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F. H. BROWN

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INTERVAL TIMER

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Fig. 1.

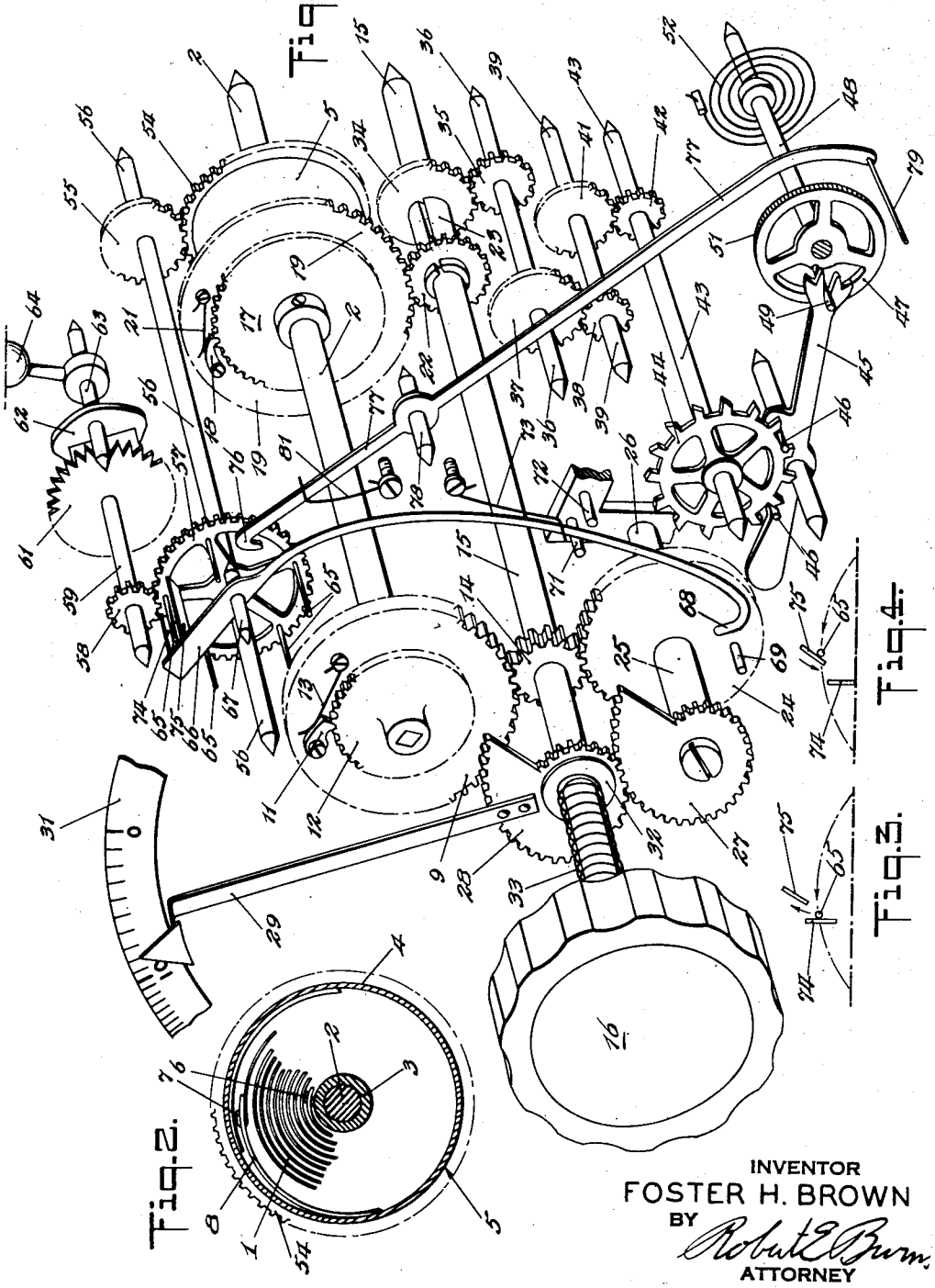

Fig. 2.

Fig. 4.

Fig. 3.

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INTERVAL TIMER

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22 Claims. (Cl. 161—1)

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This invention relates to timing devices and more particularly to an interval timer adapted to give a signal or actuate a mechanism at the end of a preselected period.

This interval timer may be useful for timing cooking periods, sunlamp exposures, photographic operations or the like, in which it is desired definitely to indicate the termination of the period by actuating an alarm or operating a valve, switch or other mechanism.

Heretofore interval timers have been provided with means for setting the time interval, winding the mainspring and cocking the alarm by one manipulation, and they have been designed to be self-starting. However, these single control devices are handicapped by the fact that the mainspring cannot store any energy to actuate the alarm. If the mainspring becomes fully run down, for example through slipping, it cannot be wound up again without disassembling the clock. Furthermore, such devices are limited to one revolution of the indicator drive. The alarm hammer is cocked at a point a considerable distance from zero. Before the end of the interval is reached the hammer is slowly uncocked and delivers a single stroke at zero, the hammer being actuated by its own separate spring.

Other devices have the disadvantage of being limited to one revolution or of being multiple controlled, or both. If such devices are modified so that the scale covers more than one hour, the divisions become so small that it is difficult to set the timer accurately. If two scales are used along with a multiplicity of controls, the device becomes undesirably complicated. While devices have been provided with spread indicators, no mechanism with a single control has been associated therewith to provide for storing more energy in the mainspring than is required for the actuation of the timing element for the set interval. There is hence inadequate power for operating an alarm or other mechanism.

An object of the present invention is to overcome the foregoing deficiencies, difficulties and disadvantages by providing a single control interval timer having a highly legible and readily comprehensible logarithmic indicator on which the setting of the time interval may be accurately made for any period indicated by the scale, resulting in an over-all high percentage of accuracy, and which has associated mechanism in which more energy is stored during setting than is used by the timing element for the selected interval. This reserve energy is used to actuate an alarm for an appreciable period after zero is reached or to operate a switch, a valve or the like at zero.

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Another object of the present invention is to provide an interval timer having a single winding and setting means which can be easily wound from fully run down to fully wound condition without disassembling the timer and which can be set even when the mainspring is fully wound without putting undue strain either on the time train or the winding mechanism.

Still another object of my invention is to provide a timer utilizing a single mainspring operating both the time mechanism and an alarm and having novel mechanism for controlling the alarm so as to operate for a predetermined period of substantial length without, however, permitting it to exhaust the energy of the mainspring.

A further object is to provide an interval timer having self-starting means which is positive in its action and is actuated by relatively slight movement of the indicator from zero position in the setting operation so as to be operative even when the timer is set for a short interval.

Still other objects of the invention are to provide a timer having an indicator which may be set to any period covered by the scale and then returned to or toward zero manually without damage to the device and to provide a timer with an indicator drive rotating more than one revolution and showing more than one hour by means of an accurate, highly legible, and readily comprehensible logarithmic indicator on which fractions of any division can be readily set and observed.

A further object of the invention is to provide a compact, self-contained and attractive timer which may be either portable or can be mounted in or on a wall, machine, instrument, appliance or fixture, while maintaining complete accessibility of control and which is sufficiently accurate to meet the demands of professional men and technicians while yet being inexpensive and simple enough to be useful to the average housewife to time cooking periods, etc.

In accordance with the invention these objects are accomplished by providing a timing device in which the alarm or actuating mechanism is cocked, the mainspring is wound, the time interval is set and the balance is started all by one manipulation of a single knob, the mainspring being wound to a greater degree than it runs down in operating the time train for the preselected time interval. At the end of the interval, reserve power thus stored in the mainspring is utilized to operate the alarm or control and the entire mechanism is stopped.

Other objects and advantages of the invention will be apparent from the following description

and from the accompanying drawings which show, by way of example, a preferred embodiment of the invention.

In the drawings:

Fig. 1 is an expanded perspective view of timing mechanism embodying my invention.

Fig. 2 is a cross-section showing the mainspring and associated parts.

Fig. 3 is a diagrammatic view illustrating the operation of the alarm control mechanism, which is shown in "cocked" position.

Fig. 4 is a view similar to Fig. 3 but showing the parts in the position occupied at the end of the alarm period.

The timing mechanism illustrated in the drawings includes a mainspring as a source of power; a winding gear train; a second gear train adapted to effect relative movement between an indexing means and a scale; a time train to regulate the speed at which the mainspring drives the indicating means; actuating mechanism for an alarm or for a valve, switch or the like; mechanism for starting and stopping the time train, and a single control member operable by the user of the timer to set the time interval, wind the mainspring, cock the alarm, and set the time train in motion.

The mainspring 1, which not only drives the timing mechanism but also provides power for operating an alarm, valve, switch or other mechanism, is shown as being of the spiral type and is confined about a barrel arbor 2 by the wall 4 of a barrel 5. The inner end of the mainspring 1 is attached to the barrel arbor 2 for example by means of a hook 6, the portion of the arbor surrounded by the mainspring being enlarged by a fixed sleeve 3 to avoid bending the mainspring too sharply. It will be understood that the enlargement 3 may, if desired, be integral with the barrel arbor or may be omitted altogether if the barrel arbor is of sufficient diameter. The outer end of the mainspring 1 is connected, for example by a hook 7, to a drag unit 8 which frictionally engages the barrel wall 4. The frictional engagement between the drag unit 8 and the barrel wall is such as to provide normal power drive while permitting slippage upon overwinding of the spring. As pointed out below, such slippage may if desired be provided elsewhere in the mechanism, making the drag unit 8 unnecessary. In such event, the outer end of the mainspring is connected by a hook or otherwise directly to the barrel.

The winding of the mainspring 1 is effected by rotation of the barrel arbor 2 in a clockwise direction as viewed in Figs. 1 and 2. The barrel arbor is rotated through a winding wheel 9 which is rotatably mounted on the arbor and carries a pawl 11 engaging a ratchet wheel 12 fixedly mounted on the arbor 2. The pawl 11 is pressed into engagement with the ratchet 12 by a spring 13, the arrangement being such that when the winding wheel 9 is rotated in a clockwise direction the ratchet wheel 12 is carried with it to turn the barrel arbor 2 and wind the mainspring. When the relative rotation is in the opposite direction as by rotation of the winding wheel 9 in a counter-clockwise direction or rotation of ratchet wheel 12 in a clockwise direction relative to the winding wheel, the winding wheel is free to turn on the barrel arbor 2 and becomes an idler. The winding wheel 9 meshes with a winding pinion or cannon wheel 14 fixedly mounted on a central shaft 15, usually referred to as the center post, which is rotatable by means of a winding and setting knob or handle 16. Rotation of the knob 16, center post 15 and pinion 14 in a counter-clockwise direction rotates the winding wheel 9 in a clockwise direction. By reason of the engagement of the pawl 11 with the ratchet wheel 12, the ratchet and the barrel arbor 2 on which it is fixedly mounted are also rotated in a clockwise direction to wind the mainspring.

The mainspring power resulting from rotation of the barrel arbor 2 in a clockwise direction as described above is held by a ratchet wheel 17 secured to the arbor and engaged by a pawl 18 which is carried by a concentrically mounted gear wheel 19 and is pressed into engagement with the ratchet by a spring 21. The gear wheel 19 is rotatably mounted on the barrel arbor and is the first wheel or "great wheel" in the time gear train described below. During the winding of the mainspring, the gear wheel 19 is held substantially stationary by the time gear train while the ratchet wheel 17 rotates with the arbor 2 in a clockwise direction relative to gear wheel 19. When the winding operation is completed or interrupted, engagement of the pawl 18 with the ratchet wheel 17 prevents the ratchet and the barrel arbor from being turned in the opposite direction by the tension of the spring and thus holds the spring tension produced by the winding operation. The force of the wound spring acting through the barrel arbor 2, the ratchet wheel 17 and pawl 18 tends to turn the great wheel 19 in a counter-clockwise direction to drive the timing mechanism. Except as hereinafter noted, the great wheel 19 and ratchet wheel 17 rotate together during the period the timing mechanism is running.

The gear train for effecting movement of the indexing mechanism for indicating the time interval includes the great wheel 19 which meshes with a center wheel pinion 22 carried by a clutch member 23 on the center post 15. This clutch member provides a friction drive between the center wheel pinion 22 and the center post so that rotation of the gear 22 by the great wheel 19 produces rotation of the center post and of the pinion 14 which is fixedly mounted on the latter. In the embodiment shown in the drawing, the pinion 14 not only forms an element of the winding gear train as described above but also meshes with a gear wheel 24 mounted on a hollow shaft 25 which is rotatably supported by a post 26. If desired, the center post can be provided with separate gears meshing with wheel 24 and wheel 9 respectively. The hollow shaft 25 also carries a spiral-shaped snail gear 27 meshing with a second snail gear 28 which is freely mounted on center post 15. Snail gear 28 carries an indicator which is shown in the form of a hand or pointer 29 cooperating with a logarithmic scale 31 to indicate a time interval. The scale is substantially annular although the maximum reading and the zero point preferably do not coincide. The snail gears 27 and 28 are complementary and are designed to provide a progressively varying gear ratio. The driving snail gear 27 rotates at a substantially uniform speed as regulated by the time train described below. By reason of the spiral shape of the complementary snail gears, the rate of rotation of the driven snail gear 28 and the corresponding rate of travel of the pointer 29 over the scale 31 increases pari passu with the increasing length of the divisions of the logarithmic scale. Thus the rate of travel of the pointer and the length of the divisions of the scale increase progressively from the maximum reading to the zero point. For example, if the scale is calibrated for a maximum time interval

of three hours, the length of divisions in the first hour and particularly in the first portion of the first hour is much greater than the length of corresponding divisions in the third hour. An error of a minute in setting or reading a time interval of three hours would be of no consequence whereas error of a minute in a time interval of three or four minutes would be substantial. By utilizing a logarithmic scale in which the length of the divisions progressively increases in proceeding from the maximum reading to zero, it is possible within the compass of 360 degrees to provide a maximum time interval greater than one hour while at the same time assuring an accuracy of a fraction of a minute at the lower end of the scale. The arrangement in accordance with my invention thus permits high over-all accuracy in selecting the time interval desired whatsoever its length.

The accuracy of the timer is still further increased by the provision of a dial washer **32** which encircles the center post **15** and is pressed into frictional engagement with the snail gears **27** and **28** by a compression spring **33**. The dial washer **32** takes the play out of the indicating mechanism which might otherwise be caused by backlash in the gear wheels **14**, **24**, **27** and **28**. Instead of employing a separate spring, the dial washer **32** may be made in the form of a spring washer or some other suitable form of friction member acting as a drag on the final member of the time train.

The ratio between the pinion **14** on the center post **15** and the gear wheel **24** through which the snail gears **27** and **28** and the pointer **29** are driven is preferably selected in accordance with the maximum time interval for which the scale is calibrated so that the center post makes one complete revolution each hour as in standard clock practice. For example, if the scale is calibrated for a maximum time interval of three hours, the ratio is approximately 1 to 3. Preferably, a somewhat higher ratio is selected so that three revolutions of the center post and the pinion **14** result in gear wheel **24** and hence the pointer **29** making slightly less than one revolution. For example, the pinion **14** can be provided with twelve teeth while the gear wheel **24** has forty. This permits the use of a scale the two ends of which do not coincide.

The setting of the pointer or indicator **29** for the time interval desired is accomplished by turning the knob **16** in a counter-clockwise direction. Rotation of the knob is transmitted through the center post **15**, the pinion **14**, gear wheel **24**, and snail gear **27** to the second snail gear **28** which carries the pointer. Thus in the setting operation, movement is transmitted from the setting knob to the pointer or indicator through a reducing gear train. With a gear ratio between the pinion **14** and the gear wheel **24** such as that described above, the setting knob **16** is turned approximately 3 revolutions to rotate the pointer approximately 1 revolution from the zero point to maximum setting. Moreover, the ratio between the rate of movement of the setting knob **16** and the rate of movement of the pointer **29** varies as the pointer moves from zero to maximum setting by reason of the varying gear ratio provided by the snail gears **27** and **28**. The rotation of the setting knob through a greater angular displacement than the pointer **29** provides vernier setting characteristics which facilitate setting the pointer more accurately and thereby contribute to the over-all accuracy of the timer.

During the setting operation, the center post

15 rotates in the clutch member **23**, the latter being held stationary by the time train described below. If after setting the pointer, the operator wishes to change the setting, the knob **16** may be turned in either direction to reset the pointer as desired. It will be understood from the preceding description that rotation of the knob **16** in a counter-clockwise direction to set the pointer **29** also acts through the pinion **14**, winding wheel **9**, ratchet wheel **12** and barrel arbor **2** to wind the mainspring. If additional winding is desired this is readily accomplished by turning the knob back and forth one or more times before setting the pointer to the desired time interval. If the mainspring is already fully wound, the knob **16** can nevertheless be turned to set the pointer, rotation being permitted by the slipping of the drag unit **8** (Fig. 2). After the pointer has been set, it is driven in the opposite direction by the mainspring acting through the great wheel **19**, center wheel pinion **22**, center wheel clutch **23**, center post **15** and the gears **14**, **24**, **27** and **28** as previously described.

The time train for regulating the speed at which the mainspring drives the indicating means includes a center wheel **34** mounted on the clutch member **23** which also carries the previously mentioned center wheel pinion **22** driven by wheel **19**. The center wheel **34** drives a third wheel pinion **35** on a shaft **36** carrying the third wheel **37** which in turn engages fourth wheel pinion **38** on shaft **39** which carries fourth wheel **41**. The wheel **41** engages an escape wheel pinion **42** mounted on a shaft **43** carrying an escape wheel **44** which engages with pallet fork **45** through two pallet pins **46**. A balance wheel **47** mounted on balance staff **48** is operated by pallet fork **45** through a roller pin **49**. The rim of the balance wheel **47** is serrated as indicated at **51** for a purpose hereinafter explained. A hair spring **52** is mounted on the balance staff **48** and is preferably provided with means for adjusting its effective length. The rate of movement of the time train is controlled by oscillation of the balance wheel in customary manner and in turn controls the rate at which the indicating means is driven by the mainspring.

Energy for actuating an alarm or for operating other mechanism at the end of the selected time interval is taken from the outer end of the mainspring by means of teeth **54** provided on the barrel **5**, the wall **4** of which is engaged by the drag unit **8** with which the outer end of the mainspring is connected so that the spring tends to turn the barrel in a clockwise direction.

The barrel teeth **54** engage a pinion **55** mounted on a rotatable shaft **56** having an alarm train wheel **57** fixedly attached thereto. The alarm train wheel **57** drives a pinion **58** on a rotatable shaft **59** which carries an alarm escape wheel **61** operating a double ratchet **62** mounted on a shaft **63** carrying a hammer **64** adapted to strike an alarm bell (not shown). Alternatively, other mechanism such as a valve, switch or the like can be actuated from the shaft **63** or from shaft **59** or **56**, suitable connections being made to supply the type and rate of movement desired.

The alarm train wheel **57** is provided with one or more pins **65** positioned about its face near its periphery and planted approximately perpendicular to the radius of the wheel. Five such pins are shown in the embodiment illustrated in the drawings. These pins **65** are used in controlling the period during which energy is delivered to the alarm or other mechanism. This period is

variable depending on the number of pins used and the gear ratios employed. If only one pin is used, the wheel 57 is permitted to make one complete revolution whereas if two pins are used it is permitted to make only half a revolution, etc. While in the following description reference is made to a plurality of pins, a single pin will suffice.

Rotation of the alarm train wheel 57 to operate the alarm or other mechanism is controlled by means of a pallet lever 66 which is pivotally mounted by means of a pivot shaft or fulcrum 67 and has a tail portion 68 adapted to be engaged by a trip pin or abutment 69 on the gear wheel 24 of the previously described gear train for driving the indicator or pointer 29. The trip pin can, if desired, be mounted on one of the other members which move in synchronism with the pointer, for example on one of the snail gears. The position of the trip pin 69 is such that it engages the tail portion 68 to swing the pallet lever about its pivot in a counter-clockwise direction when the pointer reaches its zero position. Movement of the pallet lever is preferably limited by suitable stops 71 and 72. A spring 73 acts on the pallet lever to swing it in the opposite direction to that in which it is pushed by the trip pin and normally holds the lever against the stop 71 except when the tail portion 68 is engaged by the trip pin 69.

At its opposite end the pallet lever 66 carries two pallets 74 and 75 which are movable alternately into and out of the path of the pins 65 by oscillation of the pallet lever about its pivot and form in effect an escapement movement. When the tail portion of the pallet lever is against the stop 71, which is its normal position when the clock is running, the pallet 74 is in the path of the pins 65 and prevents the alarm train wheel 57 from turning (Fig. 3). When the pointer 29 has been rotated back to zero by the driving mechanism and time train described above, the trip 69 on gear wheel 24 engages the tail portion of the pallet lever 66 to swing the pallet lever about its pivot and thereby move pallet 74 out of the path of the pin 65. The alarm train is thereby released and is actuated by power supplied from the mainspring through pinion 55 and shaft 56. The wheel 57 continues to turn until the next pin 65 engages the pallet 75 which is slightly ahead of the pallet 74 and has been moved into the path of the pins 65 by engagement of the trip pin with the pallet lever (Fig. 4). This stops the alarm. When the setting knob 16 is again turned in a counter-clockwise direction to set the timer for its next operation, the trip pin 69 is moved away from the tail portion of the pallet lever permitting the lever to swing over against the stop 71 under action of the spring 73. This moves pallet 75 out of the path of pin 65 and simultaneously moves pallet 74 into the path of the pin permitting the pin 65 to move a desired distance until it engages the pallet 74 (Fig. 3). This cocks the alarm mechanism for its next operation. It will be seen that only a slight movement of the pointer from the zero position is required to release the pallet lever from the pressure of the trip pin 69. Hence the alarm is cocked even when the timer is set for a short interval of time. The pallet 75 is preferably inclined slightly to the radius of the wheel 57 which carries the pins 65 so that pressure of one of the pins against the pallet tends to swing the pallet lever to move the pallet out of the path of the pin. The pallet 74 is approximately perpendicular to the direction of movement of the pins 65.

The mechanism just described for controlling the alarm is also utilized in actuating mechanism for starting and stopping the time train. As the alarm train wheel 57 approaches the end of its movement as permitted by the pins 65 cooperating with the escapement mechanism which controls the period of operation of the alarm, one of the pins 65 engages a cam shaped end portion 76 of a starting and stopping lever 77 which is pivotally supported by a shaft or fulcrum 78 and carries at its opposite end a resilient finger 79. When the end 76 rides up on one of the pins 65, the lever 77 is swung in a clockwise direction against the action of a spring 81 causing the finger 79 to press lightly against the serrated periphery 51 of the balance wheel 47, thereby stopping its movement. When the setting knob 16 is turned in a counter-clockwise direction to set the timer for its next operation, movement of the trip pin 69 away from the tail portion 68 of the pallet lever 66 and the resulting movement of the alarm train wheel 57 as the pin 65 drops from one pallet to the other to cock the alarm, causes the bent end 76 of lever 77 to drop off of the pin 65 which it engages. The spring 81 thereupon snaps the lever 77 back to its original position causing the resilient finger 79 to be swung away from the balance wheel in an approximately tangential direction. By reason of the resiliency of the finger 79 and the direction of its movement, the finger remains in contact with the periphery of the balance during a substantial portion of its arcuate movement and then swings clear, thereby giving the balance wheel an energetic flip which starts its oscillating movement and sets the time train in motion. The serrated periphery of the balance wheel provides more positive engagement between the balance wheel and the resilient finger 79, greatly increasing the effectiveness of the starting mechanism.

If a single pin 65 is used on wheel 57, it is preferably extended to the opposite side of the wheel. Pallets 74 and 75 act on one end of the pin while lever 77 is actuated by the other end. Alternatively the lever 77 may be actuated by another abutment or surface provided on a member of the alarm train.

The novel starting mechanism in accordance with the present invention makes possible the use of more accurate escapements which are not inherently self-starting while assuring starting under all conditions regardless of whether the setting knob is operated rapidly or slowly.

It will be seen from the preceding description that the single knob 16 serves not only to set the timer for the desired interval but also winds the mainspring, cocks the alarm and starts the time train. Moreover, all of these operations are performed merely by turning the knob 16 to set the pointer, no pushing or pulling of the knob being required. The relation of the winding mechanism and the timing mechanism which drives the indicating means is such that rotation of the knob 16 to set the pointer for a selected interval results in winding the mainspring a greater amount than is required to operate the timing mechanism for the period for which the timer is set. This is accomplished by a difference in gear ratios. In winding the mainspring, the wheel 14 on the center post 15 drives winding wheel 9 at a ratio of about 3 to 1, that is, wheel 14 turns about 3 revolutions for each revolution of the winding wheel 9. The output ratio of great wheel 19 driving pinion 22 of the time

train is about 1 to 6, the great wheel making 1 revolution to about 6 revolutions of the pinion 22. The power resulting from this difference in ratios is held in reserve in the mainspring 1 and is utilized to operate the alarm train. The slipping member 8 in the barrel 5 (Fig. 2) is provided to prevent overwinding to permit the knob 16 and center post 15 to be turned to set the pointer 29 even though the mainspring is fully wound. Instead of utilizing the member 8 to provide controlled slippage between the mainspring and the barrel, a suitable friction slippage unit may be utilized elsewhere in the winding gear train or the alarm train, for example at any point between the winding wheel 9 and the alarm train wheel 57.

A further feature of the mechanism is that the cocking of the alarm and the starting of the time train are accomplished quickly and effectively as the pointer is moved away from zero so that the operator is assured that the alarm is cocked and the time train is started even when the timer is set for a short period such, for example, as two or three minutes. If a still shorter interval is desired, this is readily accomplished by moving the pointer back to the time desired. Rotation of the knob to turn the pointer in either direction is permitted by the friction clutch 23.

While the frictional engagement of clutch 23 has been described as being sufficient to drive the indicating mechanism while permitting rotation of the center post to set the indicator and wind the mainspring, it has been found that a novel and surprising result can be obtained by making the slipping point sufficiently high to hold somewhat more than the energy of the mainspring 1 acting back through the barrel arbor 2, winding wheel 9, winding pinion 14 and center post 15. When the setting and winding knob 16 is rotated in a counterclockwise direction to set the timer and simultaneously wind the mainspring, the pawl 18 rides over, and is adapted to engage, successive teeth of the ratchet wheel 17 to hold the resulting tension of the mainspring. However, unless the pawl 18 happens to be exactly seated at the root of a tooth when the knob is released, the knob and hence the indicator will tend to be turned backward until a tooth of the ratchet is engaged by the pawl. In accordance with the invention, this retrogression is prevented by correctly selecting the frictional value of clutch 23 so that it will hold the force of the mainspring without slipping. The time train will thereupon be driven by energy of the mainspring acting through the barrel arbor 2, the winding wheel 9, pinion 14, center post 15 and clutch member 23. As the balance runs under the power delivered to the time train through the clutch 23, the timer is indicating and its indicator is controlled in an apparently normal fashion by the balance wheel and hair spring. As the time train runs, drawing power from the mainspring in this new and unconventional manner, the great wheel 19 is rotated as a driven idler by center wheel pinion 22. The rotation of the great wheel 19 is in the same direction as the rotation of the barrel arbor 2 and the ratchet 17 carried by the arbor. However, by reason of the different gear ratios between gears 14 and 9 and gears 19 and 22 as described above, the wheel 19 will turn more slowly than the ratchet 17. This differential movement continues until the ratchet overtakes the wheel 19 and the pawl 18 carried by wheel 19 seats on one of the teeth of the ratchet. The power of the mainspring will thereupon be transmitted through the ratchet 17 and

pawl 18 to the great wheel 19 whereupon the latter drives the time train through center wheel pinion 22 and center wheel 34 in normal manner. When the normal drive has become effective, the barrel arbor 2 and ratchet 12 turn more slowly than the winding wheel 9 which is rotated as a driven idler by the pinion 14. This results in pawl 11 becoming unseated, permitting relative movement of the wheel 9 and ratchet 12.

By thus holding the power of the mainspring and utilizing it to run the timing mechanism at normal speed until the pawl 18 seats itself and establishes normal drive through the great wheel 19 and center wheel pinion 22, the mechanism of the present invention avoids the undesirable retrogression of the indicator when the setting knob is released and facilitates the accurate setting of the indicator. By virtue of this automatic transfer of power from one pawl to the other, the mechanism can start and run on either pawl. The starting pawl is determined by the path of greatest power involved.

It will be understood that suitable bearings are provided for the shafts and other moving parts. Such bearings as well as the supporting frame members are omitted from the drawing for the sake of clarity.

The operation of the interval timer in accordance with my invention will be readily understood from the foregoing description. To set the timer, the knob 16 is rotated in a counter-clockwise direction. The center post 15 slips in clutch 23 and wheel 14 drives wheel 24 attached to the driving snail gear 27 which in turn drives snail 28 carrying the pointer 29. If after initially setting the pointer, it is desired to reset it for a longer or shorter interval, this is done merely by turning the knob 16 in the corresponding direction.

Simultaneously with the setting operation, the mainspring is wound through pinion 14, winding wheel 9, pawl 11, ratchet wheel 12 and barrel arbor 2. Slippage of the center post 15 in the friction clutch 23 permits the winding of the mainspring without damage to the time train. It will be further noted that the power for winding the mainspring is not transmitted through the snail gears 27 and 28 but directly through the shaft 15 and pinion 14 to the winding wheel 9. Hence, the snail gears, which by their nature are inclined to be more delicate than ordinary gear wheels, are relieved from the strain of winding. Moreover the gear ratio of the winding gear train remains constant, being unaffected by the variable gear ratio of the snail gears.

As the pointer 29 is moved away from zero in setting the timer, the trip pin 69 releases the tail 68 of the pallet lever 66 which is urged by spring 73 assisted by the pressure of pin 65 on the sloping pallet 75 to cock the alarm. When the tail 68 of the pallet lever engages stop 71 it is held at rest there by pressure of the pin 65 on the right angled pallet 74 assisted by spring 73.

Simultaneously with the cocking of the alarm, the end 76 of the pivotally mounted lever 77 drops off of pin 65 and spring 81 snaps the lever 77 carrying resilient finger 79 around part of the serrated periphery 51 of the balance wheel 47 thereby starting the oscillatory movement of the balance to put the time train into operation.

When the pointer has been set for the selected interval and the time train has been started, the driving mechanism will move the pointer back toward zero under control of the time train. Power for operating the driving mechanism and

time train may, as described above, be supplied either through the great wheel 19 and pinion 22 or through the winding wheel 9, pinion 14 and clutch 23. As the hand moves towards zero its rate of movement will progressively increase by reason of the varying gear ratio of the snail gears 27 and 28.

Upon return of the pointer 29 to its zero position, the trip pin 69 on wheel 24 engages the tail portion 68 of pallet lever 66 and swings the lever about its pivot to move the pallet 74 out of engagement with pin 65 on wheel 57, thereby releasing the alarm. The alarm is actuated for a predetermined period by power supplied from the mainspring until the succeeding pin 65 engages pallet 75. It will be understood that if only one pin 65 is employed, the alarm train wheel 57 will make approximately one full revolution. Engagement of the pin 65 with the pallet 75 after one revolution, or such portion of a revolution as is determined by the number of pins employed, stops the alarm and prevents continued operation of the alarm from exhausting the power of the mainspring.

Toward the end of the alarm run after return of the pointer 29 to zero, the end 76 of lever 77 is gradually lifted by and ultimately remains at rest on the next pin 65 on wheel 57 and resilient finger 79 is thereby applied to and held on the serrated periphery of the balance wheel 47 stopping the time train.

Upon resetting the timer, this cycle of operations is repeated.

From the preceding description, it will be seen that the present invention provides an accurate and highly legible timing device which is effective for periods varying from a fraction of a minute to several hours and in which the indexing mechanism is set, the mainspring is wound, the alarm is cocked and the time train is started by turning a centrally located knob on the front of the timer. This location of the single control member and the automatic starting mechanism make it feasible to mount the timer in or on a wall, machine, appliance, or fixture or in other locations where the rear of the timer is not accessible and the timer cannot be shaken to start it.

While the invention has been described and illustrated with reference to a specific embodiment, it is in no way limited to the embodiment shown by way of example in the drawing. For instance, instead of the stationary scale and moving pointer 29, other indicating means can be used as for example, a moving dial cooperating with a stationary index. Instead of being located centrally on the front of the timer, the knob or other control member can be placed at any convenient point, suitable connections being provided with the operating mechanism. Likewise, other forms of timing movements may be employed, such as the vibrating or oscillating ratchet wheel, pendulum or synchronous drive. It will further be understood that the invention is not limited to the specific gear ratios which have been referred to in the description and that the friction clutches, ratchets and other elements specifically shown may be replaced by equivalent elements performing the desired functions. Still other modifications will be apparent to those skilled in the art. Thus the form of the invention as shown in the drawings and described above should be considered as illustrative and not as limiting the scope of the following claims.

I claim:

1. An interval timing mechanism comprising a timing movement including a main spring, means to indicate a time interval, means adapted to be actuated at the end of the time interval, unitary means to wind said timing movement and set said time indicating means, winding connections between said unitary means and the timing movement for winding the mainspring, and driving connections for driving the indicating means by the timing movement, the winding connections having a higher ratio than the driving connections whereby said unitary means is adapted to store more energy in said timing movement than required to operate it during the set time interval.

2. An interval timing mechanism comprising a main spring, a timing movement driven from one end of the main spring, means to indicate a time interval, means driven from the other end of the main spring and adapted to be actuated at the end of the time interval, a single control means to wind said main spring and set said time indicating means, said control means being adapted to be actuated to change a set position of said time indicating means alternatively in either direction to another set position whereby said time interval may be changed from one time interval to another time interval before the end of said first time interval, driving connections between the timing movement and the time indicating means and means for retaining during said resetting the energy resulting from the winding of said main spring.

3. An interval timing mechanism comprising a timing movement, means to indicate a time interval, means adapted to be actuated at the end of the time interval, and unitary means to wind said time movement and set said time indicating means, said time indicatng means adapted to indicate on a scale of variably spaced marks, said unitary means operable from the front of said movement and adapted to store more energy in the spring of said time movement than required to operate said movement during the set time interval, the time movement including a single main spring connected to actuate the time movement from one end thereof and to actuate the means at the end of the time interval from the other end of the spring.

4. An interval timing device comprising time interval indicating means, a mainspring, means for winding said mainspring and setting a time interval, one gear train between said winding means and said mainspring and a second gear train between said mainspring and said time interval indicating means, said one gear train having a higher gear ratio than said second gear train whereby said mainspring is wound more turns when being set than when being unwound during a certain time interval.

5. An interval timing device comprising time interval indicating means, a mainspring, means for winding said mainspring and setting a time interval, one gear train between said winding means and said mainspring, a second gear train between said mainspring and said time interval indicating means, said one gear train having a higher gear ratio than said second gear train whereby said mainspring is wound more turns when being set than when being unwound during a selected time interval, and means to prevent overwinding of the mainspring and to permit setting even when the mainspring is fully wound.

6. An interval timing device comprising time interval indicating means, a mainspring, means for winding said mainspring and setting a time

interval, one gear train between said winding means and said mainspring, a second gear train between said mainspring and said time interval indicating means, said one gear train having a higher gear ratio than said second gear train whereby said mainspring is wound more turns when being set than when being unwound during a certain time interval, and unidirection torque-transmitting means in at least one of said gear trains.

7. An interval timing device comprising time interval indicating means, a mainspring, means for winding said mainspring and setting a time interval, one gear train between said winding means and said mainspring, a second gear train between said mainspring and said time interval indicating means, said one gear train having a higher gear ratio than said second gear train whereby said mainspring is wound more turns when being set than when being unwound during a certain time interval, and friction clutch means in said second gear train.

8. An interval timing device comprising time interval indicating means, a mainspring, unitary means for winding said mainspring and setting said time interval indicating means, said unitary means including means for winding said mainspring a certain number of turns during movement of the indicating means for a set time interval and means whereby said mainspring is unwound a lesser number of turns while operating the device for said set time interval.

9. An interval timing device comprising time interval indicating means, a mainspring, unitary means for winding said mainspring and setting said time interval indicating means, said unitary means including means for winding said mainspring a certain number of turns during movement of the indicating means to set it for a selected time interval and means whereby said mainspring is unwound a lesser number of turns while operating the device for said selected time interval, and clutch means whereby said device may be reset while operating.

10. A timing device comprising a mainspring, a variably graduated scale, a pointer adapted to coact with the scale to indicate a time interval, a mainspring, a winding and setting member, a setting gear train adapted to cause relative movement between the pointer and the scale, a winding gear train adapted to wind the mainspring, said setting and winding gear trains actuated by said winding and setting member, escapement means to allow the mainspring to unwind at a uniform rate, a driven gear train between said mainspring and said escapement means, a friction clutch, said driven gear train operatively connected to said setting gear train through said friction clutch, said clutch adapted to slip when the setting member is actuated, and ratchet means in said winding gear train, said ratchet adapted to be released when said mainspring is being unwound.

11. A timing device comprising a mainspring a variably graduated scale, a pointer adapted to coact with the scale to indicate a time interval, a winding and setting member, a setting gear train adapted to cause relative movement between the pointer and the scale, a winding gear train adapted to wind the mainspring, said setting and winding gear trains actuated by said winding and setting member, escapement means to allow the mainspring to unwind at a uniform rate, a driven gear train between the mainspring and the escapement means, a friction clutch, said driven gear train operatively connected to said setting gear train through said friction clutch, a first ratchet means in said winding gear train, and a second ratchet means in said driven gear train, said second ratchet means and said clutch being adapted to slip while said mainspring is being wound.

12. An interval timer comprising a mainspring, time indicating means including a scale having unit time divisions of progressively increasing length, a single control member for setting said indicating means and winding said mainspring, a gear train driven by the mainspring for operating said indicating means including a variable ratio drive for moving said indicating means at a varying rate corresponding to the varying length of said divisions, and a second gear train for transmitting winding movement from the control member to the mainspring.

13. An interval timer comprising time indicating means including a single scale registering more than one hour and having unit time divisions of progressively increasing length and an index movable relative to the scale, and means for operating said indicating means including a driving member rotated at a uniform rate of one revolution per hour, said driving member rotating more than one revolution, a setting member connected with said driving member to rotate in fixed speed relation therewith, a driven member rotated by said driving member at a uniform rate of less than one revolution per hour and a variable ratio drive between said driven member and said indicating means to move said indicating means at a varying rate corresponding to the varying length of said divisions.

14. An interval timer comprising time indicating means including a scale having unit time divisions of progressively increasing length, means for operating said indicating means including a driving member rotating at a uniform rate of speed, a variable ratio drive for transmitting motion from said driving member to the indicating means to move said indicating means at a varying rate corresponding to the varying length of said divisions, a control member for rotating said driving member to set the indicating means and a constant ratio drive between the control member and said driving member.

15. A timing device comprising time indicating means, a mainspring for storing energy to drive said indicating means, a single control member for setting said indicating means and winding said mainspring, a winding gear train between said control member and the mainspring, and a driving gear train between the mainspring and the indicating means, said driving train being interconnected with the winding train and including a friction drive the slipping point of which is sufficiently low to permit rotation of said control member to wind the mainspring but is greater than torque delivered back by the mainspring acting through the winding train.

16. A timing device comprising time indicating means, an alarm, a mainspring operating the time indicating means from one end of the mainspring and operating the alarm from the other end of the mainspring, a single control member for setting the time indicating means and winding the mainspring and an escapement mechanism responsive to the time indicating means to hold the alarm inoperative until the end of a selected interval and thereupon release the alarm for operation for a predetermined period.

17. An interval timer comprising a mainspring,

a timing movement powered by the mainspring and adapted to run at a constant speed, means for indicating a time interval, a single control means for setting the indicating means and simultaneously winding the mainspring throughout the setting movement, constant speed ratio winding connections between the control means and the mainspring and variable speed ratio driving connections between the indicating means and the timing movement providing a progressively varying speed ratio.

18. An interval timer comprising a constant speed timing movement, a shaft driven at a constant speed by said timing movement, time indicating means settable for a selected time interval and including a movable member, a setting member fixed on said shaft, and driving connections providing a progressively varying gear ratio between said shaft carrying the setting member and the movable member of the time-indicating means, the speed ratio between the setting member and the movable member of the time-indicating means being substantially greater than one to one in at least one range of movment.

19. In an interval timer a constant speed timing movement, a shaft driven at constant speed by said timing movement, time-indicating means settable for a selected time interval and including a rotatable member coaxial with said shaft, a setting member fixed on said shaft and driving connections including a cluster gear and providing a progressively varying gear ratio between said shaft carrying the setting member and the rotatable member of the indicating means.

20. A timing device comprising time-indicating means, an alarm, driving connections between one end of the mainspring and the time-indicating means, driving connections between the other end of the mainspring and the alarm, a control member for setting the time-indicating means and winding the mainspring, winding connections between the control member and the mainspring having a higher ratio than said driving connections whereby more energy is stored in the mainspring by a setting movement of the control member than is required to drive the time-indicating means for the interval set, means for holding the alarm inoperative until the end of the selected interval and thereupon release the alarm and means for stopping the alarm after a predetermined period.

21. A timing device comprising time-indicating means, an alarm, driving connections between one end of the mainspring and the time-indicating means, driving connections between the other end of the mainspring and the alarm, a single control member for setting the time-indicating means and winding the mainspring, means for holding the alarm inoperative until the end of the selected interval for which the time-indicating means is set and thereupon releasing the alarm and means for stopping the alarm after a predetermined period.

22. An interval timer comprising a timing movement including a mainspring, time-indicating means settable for a selected time interval, driving connections between said timing movement and indicating means including variable speed ratio gears whereby the speed ratio between the timing movement and the indicating means progressively decreases as the indicating means is driven by the timing movement, a single control member for setting the indicating means and simultaneously winding the mainspring, and constant ratio winding connections between the control member and mainspring, said winding connections by-passing said variable speed ratio gears whereby the winding torque is not transmitted through said gears.

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