- to --; line 34, after "shaft" insert -- to --.

Signed and sealed this 7th day of December 1965.

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents