April 29, 1969 R. R. MOORE ET AL 3,441,210

PRESET TIMER

Filed March 8, 1967 Sheet 1 of 2

FIG. 1

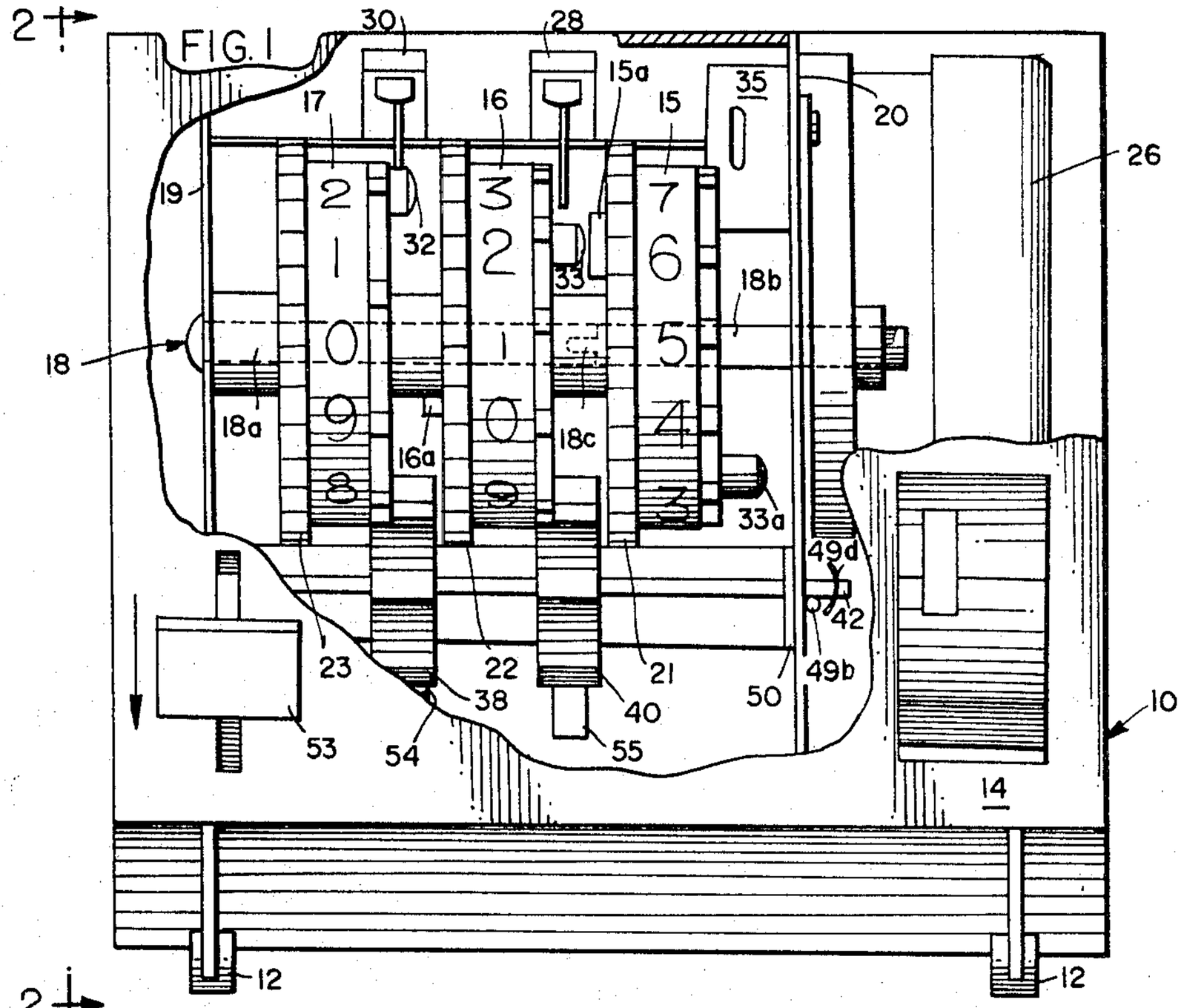
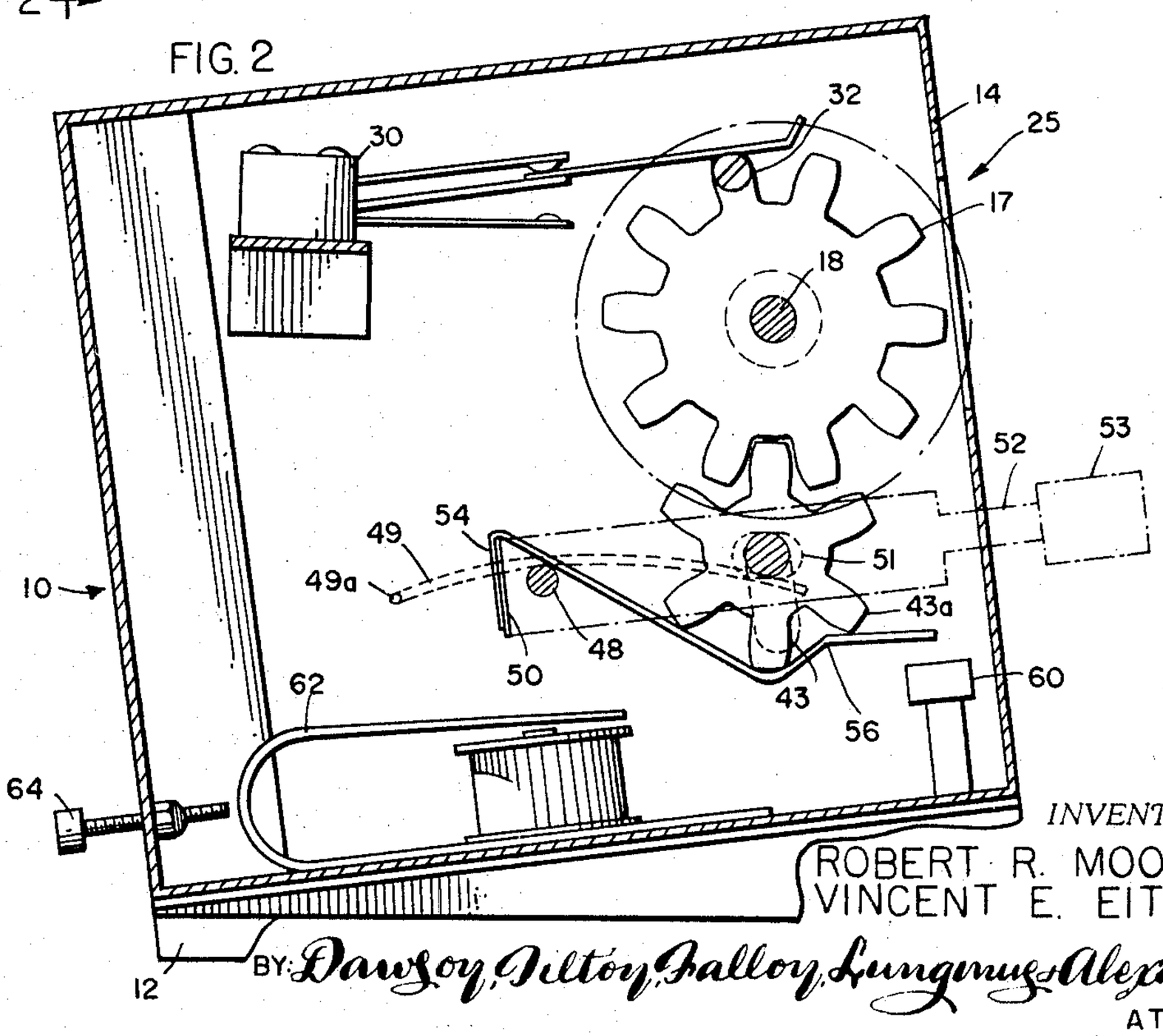


FIG. 2



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FIG. 3

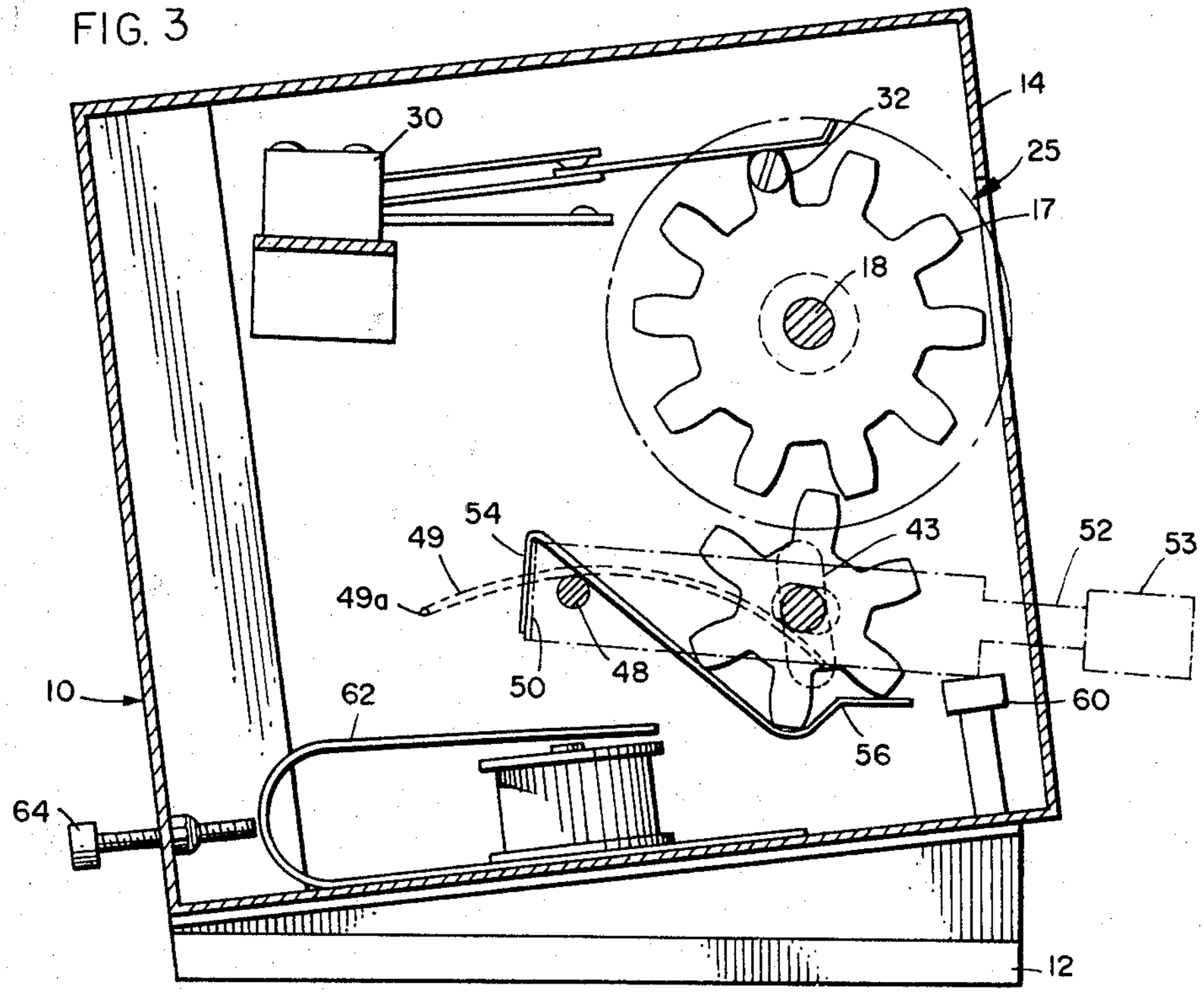
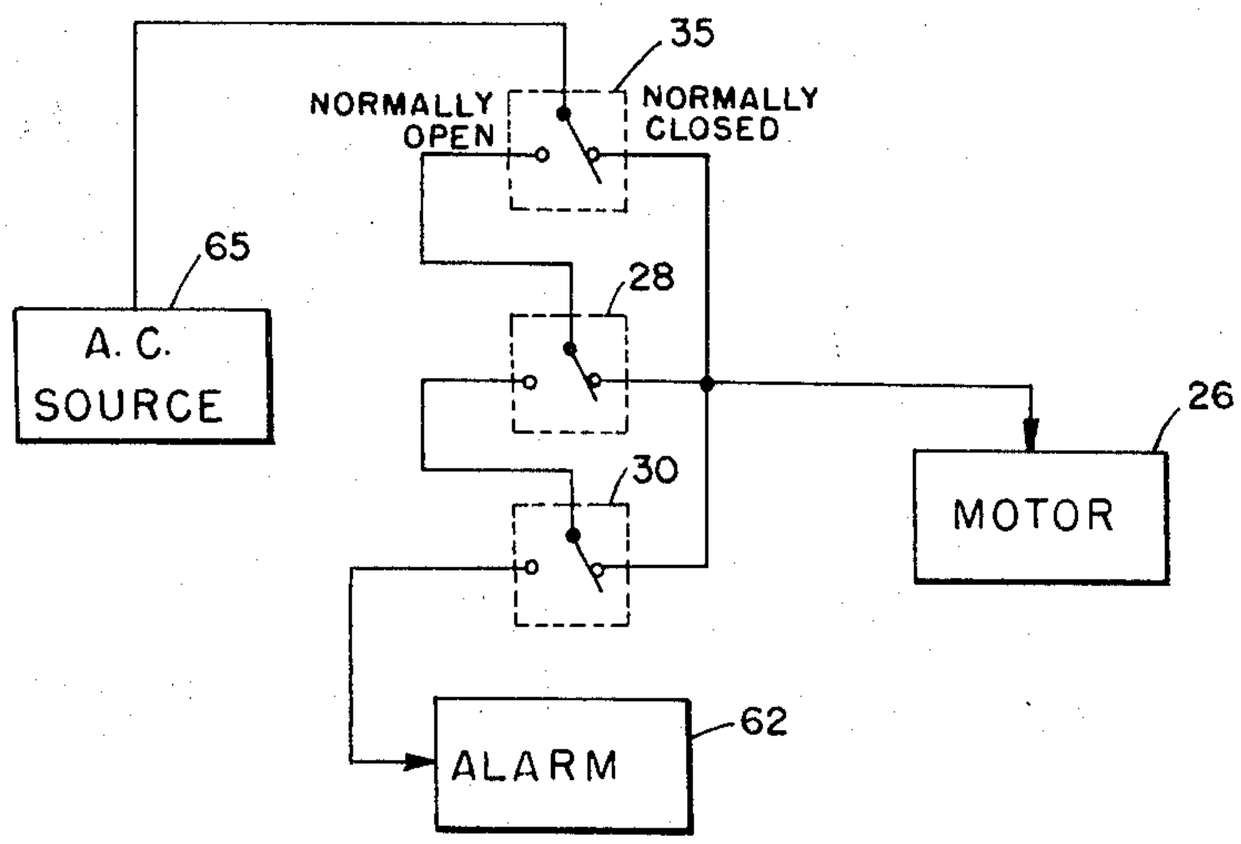


FIG. 4



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PRESET TIMER

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U.S. Cl. 235—132 13 Claims

ABSTRACT OF THE DISCLOSURE

A preset timer including a plurality of number wheels coupled through pinion gears which reduce the next higher order number wheel by one incremental unit in response to a complete revolution of the adjacent lower order number wheel. The pinions are biased into predetermined angular disposition for properly aligning the displayed numbers. Means are provided for moving the pinions to a second position in which the number wheels may be independently set without coupling to adjacent number wheels while the pinions maintain their angular disposition.

This invention relates to a preset timer, that is, a timing device which is adapted to be set to a predetermined number representing a corresponding amount of time and which will generate a signal upon the termination of that amount of time.

Counters have long been known which have a series of number wheels rotatably mounted on a common arbor, each adjacent number wheel representing a higher order of magnitude of the quantity being counted. For example, three such wheels might represent units, tens, and hundreds of miles, as in the common automobile odometer. Each wheel (for a system of radix 10) has the digits 0 through 9 on its periphery for display purposes. Conventionally, such counters include transfer mechanisms so that a complete revolution of a lower order number wheel will cause the next higher order number wheel to advance or recede depending upon whether the system is designed to count forward or count backward. The transfer means conventionally includes a set of pinion gears.

In timers using this mechanical counting principle, a distinction is drawn between preset timers which count backward from a given time and integrating timers which count forward from zero time. The former type must be capable of being preset to any arbitrary number, requiring that each number wheel be independently settable, while the latter are always reset to zero time. The counting operation is basically the same in the two timers, in that a full revolution of a lower order number wheel will cause a corresponding partial rotation of the next higher order number wheel; in one case the count is increased, while in the other it is decreased.

In the integrating or set-to-zero type of timer wherein it is desired to reset the timer after a given event has been timed, the resetting mechanism is simplified in that it is known that all of the number wheels must be set to display a zero. There are many known methods of accomplishing this result.

In the case of the preset timer, wherein it is desired to set the number wheels to display a predetermined

number, it is required that during the setting operation, there be no frictional drag or direct engagement between adjacent number wheels so that the setting of any wheel does not affect the setting of another wheel. It is further desirable that digits of the number on display be in proper horizontal alignment after the setting operation to facilitate reading of the number, as in the set-to-zero timers.

One object of the present invention is to provide a setting mechanism in a preset timer wherein there is no friction dragging or direct engagement between adjacent number wheels during the setting operation, but a positive drive engagement during normal operation.

A further object of the present invention is to provide a setting mechanism for a preset timer wherein the display digits on the number wheels maintain a proper horizontal alignment after the setting operation; that is, the number wheels are required to maintain one of a discrete number of angular dispositions relative to the main shaft on which they are mounted.

Briefly, the above objects are accomplished by providing a plurality of number wheels each equipped with a driven gear having as many teeth as there are display digits on the wheel and a drive gear having only one tooth hereinafter referred to as the transfer tooth. A set of pinion gears is further provided; each pinion gear meshes with the driven gear of a higher order number wheel and is driven by the transfer tooth of the adjacent lower order number wheel. The pinions are rotatably mounted on a common shaft and they are individually spring-biased in a normal position, defining the read position for the number wheels, whereby the pinions will rotate a higher order number wheel one unit when forced by the transfer tooth of the next lower order number wheel.

A lever is attached to the pinion shaft to move it out of the normal position to a setting position when it is desired to set the number being displayed. In this position the pinion gears are partially, but not completely disengaged from the driven gears on the number wheels. A flat detent spring which is bent to form a traverse salient angle defining a knee is positioned adjacent each pinion gear with the knee urged between adjacent teeth of the pinion by action of the spring. When a pinion is transferring motion from a lower order number wheel, it rides over the knee in the detent spring forcing it out of the way. However, when the pinions are in the setting position (by depression of the lever), each number wheel may be independently rotated, in which case its driven gear rotates the pinion far enough to permit the teeth to slip past one another but not enough to cause the pinion gear to ride over the knee in the detent spring. The knee forces the pinion back to its original angular disposition after the transfer tooth has rotated beyond the pinion. The numbers being displayed on the periphery of the number wheels are automatically aligned when the lever is returned to its normal position and the pinions again fully mesh with the driven gears of the number wheels. This is because the knee in the detent spring is urged radially between adjacent teeth of its associated pinion to force it to maintain a predetermined angular disposition. Each discrete angular disposition of the pinion, in turn, will force its associated number wheel into one of a discrete number of angular positions; and these discrete angular positions of the

number wheels are designed so that the numbers being displayed will be in proper horizontal alignment.

Other objects and advantages of the present invention will be obvious to those skilled in the art from the following detailed description accompanied by the attached drawings in which:

FIG. 1 is a partially cutaway front elevational view of a device according to the present invention;

FIG. 2 is a side elevational view of the device of FIG. 1 taken through the sight line 2—2 with the lever in its normal position;

FIG. 3 is the view of FIG. 2 showing the device in a position wherein the number wheels may be independently set; and

FIG. 4 is an electrical schematic diagram of the shut off circuitry for the device of FIG. 1.

Referring then to the drawing, like reference numerals will indicate identical parts on the various views. The device as shown is mounted in a housing, indicated by reference numeral **10**, resting on feet **12**. A faceplate **14** is provided with openings (which have been cut away in FIG. 1) for displaying one digit of each number wheel. The feet **12** are tapered toward the rear so that the faceplate forms an oblique angle with the horizontal, as seen in FIG. 2, for convenience of viewing. Number wheels **15**, **16** and **17**, respectively representing the units, tens and hundreds digits of minutes being displayed, are mounted on a split shaft **18** including a fixed section **18***a* which is attached at one end to a vertical mounting plate **19**. The shaft **18** also includes a rotatable section **18***b* which is coupled to the output shaft of the hysteresis motor **26** and rotates with it. A reduced axial pin **18***c* is journaled into a recess in the fixed section **18***a* providing beam strength for the shaft **18**. The rotatable section **18***b* is rigidly attached to the hub of the units number wheel **15** for driving it directly.

Each of the number wheels **15**, **16** and **17** is provided with a side disk which extends radially beyond the numbered circumference of the wheel and which serves as a thumb wheel. The thumb wheels are indicated respectively as **21**, **22** and **23**. Each of the thumb wheels **21**, **22** and **23** is provided with a series of horizontal serrations around its periphery and extends through the front portion of the faceplate **14** (FIG. 2), as seen at **25** of FIG. 2, for independent rotation by an operator. The transfer tooth for driving the next higher order number wheel through its associated pinion gear also protrudes from this disk.

As mentioned above, the units number wheel **15** is continuously rotated with section **18***b* of shaft **18** assuming a continuum of angular positions as distinguished from the motion of the tens number wheel **16** and hundreds number wheel **17** which are rotated incrementally. These latter wheels are incapable of assuming any angular disposition about shaft **18** other than the ten discrete positions at which numbers being displayed will be in proper alignment, as is explained below. However, the units number wheel **15** may be set to any desired angular position to provide accuracy. On the right hand side (from FIG. 1) of each of the tens and hundreds number wheels **16** and **17**, and integral therewith, is a driven gear having ten teeth, one associated with each of the display digits. Number wheel **15** is similary provided with a driven gear, as shown, but it is not used since the units number wheel is driven directly by the motor **26**. FIG. 2 shows only the teeth of number wheel **17** with the thumb wheel **23** and body segment shown in phantom.

Each of the number wheels **15** and **16** is also provided with a transfer tooth **15***a* and **16***a* extending laterally from the thumb wheels **21** and **22** on the side opposite the driven gear.

Each of the driven gears of the number wheels supports a stud extending axially therefrom, for actuating an electrical switch. Two blade switches, **28** and **30** are associated respectively with the tens number wheel **16** and the hundreds number wheel **17**.

As seen in FIG. 2, a lateral tooth extension **32** is adapted to close the upper contacts (normally open) of the blade switch **30** only when the number "0" is being displayed at the faceplate **14**. At all other times the lower contacts (normally closed) are closed. Similarly, the driven gear of the number wheel **16** is provided with a stud **33** for operating the blade switch **28**. An enclosed single pole, double throw snap switch, generally designated as **35** in FIG. 1, is actuated when the units number wheel **15** displays a zero by a suitable stud **33***a* from its driven gear. Electrical circuitry, described in more detail below, turns off the hysteresis motor **26** and generates a signal for sounding an alarm, energizing an appliance, etc., when each of the normally open contacts of the blade switches **28** and **30** and snap switch **35** are in a closed condition indicating that all of the number wheels are displaying zeros.

Two pinion gears, designated as **38** and **40**, are rotatably mounted on a pinion shaft **42** which is received in a U-shaped lever **50**. The pinion shaft **42** is parallel to the split shaft **18**. A slot **43** having a width somewhat greater than the diameter of shaft **42** is provided in each of the mounting plates **19** and **20** to permit passage of shaft **42** and limit translational movement thereof. That is, the top of slot **43**, as can be seen in FIG. 2, defines an upper limit for the shaft **42** thereby providing proper meshing engagement of the pinion gears with their associated driven gears and transfer teeth gears.

Since the device is designed to display decimal numbers, ten teeth are provided on each driven gear of the number wheels **16** and **17**. However, each of the pinions **38** and **40** has only six teeth since they are of a smaller diameter.

A shaft **48** is rotatably mounted generally parallel to and rearward of the pinion shaft **42** in each of the mounting plates **19** and **20** to provide a pivot for lever **50**. Generally rearward of the shaft **48** and below it, wire springs **49** and **49***b* are mounted in each of the mounting plates **19** and **20**. In FIG. 3 is shown in phantom a wire spring **49** fixed at **49***a* in mounting plate **19**. The wire spring **49** is then bent over the shaft **48** to bear downward on it, and beneath the pinion shaft **42** to bear upward on it thereby forcing the lever **50** and pinion shaft **42** upward in the aperture **43** and the pinion gears **38** and **40** to mesh with the driven gears of number wheels **17** and **16** respectively. Another wire spring (**49***b* in FIG. 1) similar to the wire spring **49**, is provided at the other end of pinion shaft **42** for urging it upwards. The wire springs **49** and **49***b* are prevented from slipping off the shaft **48** by retaining rings, see **49***d* in FIG. 1.

As is conventional, when a lower order number wheel is rotated through a complete revolution, its transfer tooth rotates its associated pinion gear which is in mesh with the driven gear of the next higher order number wheel thereby causing an angular displacement of the higher order number wheel by one tenth of a revolution.

The U-shaped lever **50**, as seen in FIG. 1, lies adjacent the mounting plate **20**, forms a right angle behind the shaft **48**, extends leftward just short of mounting plate **19** where it forms another right angle, and then defines a reduced section **52** for projecting through the faceplate **14**. A handle **53** is attached to the section **52**. The lever **50** is provided with slots (see **51** of FIG. 2) transverse of the slots in the mounting plates **19** and **20** for receiving the pinion shaft **42**. When the lever **50** is depressed, as shown in the direction of the arrow of FIG. 1, it rotates on shaft **48** and the pinion shaft **42** is forced downward against the action of the side wire springs **49** and **49***b* guided by the transverse slots in the side mounting plates and the lever **50**.

A stopping block **60** is fixed to the inner side of mounting plate **19** to provide a lower bearing surface beyond which the lever **50** cannot be depressed. This stopping block **60** limits the amount by which the pinion shaft

42 may be moved away from the main shaft 18, and it insures that when a number wheel is rotated with the lever 50 depressed, the gears on the rotating number wheel will engage the associated pinion gear only enough to permit the teeth to slip past each other without causing the pinion to lose its angular disposition, as will presently be described. Alternatively, the length of slot 43 may be designed to limit the downward motion of the pinion shaft 42 thereby obviating the need for the block 60.

A flat detent spring 54 is attached to the back of the lever 50, extends forward thereof and defines a knee 56 which is urged by action of the spring 54 between adjacent teeth of pinion 38 forcing it to assume a predetermined angular disposition. A similar detent spring 55 engages the pinion gear 40. The knee in each detent spring has an inverted V-shape (FIG. 2), and the inclined surfaces urged between adjacent teeth of a pinion generate counter rotary forces in those teeth to stabilize the pinion. The predetermined angular positions into which the pinions 38 and 40 are urged, force the corresponding number wheels 17 and 16, with whose driven gears they mesh, to assume discrete, stable angular positions relative to the shaft 18 for displaying the number in proper horizontal alignment. When a pinion is rotated (clockwise in FIG. 2) by the transfer tooth of a lower order number wheel, the tooth of the pinion to the right of the knee 56 in detent spring 54 (i.e. tooth 43*a* in FIG. 2) will approach the knee 56 against the action of the detent spring 54 thereby forcing it down. After the tooth 43*a* has passed the knee 56, the knee will act upon the other side of the tooth 43*a* in providing a rotary force which will assist the transfer tooth, creating a snapping action until the next stable position is reached.

When it is desired to set the number wheels to a particular number, thereby displaying an initial setting from which the device will count to zero, the lever 50 is depressed to force the pinion shaft 42 downward and the pinions partially out of meshing engagement with the driven gears of the number wheels (see FIG. 3). Each of the number wheels may then be set individually by moving the thumb wheel portion of the number wheel upward. This upward motion causes counterclockwise rotation of the number wheel as viewed in FIG. 3. During such rotation, the driven gear of the number wheel being set will partially rotate its pinion gear, one tooth of which will move toward the knee of the detent spring. Before the pinion tooth reaches the knee, however, the driven gear of the number wheel being set will have rotated beyond engagement with the displaced pinion, and the tooth of the pinion will then ride back down the detent spring away from the knee in counterrotation thereby assuming its original position while the number wheel has advanced a unit. Hence, there is no coupling from the number wheel being set to the adjacent lower order number wheel when the pinion shaft is lowered; and the pinion is jogged to and fro in oscillating motion without yielding its original angular disposition. Further, the operator can feel when the number wheel has passed the pinion indicating the wheel has advanced a unit. The stopper 60 limits depression of the lever 50 to prevent complete disengagement between a number wheel gear and its pinion.

It will be noted that the detent springs are attached to the lever 50 and rotate with it in fixed relation to the pinion gears. Hence, the relative position between the detent springs and pinion gears is independent of the stopper 60. In the setting position, the pinions are able to ride over the detent springs but do not do so because they have been partially disengaged from the number wheel gears.

Similarly, the transfer tooth of the number wheel being set partially rotates its pinion but does not cause it to yield its original angular position once the transfer tooth has been rotated beyond the partially disengaged pinion. Consequently, there is no coupling of rotary motion between the number wheel being set and the adjacent higher order number wheel.

The function of the detent spring and the stopper limiting translation of the pinion shaft in the setting position are considered important features of the present invention for if the pinions were removed from all engagement with the number wheels such that they were freely rotatable, there would be no tactile indication of when a digit being set for display had assumed a proper orientation. Secondly, the detent spring forces the pinions and their associated number wheels into angular dispositions which insure proper horizontal alignment of all the digits on display.

Also shown in FIGS. 2 and 3, in schematic representation, is a buzzer 62 for sounding an audible alarm when all zeros are being displayed on the number wheels. A nut and bolt arrangement 64 is further provided for decreasing the sound of buzzer 62 if desired.

The electrical circuitry associated with the timer will now be described. Referring to FIG. 4, an AC source 65, which may be a conventional 115 volt, 60 cycle source, is connected to the wiper of snap switch 35, which is a single-pole, double-throw switch, as shown. The normally-open contact of snap switch 35 is coupled directly to the wiper of blade switch 28 which is also a single-pole, double-throw switch, but need not be of the snapping type since it never interrupts a current, as will be clear from the following description. The normally-open contact of switch 28 is coupled to the wiper of the second blade switch 30. The normally-open contact of blade switch 30 is coupled directly to the alarm 62 which, as indicated above, may be a buzzer.

It will be recalled that the snap switch 35 is actuated by the continuously rotating units number wheel 15, and the blade switches 28 and 30 are associated respectively with the tens and hundreds number wheels 16 and 17 which are rotated incrementally. The switches 28, 30 and 35 are shown in FIG. 4 in their normal state, that is, the position asumed when its associated number wheel is not displaying a zero.

The normally-closed contacts of the switches 30, 28 and 35 are connected in parallel and coupled directly to the motor 26.

By the above-described circuit configuration, we have advantageously eliminated the need for relays to energize the alarm and to open the motor circuit when the preset time has elapsed. That is, the provision of a snap switch actuated by the continuously-driven number wheel (i.e. the units number wheel) not only provides more precise timing by decreasing switching time, but also allows the snap switch itself to break the motor circuit and energize the alarm when both blade switches have reached a quiescent state in which their normally-open contacts are closed (indicating the digit being displayed by each is a zero). This occurs only after the units number wheel has progressed through a full revolution after the tens and hundreds number wheels display zero.

By way of example, let it be assumed that the timer is preset to 101 minutes. Blade switch 30 and snap switch 35 are both in their normal states, but blade switch 28 has been actuated by its number wheel so that its wiper contacts its normally-open contact. After a minute has elapsed, snap switch 35 will change states, but the motor 26 is still energized since the AC source 65 is coupled through the normally-open contacts of each of the switches 35 and 28, and through the normally-closed contact of switch 30 to energize the motor 26. After the next minute has elapsed, the snap switch 35 will be directly coupled to the motor 26, and blade switch 30 will be actuated to change states and remain changed until the time has run out. After the tens number wheel then displays a zero, the units number wheel must still rotate through a full revolution and actuate snap switch 35 before the motor 26 is finally de-energized and the alarm signal generated by feed-

ing a signal through the previously closed normally-open contacts of the blades switches **28** and **30**.

Hence, the snap switch is the only switch which actually makes or breaks current. The blade switches merely act as conductors since they are disposed one way or the other prior to actuation of the snap switch.

Although the illustrated embodiment has included means for stopping the drive motor when all zeros are displayed on the number wheels, it is noted that in certain instances that it may be desirable to sound the buzzer but let the drive motor continue so that an operator has a ready indication of how long the predetermined time had elapsed before his arrival.

It will be obvious to those skilled in the art that our invention is not limited to timers, nor to decimal counting systems, but has been illustrated as such for purposes of explaining the principle. Other modifications may readily be made without departing from this principle, and it is therefore intended that it cover all such equivalent structures as are embraced within the spirit of the invention.

What is claimed is:

1. In a counting device including a plurality of number wheels representing successively higher order digits of a number being displayed, the lowest order of said number wheels being driven, and others of said number wheels including a driven gear and a transfer means, said device further including a set of pinion gears in mesh with the driven gear of a higher order number wheel and the transfer means of the adajcent lower order number wheel, the improvement comprising: spring means for urging each of said number wheels but said driven number wheel to assume discrete angular positions; and lever means cooperating with said pinion gears for displacing them to a setting position whereby when said number wheels are independently set, the driven gear and transfer means will engage and partially rotate their associated pinion gears and said number wheels will be returned to their angular positions by action of said spring means.

2. The device of claim **1** wherein said spring means includes a detent spring engaging each pinion for urging said pinions into discrete angular positions thereby forcing the number wheels whose driven gears are engaged to assume only those angular positions at which adjacent digits are aligned when said lever means is in its normal position.

3. The device of claim **1** wherein said pinion gears are rotatably mounted on a common shaft and wherein said spring means comprises a first spring means engaging said pinion shaft for urging said pinions in mesh with the driven gears of said number wheels and second detent spring means, one of said detent springs engaging each of said pinion gears.

4. The device of claim **3** further comprising stopper means for limiting the movement of said lever means in said setting position to a location at which said driven gears engage said pinions when rotated, said pinions being returned to their predetermined angular disposition under urge of said detent springs thereby providing a tactile indication of when the number wheel being set has advanced a unit.

5. The device of claim **4** further comprising means for driving the lowest order number wheel to assume a continuum of angular dispositions, said higher order number wheels assuming discrete angular dispositions; a snap switch having a wiper, a normally-open contact and a normally-closed contact actuated by said lowest order number wheel when displaying a predetermined number; a source of electrical energy coupled to said wiper of said snap switch; a plurality of switches having a wiper, a normally-open contact and a normally-closed contact, each switch actuated by a higher order number wheel when displaying a predetermined number; means connecting the normally-open contact of each switch associated with a lower order number wheel to the wiper of the switch associated with the next higher order number wheel; and means connecting all of the normally-closed contacts of said switches to said driving means in parallel, whereby only said snap switch makes and breaks the circuit from said energy source to said driving means.

6. The device of claim **5** characterized by said means driving the lowest order of said number wheels being a motor rotating at a constant angular velocity whereby said device is a timer.

7. The device of claim **6** further comprising circuit means coupled to said switch means for de-energizing said driving means and for generating an alarm signal in response to said number wheels assuming said predetermined angular positions.

8. The device of claim **3** wherein each of said detent spring means is characterized by a V-shaped portion defining a knee, said knee being urged radially inward of said pinion gear between adjacent teeth in fixed angular relation with said pinion shaft whereby said pinions are urged to assume discrete angular positions.

9. In a preset timer including a plurality of number wheels for displaying a number indicative of time and means for rotating said number wheels for changing the displayed number responsive to rotation of the lowest order of said wheels, angular position being transferred through a set of pinions on a common shaft engaging gears of adjacent number wheels, the improvement comprising:

first spring means for urging said pinions in a normal position in mesh with said number wheels wherein rotary motion is transferred to adjacent gears;

detent spring means resiliently urged against said pinons defining a knee between adjacent teeth of said pinion; and

means including a lever for moving said pinion shaft against the urge of said first spring means to a setting position wherein said number wheels when rotated will partially rotate said pinion gears to ride up said detent means and said knee will remain between said adjacent teeth of said pinion to return said pinion to its original angular position after said number wheel is set.

10. The device of claim **9** characterized by said detent spring means comprising a plurality of flat springs, one engaging each of said pinions, the knee of each detent spring defining a V-shape.

11. The device of claim **10** further including means for limiting the motion of said lever means to a position at which said pinion gears are partially rotated by a rotating number wheel and return to their original angular position in response to the urge of said knee when said number wheel gear has rotated beyond engagement with said pinion gears.

12. In a counting device including a plurality of number wheels representing successively higher order digits of a number being displayed, transfer means coupling rotary motion from each lower order number wheel to the next higher order number wheel in response to a complete revolution of said lower order number wheel, electrically-energized means for driving the lowest order number wheel in continuous rotation, the improvement comprising: means for urging each of said pinion gears and thereby all of said number wheels of order higher than said lowest order number wheel in predetermined angular disposition; a snap switch having a wiper, a normally-open contact, and a normally-closed contact, said snap switch being actuated by said lowest order number wheel when displaying a predetermined number; a source of electrical energy connected to the wiper of said snap switch; a plurality of switches each having a wiper, a normally-open contact and a normally-closed contact, one of said switches being actuated by each of said number wheels of order higher than the lowest when displaying predetermined numbers; means connecting the normally-open contact of each switch to the wiper of the switch associated with the next higher number wheel; and means connecting all of the normally-closed contacts of said switches to said driving means in parallel, whereby said

driving means is de-energized when said number wheels display said predetermined numbers by said snap switch breaking its circuit.

13. The device of claim **12** further comprising alarm means connected to the normally-open contact of the highest order of said number wheels, whereby said alarm means is energized when said predetermined number is displayed by said snap switch coupling said source thereto through the normally-closed contacts of all of said switches of higher order number wheels.

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