

Feb. 14, 1956

E. J. UHLIG ET AL

2,734,338

24-HOUR DIRECT-READING CLOCK

Filed Jan. 12, 1953

4 Sheets-Sheet 1

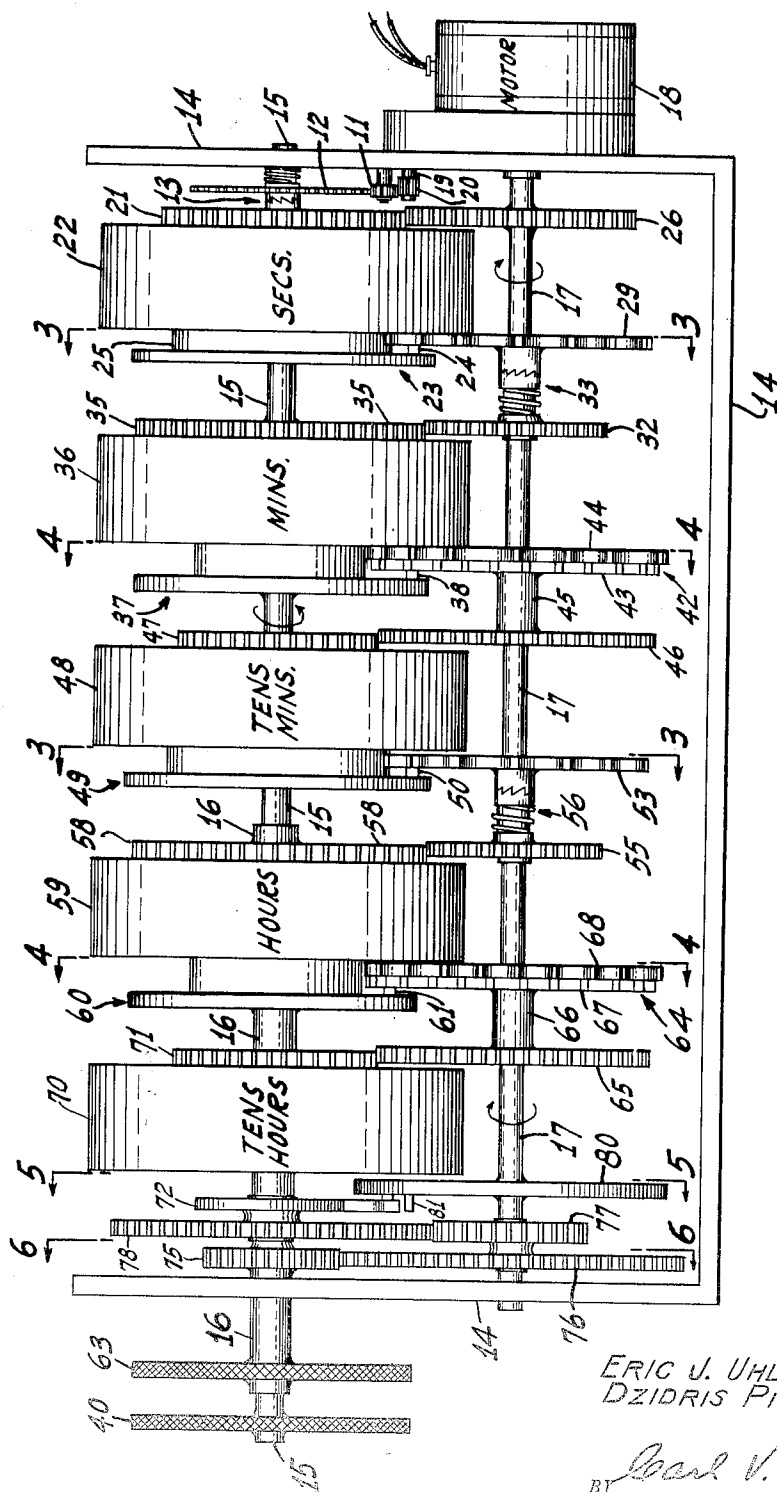


Fig. 1

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4 Sheets-Sheet 2

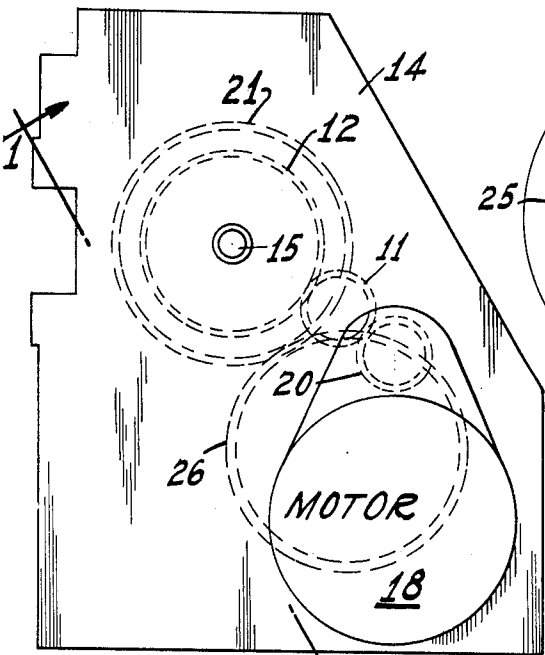


Fig-2

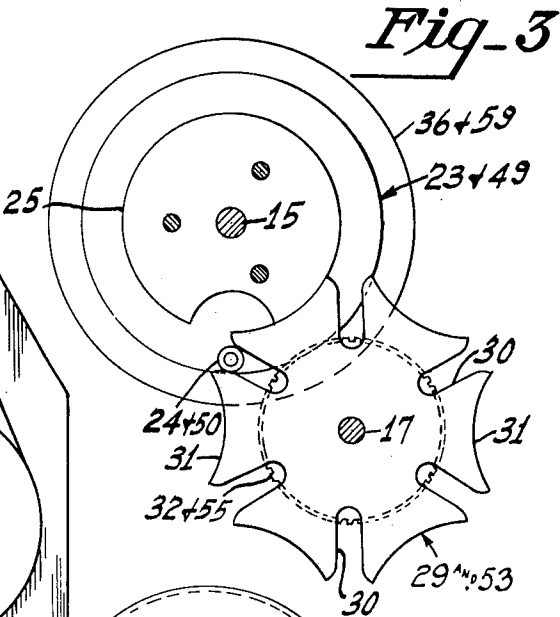


Fig-3

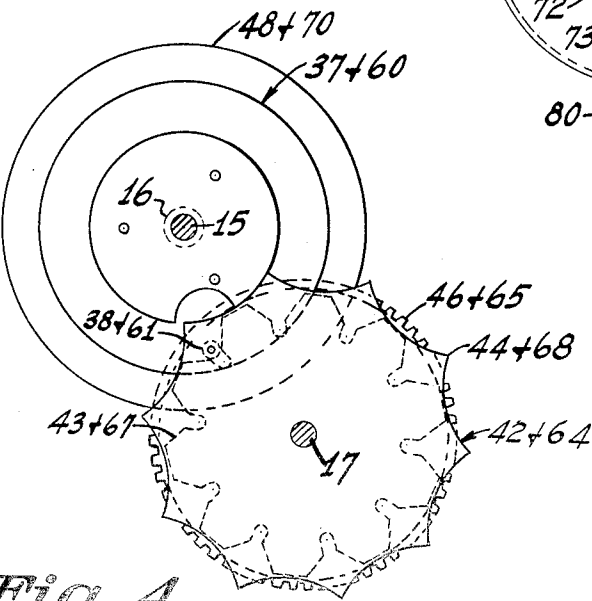


Fig-4

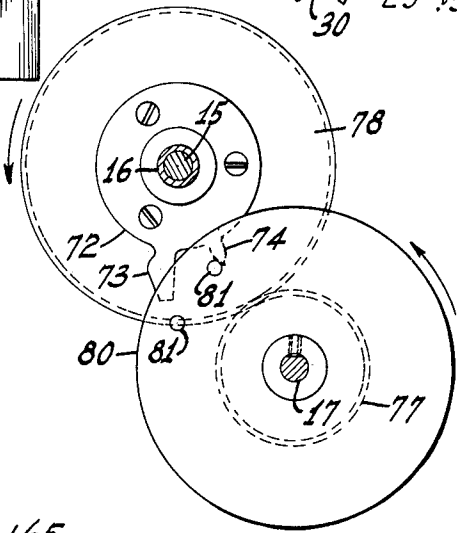


Fig-5

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4 Sheets-Sheet 3

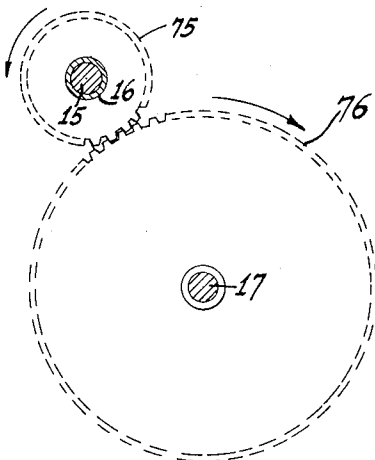


Fig-6

70	59	48	36	22	
0	0	0	0	00	360°
1	1	1	1	05	
2	2	2	2	10	
3	3	3	3	15	
4	4	4	4	20	
5	5	5	5	25	
6	6	6	6	30	
7	7	7	7	35	
8	8	8	8	40	
9	9	9	9	45	
				50	
				55	

Fig-7

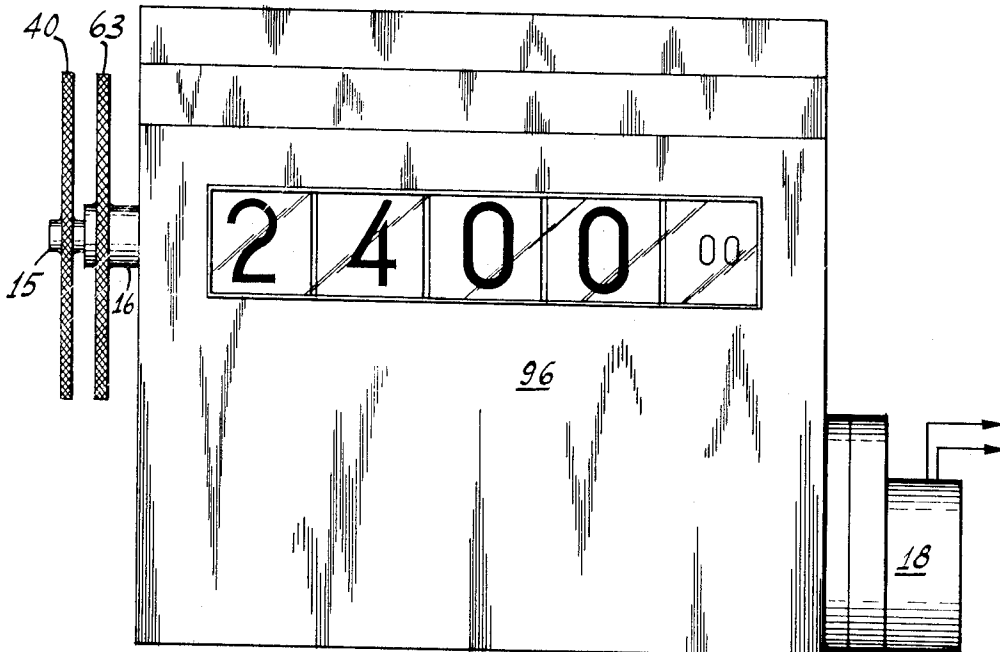


Fig-9

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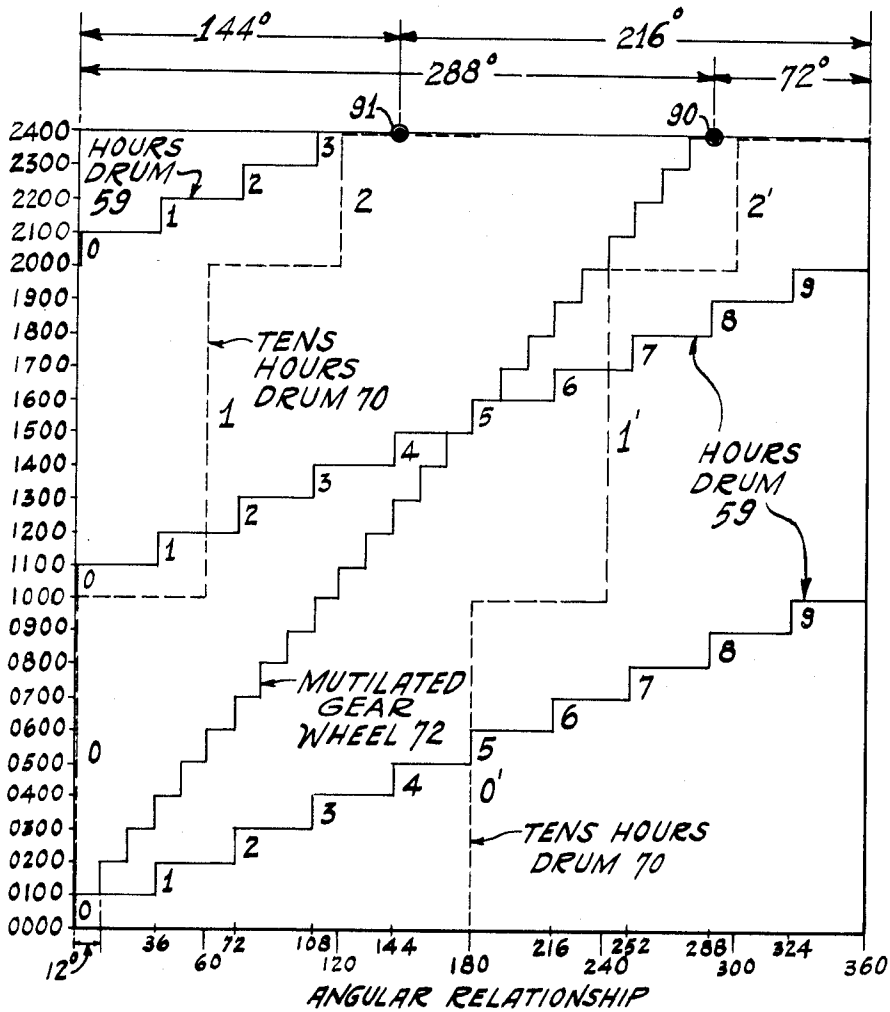
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4 Sheets-Sheet 4

Fig-8



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24-HOUR DIRECT-READING CLOCK

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Application January 12, 1953, Serial No. 330,704

4 Claims. (Cl. 58—125)

This invention relates to direct-reading clocks or the like, and more particularly to direct-reading clocks which indicate time on a 24-hour basis.

Drum-type direct-reading clocks operating on a 12-hour cycle are well known in the art. Such clocks normally have an hours drum with the numbers 0 through 12 thereon, a tens of minutes drum with the numbers 0 through 5 thereon, a minutes drum with the numbers 0 through 9 thereon, and a seconds drum with indicia for numbers 00 through 59 thereon. The seconds drum is driven, through appropriate gearing, by a synchronous motor; and the minutes, tens of minutes and hours drums are coupled back to the seconds drum through Geneva-movement mechanisms so that they move intermittently in proper time-indicating fashion.

Ten, or even twelve numbers of adequate size for easy reading can be put around a drum without the drum and clock case becoming excessively large and bulky. A 24-hour clock with the numbers 0 through 24 arranged on a single drum would be so large and cumbersome as to be impractical for most applications.

As an alternative to having a single hours drum with numbers 0 through 24 thereon, separate hours and tens of hours drums may be considered. The problem immediately encountered arises from the fact that the hours drum must contain ten numbers but a 24-hour cycle is not evenly divisible by ten. Therefore, the hours drum must successively indicate the discontinuous series of numbers 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, 1, 2, 3, 4 and then 0 during one 24-hour cycle.

A very satisfactory 24-hour direct-reading clock is described and claimed in a copending application Serial No. 292,072 filed on June 6, 1952 by Eric J. Uhlig and John R. Lewis, now U. S. Patent No. 2,645,896, issued on July 21, 1953, and assigned to the assignee of this application. According to the present invention, improvements have been made in 24-hour direct-reading clocks which further simplify the construction, further reduce the cost of manufacture and further improve the reliability. It is therefore the general object of this invention to provide an improved 24-hour direct reading clock which combines good legibility with compactness in physical size.

It is another object to provide a 24-hour clock employing a mechanism requiring a minimum number of parts.

It is a further object to provide a clock which is reliable, simple in construction and relatively inexpensive to manufacture.

It is a further object to provide a clock wherein the four visible numbers indicating hours and minutes are of equal size and are equally spaced so as to maximize readability.

It is a further object to provide a clock wherein the hours and minutes drums may be reset independently without any possibility of the drums getting out of proper time-indicating synchronism.

Other objects and novel features of the construction and arrangement of parts comprising this improved clock will be apparent as the description of the invention progresses.

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According to the present invention, separate number drums are used for the tens of hours, hours, tens of minutes, minutes and seconds. The seconds drum is rotated at a constant speed of one revolution per minute by a clock motor. Geneva-movement mechanisms are interposed between the five drums so that all drums except the driven seconds drum are rotated with intermittent motions in time-indicating fashion.

The hours drum, having numbers 0 through 9 thereon, is advanced one number (thirty-six degrees) every hour by a Geneva mechanism driven from the tens of minutes drum. The tens of hours drum has numbers 0, 1, 2, 0, 1 and 2 evenly distributed over 360 degrees of its peripheral surface. A Geneva mechanism driven from the hours drum advances the tens of hours drum one number (sixty degrees) once in every complete revolution (ten hours) of the hours drum. The numbers 0, 1 and 2 on the tens of hours drum are repeated, and the drum makes half a revolution in twenty-four hours. During the first ten hours, the 0 on the tens of hours drum is visible while the numbers 0 through 9 on the hours drum are successively visible. During the second ten hours, the 1 on the tens of hours drum is visible while the numbers 0 through 9 on the hours drum are successively visible. During the following four hours, the 2 on the tens of hours drum is visible while the numbers 0, 1, 2 and 3 on the hours drum are successively visible. At the end of this four-hour period, the hours drum is advanced to make the number 4 visible and the clock then reads time 2400. At this instant, the hours drum must be advanced 216 degrees through positions with numbers 4, 5, 6, 7, 8 and 9 visible to the position showing number 0. At the same time, the tens of hours drum must be advanced sixty degrees from the position with the number 2 visible to the following position with the number 0 visible. The clock will then read time 0000, and shortly thereafter, time 0001. This recycling action is performed as follows: A mutilated gear wheel is driven through a gear train from the hours drum at one-third the angular displacement of the hours drum. Every third time the hours drum reaches the position with the number 4 visible, the mutilated gear wheel reaches a position where it can be acted upon by a mutilated gear driver driven by an auxiliary shaft at one revolution per minute. The driver causes the mutilated gear wheel to advance seventy-two degrees, and due to the 3-to-1 gearing this causes the hours drum to advance 216 degrees from the position with the number 4 visible to the position with the number 0 visible. The motion of the hours drum, acting through the conventional Geneva mechanism, causes the tens of hours drum to move sixty degrees from the position indicating number 2 to the position indicating number 0.

A more detailed description of the invention will now be made with reference to the accompanying drawings wherein:

Fig. 1 is a representation of the overall mechanism of one embodiment of the invention, the view being that seen from the line 1—1 of Fig. 2.

Fig. 2 is an end elevation.

Fig. 3 is a sectional view taken on the lines 3—3 of Fig. 1.

Fig. 4 is a sectional view taken on the lines 4—4 of Fig. 1.

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 1.

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 1.

Fig. 7 is a representation of the distribution of numbers around the various drums.

Fig. 8 is a graphical representation of the motions of parts of the mechanism which will be used in explaining the operation thereof.

Fig. 9 is a front elevation showing the appearance of a 24-hour direct-reading clock.

Referring now in greater detail to the drawings, wherein like parts in the several views are given the same numeral, a frame 14 has journaled therein a compound shaft consisting of a main shaft 15 and a concentric sleeve shaft 16, both shafts being freely rotatable relative to the frame and to each other. An auxiliary shaft 17 is also journaled in frame 14 in parallel spaced relationship with the compound shaft. A clock motor or synchronous gear motor 18 mounted on frame 14 has an output shaft 19 provided with a pinion 20 for driving a seconds assembly, the drive being through a reversing pinion 11, a gear wheel 12 and a ratchet 13.

The seconds assembly is freely rotatable as a unit on main shaft 15 and it comprises a gear wheel 21 driven by ratchet 13, a seconds drum 22 with indicia thereon as represented in Fig. 7, and a Geneva driver 23 having a drive pin 24 and a locking disc 25. Motor 18 drives the seconds assembly at the constant speed of one revolution per minute. Gear wheel 21 drives gear 26 which is fixed on auxiliary shaft 17 so that shaft 17 also rotates at one revolution per minute for purposes which will become apparent as the description proceeds.

The Geneva driver 23 drives a Geneva star wheel 29 which is freely rotatable on shaft 17 and which has six drive slots 30 and six lock surfaces 31, the construction being shown to advantage in Fig. 3. Geneva star wheel 29 is coupled to gear wheel 32 through a spring-loaded ratchet 33, the teeth of the ratchet being arranged so that star wheel 29 drives gear wheel 32, but the latter can be overdriven. Both are freely rotatable on shaft 17. Once in every complete rotation of the seconds assembly, pin 24 drives star wheel 29 and gear wheel 32 sixty degrees. This motion is imparted to gear wheel 35 to cause a thirty-six degree rotation of the latter, the reduction being due to the gear ratio. It will be understood that Geneva mechanisms are old in the art and that the present invention is not on Geneva mechanisms per se. Therefore, it will not be necessary herein to describe the Geneva mechanism in great detail.

Gear wheel 32 intermittently drives a minutes assembly including gear wheel 35, minutes drum 36 with indicia thereon as shown in Fig. 7, and a Geneva driver 37 including drive pin 38. The minutes assembly is fixed on shaft 15 as is the minutes set wheel 40. When set wheel 40 is used to set the minutes drum 36 to the proper time the motion is not transmitted back to the seconds assembly by reason of the overriding action of ratchet 33.

Once during every revolution of minutes drum 36 and Geneva driver 37, drive pin 38 causes a thirty-six degree rotation of Geneva star wheel 42. Star wheel 42, as shown to advantage in Fig. 4, consists of a driven wheel 43 with ten notches and a lock wheel 44 having ten lock surfaces. The two-part construction with each part operative in a separate plane is employed because of the relatively large number of teeth needed. Star wheel 42 is directly coupled by shank 45 to gear 46; all as a unit are freely rotatable on shaft 17. Each thirty-six degree rotation of gear wheel 46 causes a sixty degree rotation of gear wheel 47 by reason of the gear ratio.

Gear wheel 46 causes rotation of a tens of minutes assembly which, as a unit, is freely rotatable on main shaft 15 and which consists of a gear wheel 47, a tens of minutes drum 48 with indicia thereon as represented in Fig. 7, and a Geneva driver 49, with drive pin 50. Driver 49 drives a Geneva star wheel 53, which is the same as star wheel 29. Star wheel 53 is coupled to gear wheel 55 through spring-loaded ratchet 56. Once during each rotation of the tens of minutes drum 48 and driver 49, star wheel 53 and gear wheel 55 are made to rotate sixty degrees, which in turn causes a thirty-six degree rotation of gear wheel 58.

An hours assembly is fixed on sleeve shaft 16 and it consists of gear wheel 58, hours drum 59 having indicia thereon as represented in Fig. 7, and a Geneva driver 60 having a driver pin 61. An hours set wheel 63 is also fixed on sleeve shaft 16 for setting the hours drum to the correct time. During the setting procedure, ratchet 56 is overridden so that the motion is not transmitted back to the tens of minutes drum 48.

A compound Geneva star wheel 64 is directly connected to gear wheel 65 by a shank 66 and the unit is freely rotatable on auxiliary shaft 17. The star wheel 64 consists of a slotted driven disk 67 and a lock disk 68 which are the same as the disks 43 and 44 of star wheel 42. Once during every revolution of hours drum 59 and Geneva driver 60, drive pin 61 causes a thirty-six degree rotation of Geneva star wheel 64 and gear wheel 65, which in turn causes a sixty degree rotation of gear wheel 71 and tens of hours drum 70. Gear wheel 71 and tens of hours drum 70 comprise a tens of hours assembly which is freely rotatable as a unit on sleeve shaft 16. The tens of hours drum 70 has the numbers 0, 1, 2, 0, 1, and 2 thereon as illustrated in Fig. 7.

A mutilated gear wheel 72, having teeth 73 and 74 as shown to advantage in Fig. 5, is driven at one-third the angular displacement of the hours drum 59 by means of a one-to-three speed ratio gear train including gear wheel 75 fixed on sleeve shaft 16 (hours drum 59 is also fixed on sleeve shaft 16), gear wheels 76 and 77 freely rotatable as a unit on auxiliary shaft 17 and a gear wheel 78 which together with mutilated star wheel 72 are freely rotatable as a unit on sleeve shaft 16. A mutilated gear driver 80 fixed on auxiliary shaft 17 is rotated by shaft 17 at a constant speed of one revolution per minutes. Two drive pins 81 on driver 80 engage the teeth 73 and 74 of mutilated gear wheel 72 at time 2400 and rotate the gear wheel 72 seventy-two degrees. This motion acting through the gear train causes a 216-degree rotation of the hours drum so that it moves from the position indicating number 4 to the position indicating number 0.

Fig. 7 illustrates the number indicia arranged around 360 degrees of the peripheral surfaces of the various drums. It will be noted that the seconds drum 22 has numbers for sixty seconds counting by fives, the minutes drum 36 has numbers 0 through 9, the tens of minutes drum 48 has numbers 0 through 5, the hours drum 59 has numbers 0 through 9, and the tens of hours drum 70 has numbers 0, 1, 2, 0, 1, and 2. The seconds drum 22 preferably has the numbers on a color coded background with 00 in the center of a red background, 15 in the center of a white background, 30 in the center of a blue background and 45 in the center of a yellow background. The numbers on all the drums are evenly distributed thereabout. In Fig. 7 the numbers are arranged to move upwardly past a window, whereas in the other figures of the drawings the number drums move downwardly past the window. Either arrangement of the numbers may be used.

Fig. 9 illustrates the appearance of the clock when provided with a mask 96 having windows through which the numbers on the disks are visible.

The operation of the 24-hour direct-reading clock will now be described and the chart of Fig. 8 will be used to explain the operation of the transfer means associated with the hours drum 59 and the tens of hours drum 70. Motor 18 drives the seconds drum 22 through pinion 20, reversing pinion 11 and gear wheel 12 at the constant speed of one revolution per minute. Once during every revolution of seconds drum 22, minutes drum 36 is advanced thirty-six degrees or one-tenth of a revolution, the motion being transmitted from Geneva driver 23 through Geneva star wheel 29, ratchet coupling 33 and gear wheels 32, 35. Once during every revolution of minutes drum 36 the tens of minutes drum 48 is advanced sixty degrees on one-sixth of a revolution, the motion being transmitted from Geneva driver 37 through Geneva star

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wheel 42, shank 45 and gears 46, 47. Once during each revolution of the tens of minutes drum 48, the hours drum 59 is advanced thirty-six degrees or one-tenth of a revolution, the motion being transmitted from Geneva driver 49 through Geneva star wheel 53, ratchet coupling 56 and gears 55, 58. Once during each revolution of hours drum 59, the tens of hours drum 70 is rotated sixty degrees or one-sixth of a revolution, the motion being transmitted from Geneva driver 60 through Geneva star wheel 64 and gears 65, 71. Drums 36, 48, 59 and 70 are normally stationary and are advanced quickly by the Geneva mechanisms from a position where one number on the drum is visible to a position where the next higher number is visible. Drums 36, 48, 59 and 70 are thus advanced in time-indicating fashion from time 0001 to time 2400.

The motion of the tens of hours drum 70 is represented in Fig. 8 by a dotted line, the vertical portions of which indicate the ten-hour periods of time during which the drum is stationary and the horizontal portions of which indicate the sixty-degree rotational shifts made by the drum at times 1000, 2000 and 2400. The repeated numbers 0, 1 and 2 in Fig. 8 are distinguished by prime designations. The horizontal axis of the chart indicates angular relationship relative to a fixed point on frame 14.

The motion of the hours drum 59 and gear wheel 75 is represented in Fig. 8 by a labeled solid line having vertical portions indicating the hour-long periods of time during which the drum is stationary and having horizontal portions indicating the thirty-six degree rotational shifts made by the drum once per hour. Mutilated gear wheel 72 is driven from hours drum 59 through the gear train including gear wheels 75, 76, 77 and 78. Due to the one-to-three ratio of the gear train, mutilated gear wheel 72 is advanced twelve degrees every hour when the hours drum 59 moves thirty-six degrees. Mutilated gear wheel 72 rotates 288 degrees in twenty-four hours while hours drum 59 moves 864 degrees ($360 \times 360 \div 144$). At time 2400, mutilated gear wheel reaches a point 90 in Fig. 8 where the teeth 73 and 74 are in the path of drive pins 81 on mutilated gear driver 80 which continuously rotates at one revolution per minute. Driver 80 then drives mutilated gear wheel 72 seventy-two degrees. Since the driver 80 is coupled to the hours drum 59 through gears 78, 77, 76 and 75 and sleeve shaft 16, the hours drum is rotated three times seventy-two degrees or 216 degrees from the position 91 with number 4 visible to the position with number 0 visible. When the hours drum 59 moves from the position with number 9 visible to the position with number 0 visible, the Geneva mechanism including driver 60 and star wheel 64 causes the tens of hours drum to rotate sixty degrees from the position with number 2 visible to the position with the following number 0 visible. The transition is thus made from an indication of time 2400 to time 0000 in the fraction of a minute it takes driver 80 to move mutilated gear wheel 72 through seventy-two degrees.

In setting the clock to the correct time, the minutes drum 36 fixed on main shaft 15 is rotated by knurled wheel 40 which is also fixed on main shaft 15. The rotation of minutes drum 36 also results in the advancement of the tens of minutes drum 48 through the action of the Geneva mechanism 37, 42 between the drums. No more than six revolutions of the minutes drum are needed to set drums 36 and 48 to any indication between 00 and 59 minutes. The rotation of minutes drum 36 does not react back to the second drum 22 because ratchet 33 between the drums is overridden. An accurate setting of the seconds drum 22 is made by switching the electricity to motor 18.

Hours drum 59 fixed on sleeve shaft 16 is set by rotating knurled set wheel 63 which is also fixed on sleeve shaft 16. The rotation of hours drum 59 also results in the advancement of the tens of hours drum 70

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through the action of Geneva mechanism 60, 64 between the drums. No more than three revolutions of hours drum 59 are needed to set the two drums to any reading between 00 and 24 hours. The rotation of hours drum 59 is not transmitted back to tens of minutes drum 48 by reason of ratchet 56 being overridden.

Ratchet 33 has ten teeth and minutes drum 36 has ten number positions. Therefore, the resetting procedure cannot disturb the necessary synchronous relationship between drums 22 and 36. Similarly, ratchet 56 has ten teeth and hours drum 59 has ten number positions so as to maintain synchronism between drums 48 and 59.

It will be noted that the Geneva mechanisms associated with the seconds drum 22 and the tens of minutes drum 48 are identical and that the Geneva mechanisms associated with the minutes drum 36 and the hours drum 59 are identical. Gear wheels 35, 46, 58 and 65 are identical, and gear wheels 32, 47, 55 and 71 are identical. This use of identical parts at various places in the clock mechanism reduces the number of different parts needed and minimizes the cost of manufacture.

It is apparent that the mechanism shown and described is made up of co-operating elements which are characterized in having a high degree of mechanical reliability. The operation of the clock depends on Geneva movements and gear trains which are substantially trouble-free.

What is claimed is:

1. A 24-hour direct-reading clock or the like comprising individual indicating drums for tens of hours, hours, tens of minutes, minutes and seconds, a driving motor geared to the seconds drum, Geneva mechanisms coupling the drums so that they rotate in time-indicating fashion, a mutilated gear wheel, a gear train operative to drive said mutilated gear wheel from the hours drum at one-third the speed thereof, and a mutilated gear driver driven at a constant rate from said motor, said driver being positioned to engage said mutilated gear wheel at a predetermined one of its positions and rotate it substantially 72 degrees, whereby said hours drum is driven by said mutilated gear wheel thru said gear train.

2. A 24-hour direct-reading clock comprising individual indicating drums for tens of hours, hours, tens of minutes, minutes and seconds, a driving motor geared to the seconds drum, Geneva mechanisms coupling the drums so that they rotate in time-indicating fashion, a mutilated gear wheel, gear coupling between said hours drum and said mutilated gear wheel so that the latter moves one-third the distance of the former, and a mutilated driver driven from said motor, said driver being positioned to engage said mutilated gear wheel at a predetermined one of its positions and rotate it substantially 72 degrees to cause a substantially 216-degree rotation of said hours drum.

3. A 24-hour direct reading clock comprising individual indicating drums for tens of hours, hours, tens of minutes, minutes and seconds, a driving motor geared to the seconds drum, Geneva mechanisms coupling the drums so that they rotate in time-indicating fashion, a mutilated gear wheel, gear coupling between said hours drum and said mutilated gear wheel so that the latter moves one-third the distance of the former, and a mutilated gear driver driven from said motor, said driver being positioned to engage said mutilated gear wheel every third time the number 4 is visible on the hours drum and quickly rotate the mutilated gear wheel and the hours drum through positions with the numbers 4 through 9 visible on the hours drum.

4. A 24-hour direct-reading clock comprising individual indicating drums for tens of hours, hours, tens of minutes, minutes and seconds, a driving motor geared to the seconds drum, Geneva mechanisms coupling the drums so that they rotate in time-indicating fashion, a mutilated gear wheel, a three-to-one gear coupling from the hours drum to said mutilated gear wheel, and a mutilated gear

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driver driven from said motor and operative through said mutilated gear wheel and gear coupling to quickly advance said hours drum through the positions with the numbers 4 through 9 visible every third time the number 4 on the hours drum is visible.

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