Jan. 12, 1943. W. W. LUNDEN 2,308,244

ELECTRIC-IMPULSE TIME-INSTRUMENT SYSTEM

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Fig. 1.

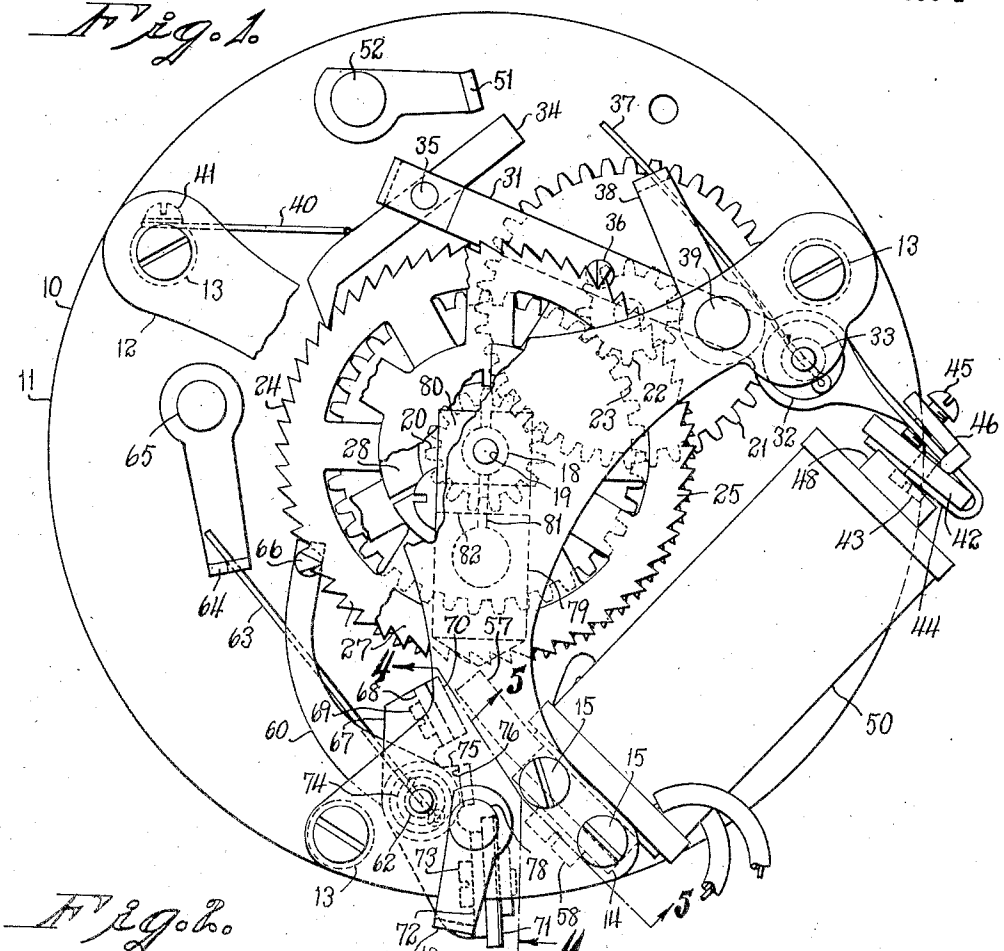
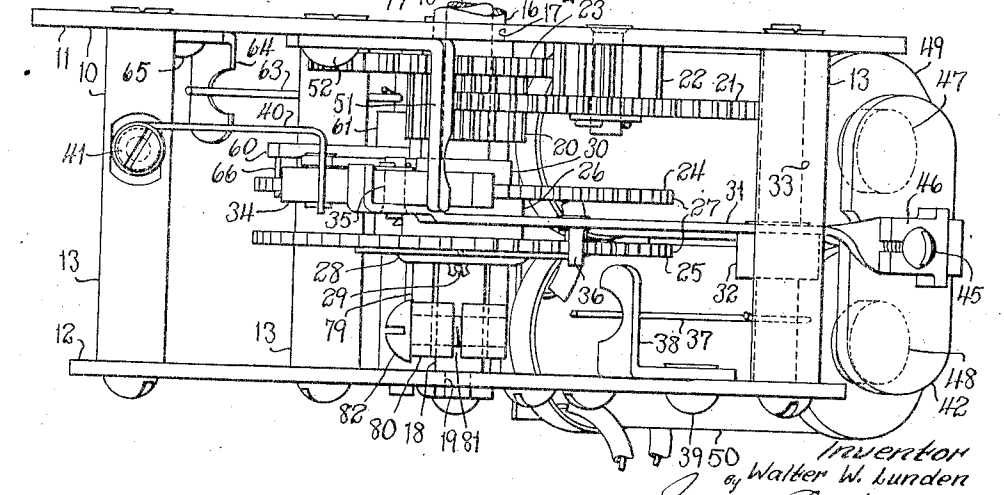


Fig. 2.



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Fig. 6.

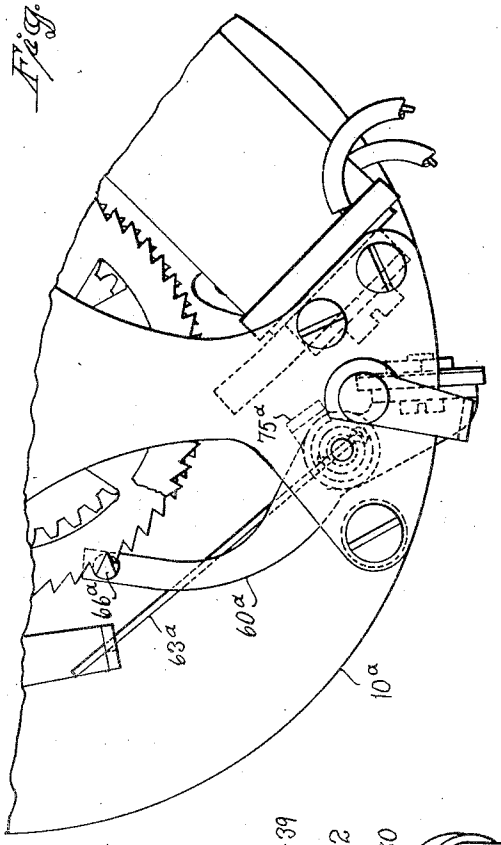


Fig. 4.

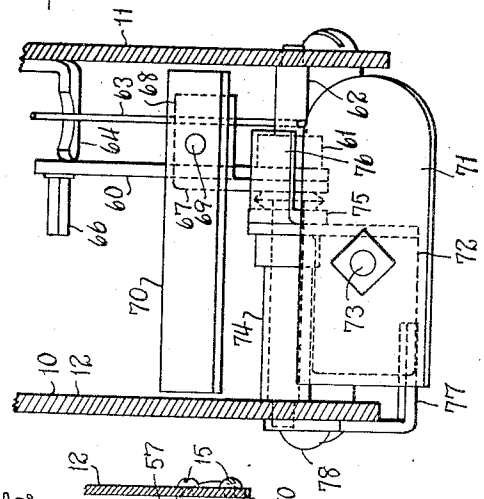


Fig. 5.

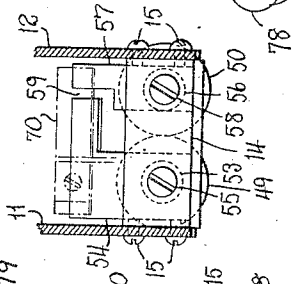
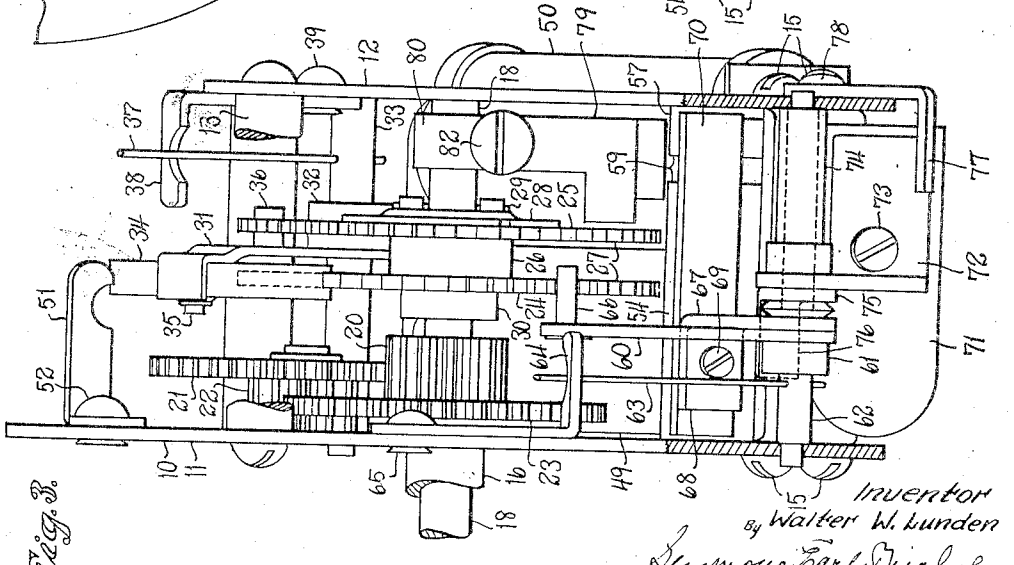


Fig. 3.



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Fig. 8.

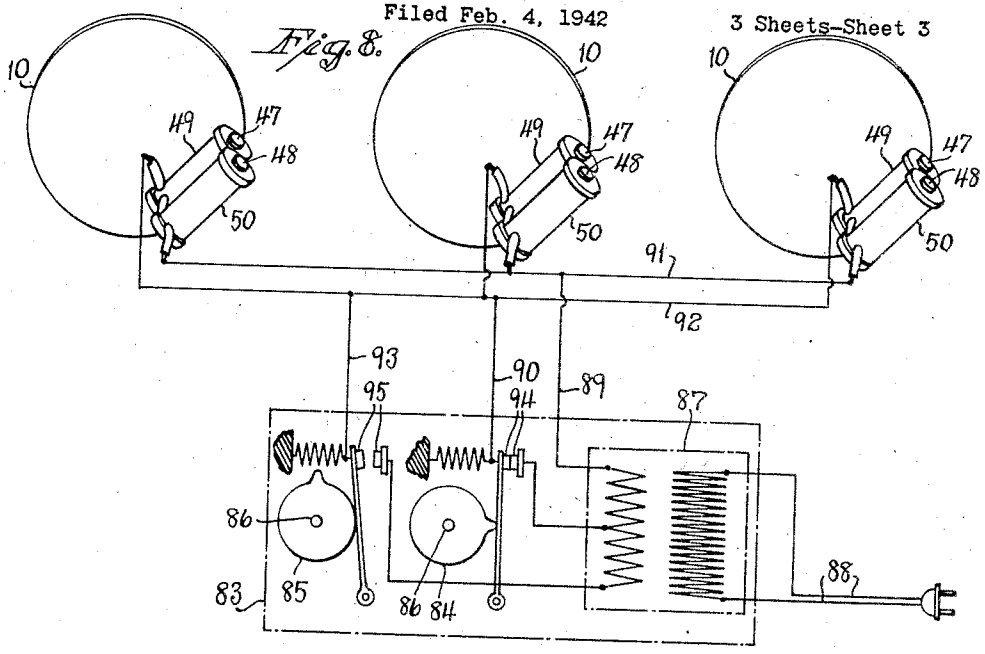
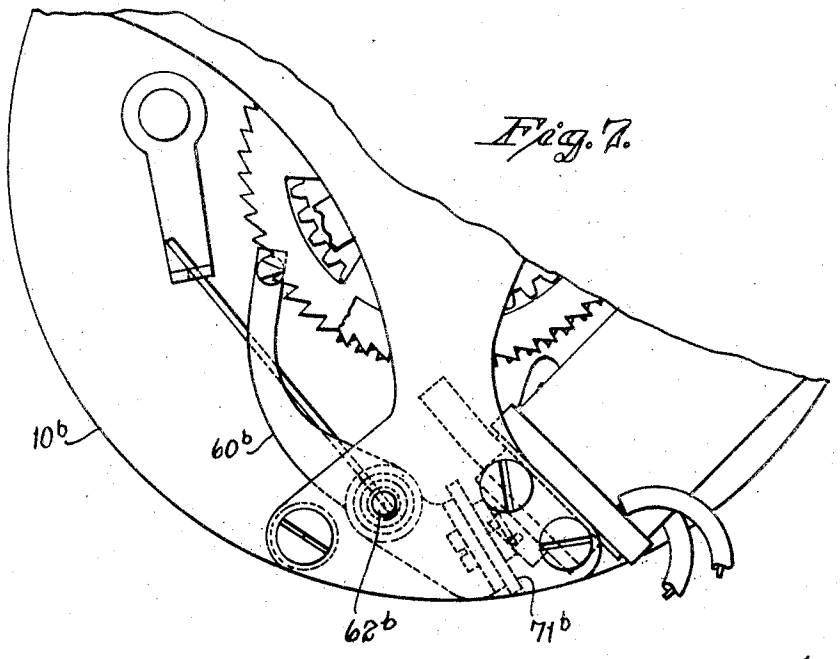


Fig. 7.



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Patented Jan. 12, 1943 2,308,244

UNITED STATES PATENT OFFICE

2,308,244

ELECTRIC-IMPULSE TIME-INSTRUMENT SYSTEM

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Application February 4, 1942, Serial No. 429,450

8 Claims. (Cl. 58—24)

This invention relates to improvements in electric-impulse time-instrument systems in which one or more impulse or secondary time-instruments are controlled by a master time-instrument.

One object of this invention is to provide an improved electric impulse time-instrument system in which one or more secondary time-instruments are controlled in all their time-indicating and resetting phases from a master time-instrument, with only two conductors interconnecting the secondary and master time-instruments and without requiring the use of switch contacts in the secondary time-instruments.

Another object of this invention is to provide an improved electric-impulse time-instrument system in which one or more secondary time-instruments are actuated by a master time-instrument formed of simple elements readily manufactured and readily assembled to produce an efficient durable construction at minimum cost.

With the above and other objects in view, as will appear to those skilled in the art from the present disclosure, this invention includes all features of the said disclosure which are novel over the prior art.

In the accompanying drawings forming a part of the present disclosure, in which certain ways of carrying out the invention are shown for illustrative purposes:

Fig. 1 is a front elevation of an impulse or secondary time-instrument or clock movement made in accordance with this invention;

Fig. 2 is a top plan view of Fig. 1;

Fig. 3 is a left-hand elevation of Fig. 1;

Fig. 4 is a fragmental sectional view on line 4—4 of Fig. 1;

Fig. 5 is a fragmental sectional view, on a smaller scale, on line 5—5 of Fig. 1, with the brake-applying armature indicated in broken lines;

Fig. 6 is a fragmental front elevation of a modified construction;

Fig. 7 is a fragmental front elevation of another modified construction; and

Fig. 8 is a schematic view illustrating three secondary clocks controlled by a master clock in accordance with the present invention.

In the description and claims, the various parts and steps are identified by specific names for convenience, but they are intended to be as generic in their application as the prior art will permit.

Referring to the particular form of the invention illustrated in Figs. 1 to 5 and 8, the secondary-clock movement 10 has front and rear movement-plates 11 and 12 secured together in spaced relation by three usual pillars 13 and a U-shaped spacer-bar 14 secured to the movement-plates by means of screws 15.

An hour-sleeve 16 is journaled for rotation in a bearing or hole 17 in the front movement-plate 11. A minute-arbor or shaft 18 is journaled at the front end in the hour-sleeve 16 and in a bearing or hole 19 in the rear movement-plate 12. The minute-arbor 18 which carries the minute-hand (not shown), has driving relation with the hour-sleeve 16 which carries an hour-hand (not shown) by means of any suitable reduction gearing which causes the hour-sleeve to rotate at one-twelfth the speed of the minute-arbor. Such reduction gearing may consist of a usual group of gears such as 20, 21, 22 and 23.

A drive-ratchet-wheel 24 and a holding- or locking-ratchet-wheel 25 are secured to or integrally formed with a bushing 26 to form a ratchet-wheel unit 27 which is rotatably mounted on the minute-arbor 18. A sheet-metal disk-spring 28 is held pressed against the adjacent face of the holding-ratchet-wheel 25 by means of a pin 29 which extends transversely through the minute-arbor 18 to frictionally press the ratchet-wheel unit 27 against a collar 30 secured to or integrally formed on the minute-arbor 18. Thus, the ratchet-wheel unit 27, owing to being held frictionally between the spring 28 and collar 30, normally rotates with the minute-arbor 18, but can be shifted or adjusted rotationally relatively to the arbor 18 for adjustment purposes.

A driving-lever 31 is secured to a bushing 32 which is secured to a shaft 33 which is pivotally mounted in the movement-plates 11 and 12. One end of the lever 31 has a driving-pawl 34 pivoted at 35 and normally engaged with the teeth of the drive-ratchet-wheel 24, and a holding- or locking-pawl 36 rigidly secured to the lever 31. The lever 31 is normally urged in a counterclockwise or driving direction as viewed in Fig. 1, by a spring 37 which has one end extending through a hole in the shaft 33 and has its other end engaged beneath an arm 38 which is riveted at 39 to the rear movement-plate 12, to thus resiliently urge the pawl 34 in driving direction. The rivet connection 39 provides suitable friction to permit of the arm 38 being pushed to any desired adjustable position about the rivet to adjust the tension on the spring 37. The pawl 34 is resiliently urged into engagement with the teeth of the ratchet-wheel 24 by means of a spring 40

secured to a pillar 13 by a screw 41. The pawl 34 is withdrawn in the opposite direction from driving, that is, in the retracted direction, by means of an armature 42 of magnetic material which is secured to the opposite end of the lever 31 by a screw 43 which passes through the bent-over end 44 of the lever 31 and threads into the armature 42. A screw 45 is threaded through a split lock-nut 46 and through the lever 31 to adjust the pressure of the screw 45 on the armature 42, and thus adjust the amount of distortion given to the end 44 of the lever 31, and in consequence to adjust the armature 42 toward or from the upper magnetic poles 47 and 48 of a pair of electromagnets 49 and 50. By unscrewing the screw 45, the spring action of the bent-over end 44 of the lever 31 adjusts the armature 42 away from the magnetic poles 47 and 48. When the lever 31 moves the pawl 34 in the upward or retracted direction, the upper end of the pawl 34 engages the limit-arm 51 which is frictionally adjustable about its rivet connection 52 to the movement-plate 11. Thus, the engagement of the pawl 34 with the limit-arm 51 positively swings the pawl-end of the pawl 34 out of engagement with the teeth of the ratchet-wheel 24 near the end of the retracted movement of the pawl 34.

The electromagnet 49 has a lower magnetic pole 53 to which a supplemental magnetic pole-piece 54 is secured by a screw 55 of magnetic material which forms a pole-extension of the pole 53. The other electromagnet 50 of the pair of electromagnets 49, 50 has a lower magnetic pole 56 to which a supplemental magnetic pole-piece 57 is secured by a screw 58 of magnetic material which forms a pole-extension of the pole 56, there being a space or air-gap 59 between the supplemental pole-pieces 54 and 57.

A brake-lever 60 (Fig. 3) is secured to a bushing 61 which is secured on a shaft 62 pivotally mounted in the movement-plates 11 and 12. A spring 63 secured to the shaft 62 and having its other end engaged by a thrust-arm 64 frictionally adjustably secured to the movement-plate 11 by the rivet 65, permits of adjusting the spring 63 to urge the brake-lever 60 toward the ratchet-wheel 24 to cause the brake-pin 66 of the brake-lever 60 to engage the teeth of the ratchet-wheel 24 with just the desired amount of force. A supplemental arm 67 secured firmly to the bushing 61 and hence to the brake-lever 60 has its bent outer end 68 secured by a screw 69 to a brake-applying magnetic armature 70 closely adjacent the supplemental magnetic pole-pieces 54, 57.

A reset-armature 71 is secured to an arm 72 by means of a screw 73, which arm 72 is firmly secured to a sleeve 74 which is freely pivoted upon the pivot-shaft 62. Also firmly secured to the sleeve 74 is a brake-release arm 75 having an angular extension 76 adapted to engage the arm 67 to swing the brake-lever 60 and brake-pin 66 away from the ratchet-wheel 24. The reset-armature 71 is normally swung to a position such as appears in Fig. 1, and held therein by gravity, the exact position or distance of the reset-armature 71 from the pole-piece screws 55 and 58 is determined by the rotational position of the limit-arm 77 frictionally adjustably secured to the movement-plate 12 by the rivet 78.

A weight 79 of magnetic material has an arm-portion 80 provided with a split 81, the two parts of the arm-portion 80 being drawn together by a screw 82 to clamp the parts of the arm-portion firmly to the minute-arbor 18.

While a single secondary clock or clock movement 10 could be employed in accordance with the present invention, ordinarily a plurality of such secondary clocks 10 as illustrated in Fig. 8 of the drawings, are employed in connection with one master clock indicated in Fig. 8 by the broken line outline 83. The master clock 83 contains two cam-switch closers 84 and 85 mounted on one or more shafts 86 actuable by any suitable master-clock mechanism such, for example, as a pendulum clock. A suitable transformer indicated diagrammatically as enclosed in the broken line outline 87 is adapted to take ordinary 110-volt alternating current from the line-wires 88, the secondary of the transformer supplying suitable low-voltage current through the wires 89 and 90 to the two main wires 91 and 92 of the clock-system leading to the secondary clocks 10, and the wires 89 and 93 supplying suitable higher-voltage electric current to the main wires 91 and 92 leading to the secondary clocks. Ordinarily, the cam-switch closer 84 will be operated once per minute to close the switch 94 to supply low-voltage current to the wires 91 and 92 to deliver low-voltage impulses once per minute to the electric-impulse driving-means of the secondary clocks 10, and the switch-closer 85 will ordinarily be rotated once an hour to close the switch 95 to deliver a high-voltage impulse once an hour to reset the clock to accurate time.

The two wires 91 and 92 are permanently connected to all of the wire-coils of the electromagnets of the secondary clocks in any suitable formation such that at all times all low-voltage electric impulses through the switch 94 and all high-voltage impulses through the switch 95 will be delivered to all of the said wire-coils of all the electromagnets without any switches in the secondary clocks needing to be closed or opened. In the particular arrangement shown in Fig. 8, the coils of the electromagnets 49 and 50 are connected in series from the wire 91 to the wire 92. Instead of using a transformer, any other suitable source of current-supply, whether alternating or direct, could be employed.

When the switch-closer 84 of the master clock 83 closes the switch 94, low-voltage current passes through the wires 91 and 92 to the electromagnets 49 and 50 of each of the secondary clocks 10. The low-voltage current passed by the switch 94 is of such voltage as to produce a sufficient current to cause the electromagnets 49 and 50 to pull down the armature 42, but the reset-armature will have been adjusted to such position resting against the limit-arm 77 that the reset-armature 71 will not be swung upward by such low-voltage current. Thus, the switch-closer 84 which closes the switch 94 once each minute causes the armature 42 to be pulled down once each minute to thus lift up the left end of the driving-lever 31 to thus drag the pawl 34 to the right (Fig. 1) and permit it to engage in the next tooth-notch of the drive-ratchet-wheel 24 ready for the next downward movement. Immediately upon the switch-closer 84 coming to a position to permit the switch 94 to spring open, the current to the electromagnets 49 and 50 is broken with the consequence that the spring 37 causes the left end of the driving-lever 31 to swing downward, thus pushing the pawl 34 to the left and advancing the ratchet-wheel unit 27 counterclockwise (Fig. 1), and consequently rotating the minute-arbor 18 a distance of one minute of time. The parts 31, 34, 37, 42, 49 and 50 may be referred to as step-by-step impelling

means. At the same time that the left end of the lever 31 moves the pawl 34 down, it also moves the holding-pawl 36 into a notch of the holding-ratchet-wheel 25 to thus lock the ratchet-wheel unit 27 against further counter-clockwise movement (Fig. 1). As each minute-indication distance of movement is made by the ratchet-wheel unit 27 and minute-arbor 18, the resetting-weight 79 secured to the minute-arbor 18, is also rotated.

Once each hour, or any period that it is desired to reset the clocks to insure that they are all reset to proper time to make up for any defects or causes which may have resulted in one or more of them indicating incorrect time, the switch-closer 85 is caused by the master clock to close the switch 95, which sends high-voltage electric current through the wires 91 and 92 to both of the electromagnets 49 and 50. This high-voltage current actuates the armature 42 and its connected parts just the same as the low-voltage current somewhat more vigorously, but results in no different actuation thereof. But the high-voltage current now for the first time actuates the reset-armature 71 to pull the latter up toward the pole-piece screws 55 and 58, thus causing the angular arm-portion 76 of the brake-release arm 75 to engage the arm 67 and cause the brake-lever 60 and its brake-pin 66 to be swung out of braking engagement with the ratchet-wheel 24, thus permitting the resetting-weight 79 to rotate the minute-arbor 18 and its connected parts to reset position as it moves downward to its dotted-line position shown in Fig. 1 where it is pulled and held to accurate position by the pole-pieces 54 and 57, to thus insure the accurate resetting of the clock. When the switch-closer 85 rotates to a position to permit the switch 95 to open, the high-voltage current to the electromagnets is broken, in consequence of which the armature 71 is permitted to fall to its lower open position, thus permitting the brake-lever 60 and brake-pin 66 to be returned to their braking position by the spring 63, whereupon the step-by-step drive-mechanism and associated parts will be enabled to again properly actuate the minute-arbor 18 and its associated parts.

Each time an electric impulse passes through the electromagnets 49 and 50, regardless of whether they are high voltage or low voltage, the pole-pieces 54 and 57 exercise a magnetic pull upon the brake-applying or brake-increasing armature 70 to thus apply or increase the pressure of the brake-pin 66 against the ratchet-wheel 24. Thus, due to the action of this brake-applying armature 70, it is possible to have the spring 63 a very light spring and to have it very lightly adjusted so that the brake-pin 66 would not be capable of functioning properly by the action of the spring 63 alone, but owing to the supplemental magnetic action upon the brake-applying armature 70 which occurs each time when the pawls 34 and 36 have been lifted out of engagement with the ratchet-wheel unit 27, it will be seen that an increase of pressure of the brake-pin 66 is given at each minute impulse, thus providing a repeatedly varied degree of braking action nicely fitted to the requirements of the situation and thus causing a minimum of wear of the parts.

In this application, a simple form of two types of impulses has been described, namely, low-voltage and high-voltage impulses, although it will be appreciated that a more apt explanation of the different functions of the different voltage currents is in reality a question of there being different flux strength of the electromagnets for the two types of operations, namely, the driving movement and the resetting movement. In other words, in the particular form of the invention illustrated, the low-voltage current gives low flux strength to the electromagnet while the high-voltage current gives high flux strength to an electromagnet. It will be appreciated that these results could be accomplished by a single voltage by employing a relatively-high rate of alternation of the current to secure low flux strength and a relatively-low rate of alternation of the current to secure a higher flux strength.

From the foregoing, it will be clear that only two wires, namely, the wires indicated at 91 and 92, are necessary for transmitting all impulses for all required actions, from the master clock 83 to the various secondary clocks 10, and that switches or equivalent mechanism are not needed in the secondary clocks, which, as will be seen, are of very simple construction. This is extremely important inasmuch as secondary clocks are usually quite numerous in number whereas only one master clock is utilized for a large number of secondary clocks. All ordinary switches have a tendency to have one or more of their points of contact foul, thus periodically resulting in one or more switches failing to properly work.

The preferred form of the invention illustrated in Figs. 1 to 5 can have its reset-armature so adjusted in position as to be operable by a current voltage only two volts higher than the current for accomplishing the step-by-step minute-indicating movement. Thus, in an actual device constructed, the step-by-step movement has been operated at twenty-four volts and the reset operation has been accomplished by only two volts more, namely, twenty-six volts. By virtue of the adjustable limit-arm 77 for adjusting the position of the reset-armature 71, it is possible to have a series of secondary clocks on a long system where the supply wires for the secondary clocks may be smaller than usual, in consequence of which there is a bigger potential drop along the line, since the various reset-armatures permit of giving different adjustments to the limit-arms of the reset-armatures of the various secondary clocks in the system, so that under this large voltage drop, the various secondary clocks of the system can be made to operate properly.

In the modified form of movement 10*a* illustrated in Fig. 6, the construction is very similar to the movement 10 heretofore described, except that there is no brake increasing or applying armature employed, thus requiring a somewhat stronger spring-action by the spring 63*a* for actuating the brake-lever 60*a* and brake-pin 66*a*. In this construction, the brake-release arm 75*a* is positioned to directly engage and actuate the brake-lever 60*a*.

In the modified form of clock movement 10*b*, illustrated in Fig. 7, the reset-armature 71*b* and brake-lever 60*b* are rigid with one another and with the pivot-shaft 62*b*.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. An electric-impulse time-instrument system including: a rotatable time-shaft having a predetermined reset position; electric-impulse driving-means including impelling-means adapted to drive said time-shaft by step-by-step movements; electric-impulse resetting-means including weight-means adapted to rotate said time-shaft to said reset position; master time-means having impulse-means adapted to selectively deliver two different types of electric impulses; electric connection-means for interconnecting said impulse-means with said driving-means and said resetting-means to deliver all of said different types of impulses to said driving-means and said resetting-means; said driving-means including brake-means for said time-shaft normally yieldingly urged to braking position; said impelling-means being actuable by both of said types of impulses; and said resetting-means being actuable only by one of said types of impulses, and when so actuated, acting to overcome said brake-means and free said time-shaft and said weight-means to permit said weight-means to rotate said time-shaft to reset position.

2. An electric-impulse time-instrument system including: a rotatable time-shaft having a predetermined reset position; electric-impulse driving-means including impelling-means adapted to drive said time-shaft by step-by-step movements; electric-impulse resetting-means including weight-means adapted to rotate said time-shaft to said reset position; master time-means having impulse-means adapted to selectively deliver two different types of electric impulses; electric connection-means for interconnecting said impulse-means with said driving-means and said resetting-means to deliver all of said different types of impulses to said driving-means and said resetting-means; said driving-means including brake-means for said time-shaft normally yieldingly urged to braking position; said impelling-means being actuable by both of said types of impulses; and said resetting-means including brake-release armature-means which has a substantial distance of movement before engaging said brake-means and then engages and overcomes said brake-means, and said resetting-means being actuable only by one of said types of impulses, and when so actuated, acting to overcome said brake-means and free said time-shaft and said weight-means to permit said weight-means to rotate said time-shaft to reset position.

3. An electric-impulse time-instrument system including: a rotatable time-shaft having a predetermined reset position; electric-impulse driving-means including impelling-means adapted to drive said time-shaft by step-by-step movements; electric-impulse resetting-means including weight-means adapted to rotate said time-shaft to said reset position; master time-means having impulse-means adapted to selectively deliver two different types of electric impulses; electric connection-means for interconnecting said impulse-means with said driving-means and said resetting-means to deliver all of said different types of impulses to said driving-means and said resetting-means; said driving means including brake-means for said time-shaft normally yieldingly urged to braking position, said brake-means having brake-applying armature-means actuated by electric impulses to said driving-means to increase braking action; said impelling-means being actuable by both of said types of impulses; and said resetting-means being actuable only by one of said types of impulses, and when so actuated, acting to overcome said brake-means and free said time-shaft and said weight-means to permit said weight-means to rotate said time-shaft to reset position.

4. An electric-impulse time-instrument system including: a rotatable time-shaft having a predetermined reset position; electric-impulse driving-means including impelling-means adapted to drive said time-shaft by step-by-step movements; electric-impulse resetting-means including weight-means adapted to rotate said time-shaft to said reset position; master time-means having impulse-means adapted to selectively deliver two different types of electric impulses; electric connection-means for interconnecting said impulse-means with said driving-means and said resetting-means to deliver all of said different types of impulses to said driving-means and said resetting-means; said driving-means including brake-means for said time-shaft normally yieldingly urged to braking position, said brake-means having brake-applying armature-means actuated by electric impulses to said driving-means to increase braking action; said impelling-means being actuable by both of said types of impulses; and said resetting-means including brake-release armature-means which has a substantial distance of movement before engaging said brake-means and then engages and overcomes said brake-means, and said resetting-means being actuable only by one of said types of impulses, and when so actuated, acting to overcome said brake-means and free said time-shaft and said weight-means to permit said weight-means to rotate said time-shaft to reset position.

5. An electric-impulse time-instrument system including: a rotatable time-shaft having a predetermined reset position; electric-impulse driving-means including impelling-means adapted to drive said time-shaft by step-by-step movements; electric-impulse resetting-means adapted to rotate said time-shaft to said reset position; master time-means having impulse-means adapted to selectively deliver two different types of electric impulses; electric connection-means for interconnecting said impulse-means with said driving-means and said resetting-means to deliver all of said different types of impulses to said driving-means and said resetting-means; said driving-means including brake-means for said time-shaft normally yieldingly urged to braking position, said brake-means having brake-applying armature-means actuated by electric impulses to said driving-means to increase braking action; said impelling-means being actuable by both of said types of impulses; and said resetting-means being actuable only by one of said types of impulses, and when so actuated, acting to overcome said brake-means and free said time-shaft to permit said electric-impulse resetting-means to rotate said time-shaft to reset position.

6. An electric-impulse time-instrument system including: a rotatable time-shaft having a predetermined reset position; electric-impulse driving-means including impelling-means adapted to drive said time-shaft by step-by-step movements; electric-impulse resetting-means adapted to rotate said time-shaft to said reset position; master time-means having impulse-means adapted to selectively deliver two different types of electric impulses; electric connection-means for interconnecting said impulse-means with said driving-means and said resetting-means to deliver all of said different types of impulses to said driving-

means and said resetting-means; said driving-means including brake-means for said time-shaft normally yieldingly urged to braking position, said brake-means having brake-applying armature-means actuated by electric impulses to said driving-means to increase braking action; said impelling-means being actuable by both of said types of impulses; and said resetting-means including brake-release armature-means which has a substantial distance of movement before engaging said brake-means and then engages and overcomes said brake-means, and said resetting-means being actuable only by one of said types of impulses, and when so actuated, acting to overcome said brake-means and free said time-shaft to permit said electric-impulse resetting-means to rotate said time-shaft to reset position.

7. An electric-impulse time-instrument system including: a rotatable time-shaft having a predetermined reset position; electric-impulse driving-means including impelling-means adapted to drive said time-shaft by step-by-step movements; electric-impulse resetting-means adapted to rotate said time-shaft to said reset position; master time-means having impulse-means adapted to selectively deliver two different types of electric impulses; electric connection-means for interconnecting said impulse-means with said driving-means and said resetting-means to deliver all of said different types of impulses to said driving-means and said resetting-means; said driving-means including brake-means for said time-shaft, said brake-means having brake-applying armature-means actuated by electric impulses to said driving-means to apply braking action; said impelling-means being actuable by both of said types of impulses; and said resetting-means including brake-release armature-means which has an adjustable distance of movement before engaging said brake-means and then engages and overcomes said brake-means, and said resetting-means being actuable only by one of said types of impulses, and when so actuated, acting to overcome said brake-means and free said time-shaft to permit said electric-impulse resetting-means to rotate said time-shaft to reset position.

8. An electric-impulse time-instrument system including: a rotatable time-shaft having a predetermined reset position; electric-impulse driving-means including impelling-means adapted to drive said time-shaft by step-by-step movements; electric-impulse resetting-means including weight-means adapted to rotate said time-shaft to said reset position; master time-means having impulse-means adapted to selectively deliver two different types of electric impulses; electric connection-means for interconnecting said impulse-means with said driving-means and said resetting-means to deliver all of said different types of impulses to said driving-means and said resetting-means; said driving-means including brake-means for said time-shaft normally yieldingly urged to braking position, said brake-means having brake-applying armature-means actuated by electric impulses to said driving-means to increase braking action; said impelling-means being actuable by both of said types of impulses; and said resetting-means including brake-release armature-means which has an adjustable distance of movement before engaging said brake-means and then engages and overcomes said brake-means, and said resetting-means being actuable only by one of said types of impulses, and when so actuated, acting to overcome said brake-means and free said time-shaft and said weight-means to permit said weight-means to rotate said time-shaft to reset position.

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