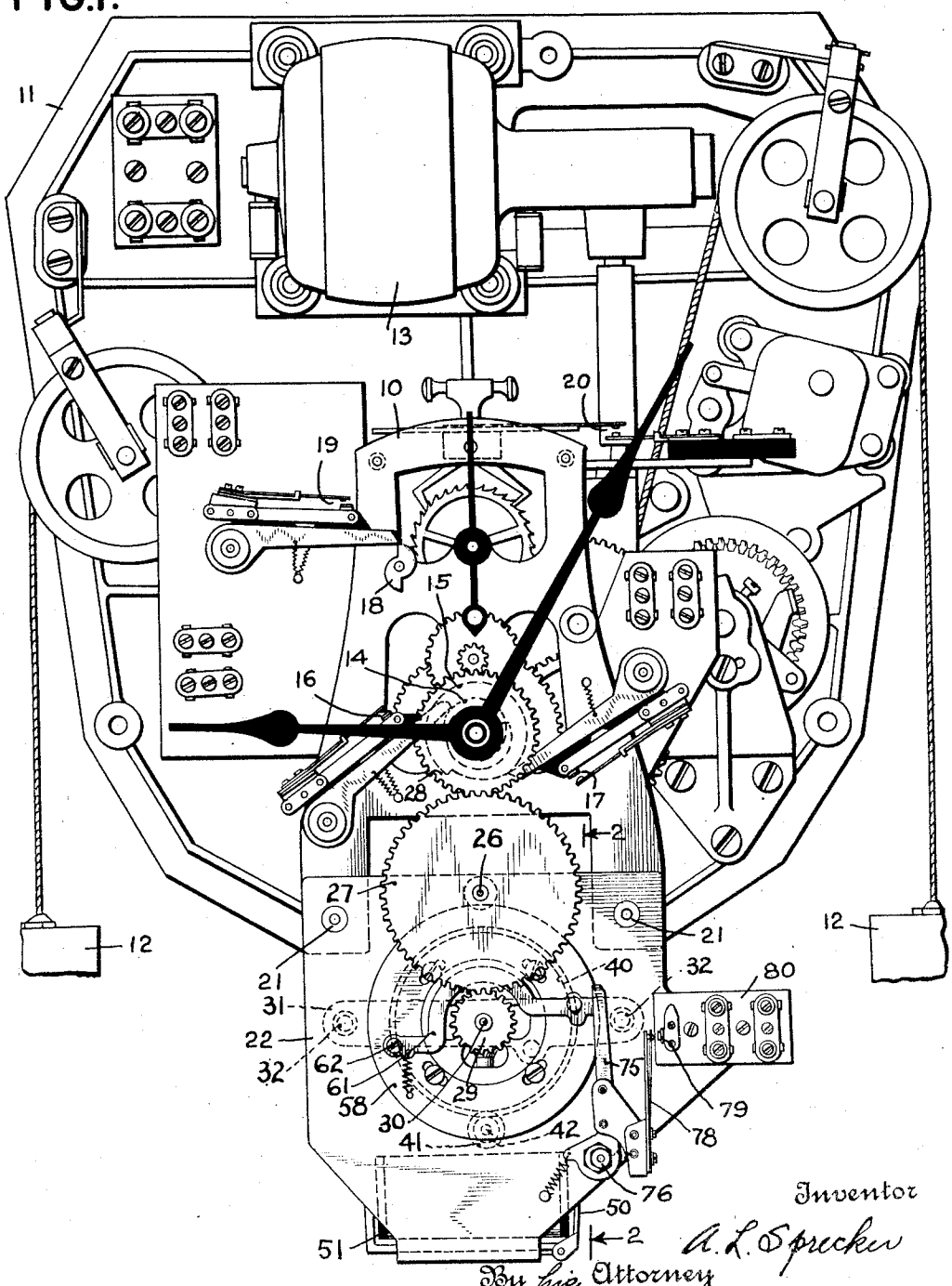
Oct. 10, 1933. A. L. SPRECKER 1,930,256

SELF REGULATING CLOCK SYSTEM

Filed April 30, 1929 4 Sheets-Sheet 1

FIG. 1.



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SELF REGULATING CLOCK SYSTEM

Filed April 30, 1929 4 Sheets-Sheet 2

FIG.2.

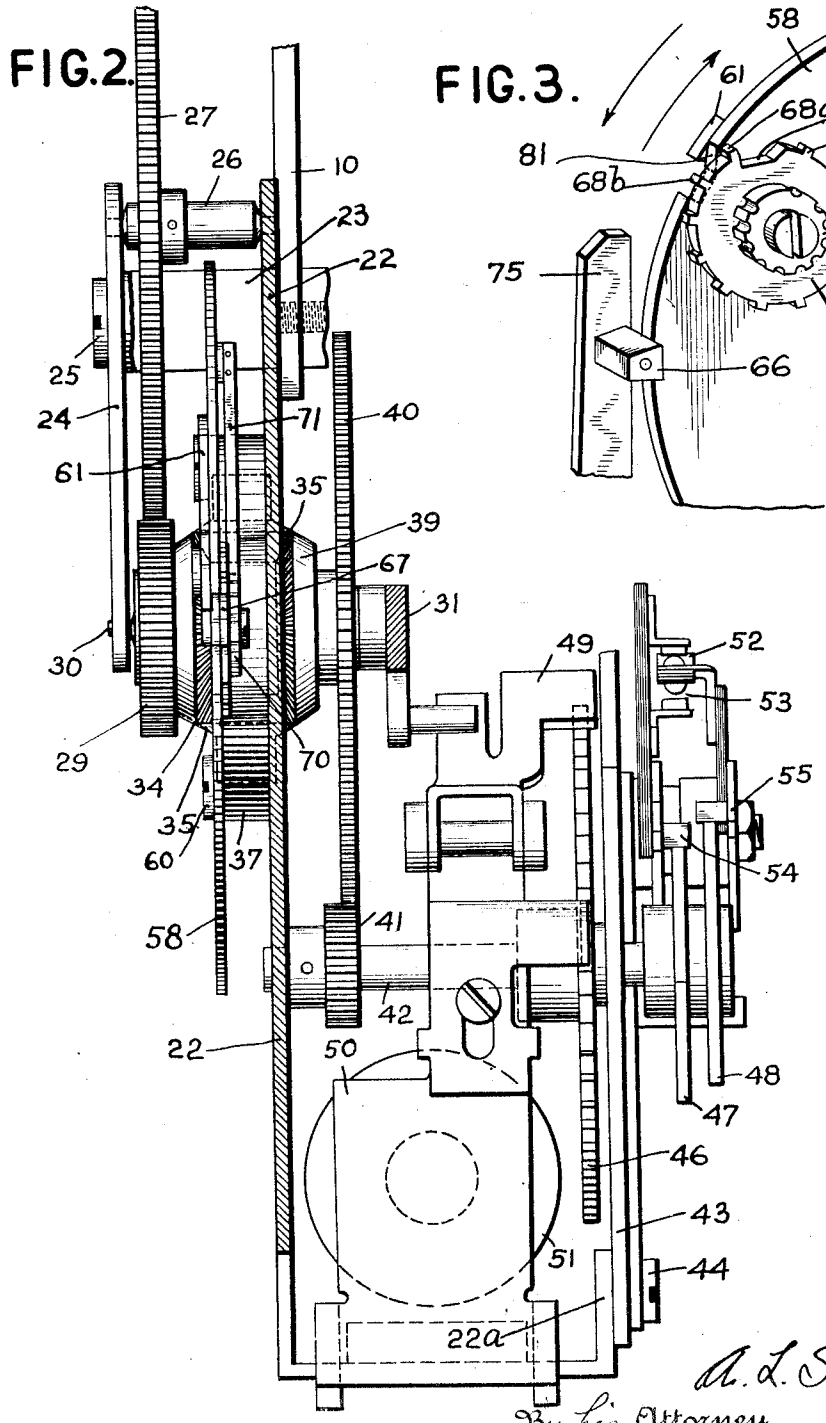


FIG.3.

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SELF REGULATING CLOCK SYSTEM

Filed April 30, 1929 4 Sheets-Sheet 3

FIG. 4.

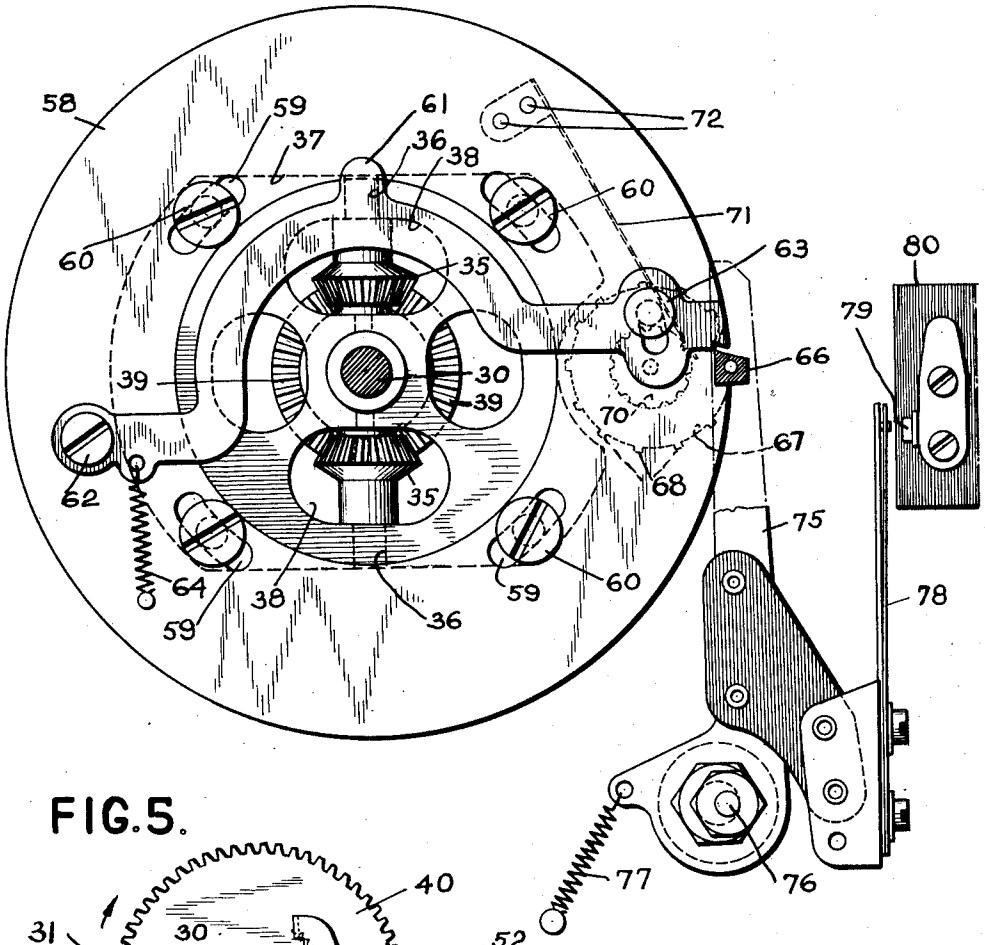
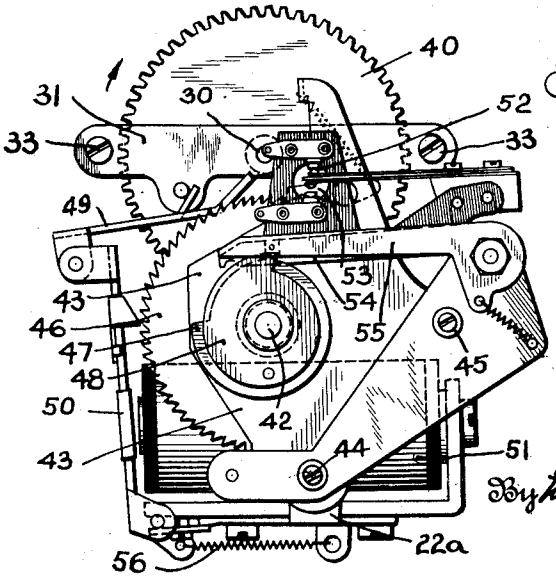


FIG. 5.



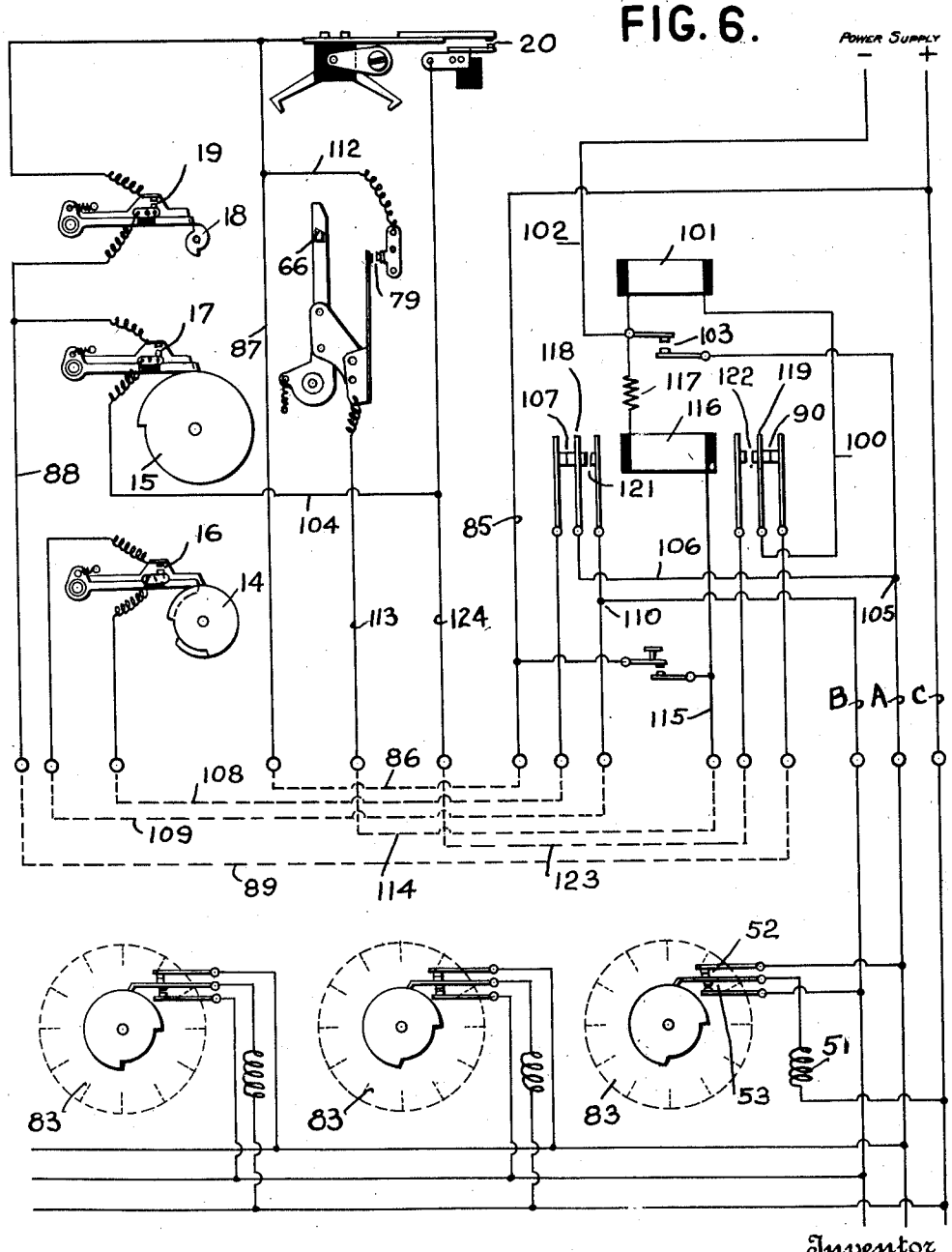
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SELF REGULATING CLOCK SYSTEM

Filed April 30, 1929 4 Sheets-Sheet 4

FIG. 6.



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UNITED STATES PATENT OFFICE

1,930,256

SELF REGULATING CLOCK SYSTEM

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Application April 30, 1929. Serial No. 359,283

3 Claims. (Cl. 58—24)

This invention relates to electric time systems and more particularly to synchronization of electric time systems of the minute impulse type. This invention further constitutes an improvement in synchronization of clocks in that it covers a greater range of synchronization than has heretofore been accomplished.

Previous known methods of synchronizing minute impulse systems have been confined to such narrow limits of variation that a complete shut down of the supply current for periods exceeding one hour make it impossible for the secondary units to be brought to the correct time or into synchronism with the master clock when the power supply is again turned on. In many factories where electric impulse time systems are used the power is shut off over the week-end so that in such cases it has been necessary to use batteries to operate such a system to keep the clock system in operation so that it will be on time when the factory starts operation at the beginning of the week. The purpose of the present invention therefore is to permit a clock system to be operated direct from the power supply and to take care of such long interruptions by immediately correcting the system as soon as the power supply is again turned on. It will be seen that where recording clocks having day or date type wheels are being used it will be necessary to advance the clocks an amount equivalent to the time said clocks were stopped.

An object of this invention is to provide novel means for rapidly advancing secondary clocks, which have stopped due to current failure over an extended period, an amount equivalent to the period of current failure to bring them into synchronism with the master clock controlling said secondaries, when the current is next available.

Another object is to provide novel means for sending out a series of rapid impulses over the line of a self synchronizing electric time system sufficient to bring secondary time units on said line into the synchronizing range of the controlling master clock after a period of current failure has caused said clocks to be stopped.

A further object is to provide an accumulator in conjunction with a self synchronizing electric time system which senses a failure of the power supply to the time system and accumulates the time during which supply has failed.

A still further object is to provide novel means for sensing the current failure in an electric self synchronizing time system and accumulating the duration of said failure and after the restoration of said current to rapidly advance the secondary clocks on said time system to bring them to within the normal self synchronizing range of the master clock controlling said system.

Still another object is to provide novel means for reestablishing synchronization in a self synchronizing clock system when the secondaries of said clock system have become out of step with the master clock to an extent exceeding the normal self synchronizing means.

Other objects and advantages of this invention will be apparent from the specification and the accompanying drawings which show one embodiment of this invention and wherein similar reference numerals indicate similar parts and wherein in the drawings,

Fig. 1 shows a front elevation of the device cooperating with a master clock;

Fig. 2 shows a section on line 2—2 of Fig. 1;

Fig. 3 shows a detailed view of the accumulator members;

Fig. 4 shows a detailed view of the accumulator members and differential operating means;

Fig. 5 shows a detailed view of the power operated driving unit;

Fig. 6 is a wiring diagram of the system.

A master clock movement such as indicated generally at 10 may be provided, said movement being mounted to a back frame 11 and being driven by weights 12 which are wound up periodically by a motor 13, said weights storing sufficient power to operate the master clock for several days without a winding operation being effected by said motor. A detailed description of such a master clock movement and cooperating driving means may be found in the patent to J. W. Bryce, No. 1,390,018 issued September 6, 1921 and as this mechanism has no part in the present invention no further detailed explanation will be given here.

The master clock movement 10 is provided with the usual time train adapted to drive the minute arbor on which are mounted cams 14 and 15 cooperating with hourly synchronizing contacts 16 and 17 respectively. A cam 18 operated by the clock mechanism actuates the minute impulse contact 19 once a minute and contact 20 mounted on the verge closes every two seconds to provide rapid impulses when cut into the clock circuit by the proper synchronizing contacts. A more detailed operation and description of these contacts may be found in the patent to J. W. Bryce, No. 1,687,491 issued October 16, 1928.

Fixed to the two lower frame posts 21 of the movement 10 is a supporting plate 22, said plate being fixed thereto by means of space studs 23

(Fig. 2) having a threaded extension engaging a threaded hole in the ends of the frame posts. At the opposite ends of the space studs 23 is fixed another supporting plate 24, said plate being held rigidly by screws 25 engaging threaded holes in the end of said space studs. The supporting plate 24 is not shown in Fig. 1 having been omitted to make the illustration of the mechanisms behind said plate clearer.

Journalled in the supporting plates 22 and 24 is a shaft 26 on which is fixed a gear 27 meshing on its upper side with a gear 28 fixed to the hour hand arbor, said last named gear making, therefore, one revolution in twelve hours. The lower side of gear 27 meshes with a gear 29 which is loosely mounted on a shaft 30 (Figs. 2 and 4) supported in the plate 24 and fixed to the plate 31. The supporting plate 31 is mounted by means of spacing studs 32 (Fig. 1) on the plate 22. Said studs are fixed to the plate 22 and the plate 31 is fixed to the opposite ends of studs 32 by means of screws 33 (Fig. 5) cooperating with threaded holes in the end of the studs.

Fixed to the face of the gear 29 is a beveled gear 34 which in turn meshes with two planetary bevel gears 35 positioned at opposite sides of the periphery of the beveled gear 34. These planetary beveled gears 35 are rotatably mounted on pins 36 which are driven into a member 37 which constitutes the supporting structures for said planetary gears.

This supporting structure 37 is provided with holes 38 to permit the periphery of the planetary gears to extend on either side. On the side opposite to that of the bevel gear 34 is a similar bevel gear 39 pivotally mounted on the shaft 30 and meshing with the planetary gears 35 (Figs. 2 and 4). Gear 39 is fixed to a gear 40 which is free to rotate with the gear 39 about the shaft 30. The gear 40 meshes with a spur gear 41 fixed to a shaft 42, said shaft being journalled at one end in the plate 22 and at the other end in the plate 43. The plate 43 is supported by means of screws 44 and 45 (Figs. 2 and 5), the screw 44 engaging a formed-up portion 22*a* of the plate 22 and the screw 45 engaging a stud which runs from the plate 43 to the plate 22 and being fixed to the latter. This stud is omitted from the drawings as it is of old construction and its omission simplifies the drawing.

Fixed to the shaft 42 is a ratchet wheel 46 and two cams 47 and 48. Coacting with the ratchet wheel is a pawl member 49 pivotally mounted to an armature 50 which cooperates with a magnet 51, the armature being biased in a counterclockwise direction by a spring 56 (as shown in Fig. 5). This construction constitutes a magnet driving mechanism such as shown and fully described in the copending application to J. W. Bryce, Serial No. 39,459 filed June 25, 1925.

Two contacts 52 and 53 actuated by cam followers 54 and 55 cooperating with the cams 47 and 48 respectively are also completely shown and described in the above mentioned copending application.

The supporting structure 37 has adjustably mounted thereon a plate 58 having a circular aperture in the center to permit the bevel gears 35 to extend past the plane of said plate. This plate is adjustably mounted by means of the slots 59 in said plate and the screws 60 cooperating with the supporting structure 37. A lever 61 is pivotally mounted at one end to the plate 58 by means of the stud 62 and guided at the opposite end by means of a pin and slot connection 63 said lever being biased in a clockwise direction by the spring 64. The end of the lever coincides with the periphery of the plate 58 and has one side undercut to permit a quick drop of a cam follower 66 on such occasions as this cam follower may have to drop from the periphery of the plate 58 into the position in a groove of said plate as shown in Fig. 4, said cam follower at all times coacting with the edge of the plate 58 as shown in Figs. 3 and 4. Pivotally mounted to the plate 58 is an accumulator member 67 having a series of projections 68 and a deep indentation 69. The portions of the accumulator between the projections 68 with the exception of the one indentation 69 coincide with the extreme outside diameter of the plate 58 so that the projections 68 extend beyond said last mentioned plate. The indentation 69 falls below the outside diameter of the plate 58 but coincides when in proper alinement to a similar indentation in the plate 58. Fixed to the accumulator disk 67 is an alining member 70 which cooperates with an impositive stop spring 71 also fixed to the plate 58 at 72 (Figs. 3 and 4).

It will be seen that the bevel gears 34, the planetary gears 35 and bevel gear 39 constitute a differential mechanism, one side of which is being driven through direct gearing from the master clock movement, the other side of which is being driven by the magnet driving unit which receives current impulses through the control of the master clock impulse contacts in the same manner as do the secondary clock units being operated by said master clock. When the current supply is available and the magnet 51 receives minute impulses which through the attraction of its armature 50 actuates the pawl 49 and thus rotates the ratchet 46 the gear 40 and therefore the bevel gear 39 will be rotated a slight amount each minute. The gear 29 and bevel gear 34 will be rotated continually through the gear train from the master clock. The ratios of these gears are such that with the current supply available to operate the magnet driving device, the bevel gears 39 and 34 will turn the same angular amount per minute and in opposite directions thus holding the supporting structure for the planetary gears and with it the plate 58 in one position whereas should the power supply be interrupted so that the magnet driven mechanism is no longer operated, the continuous operation of the bevel gear 34 due to its direct connection with the master clock will cause the bevel gear 35 to be rolled around the bevel gear 39 now still and thus to rotate the plate 58.

As previously stated, a cam wiper 66 cooperates with the edge of the plate 58, said cam wiper being fixed to a finger 75, said finger being pivotally mounted to a stud 76 fixed to plate 22, said finger being spring pressed in a counterclockwise direction by a spring 77 to keep the cam follower 66 in constant cooperation with the edge of the plate 58.

Mounted upon said finger is a contact arm 78 carrying a contact which cooperates with the contact 79 fixed to an insulating block 80 which is mounted on the plate 22.

When the master clock and clock systems in general are operating and functioning normally, the contact 79 will be open. If the current is interrupted, causing the minute impulses to fail to be sent over the line thus rendering the magnet drive inoperative, the disk 58 will be rotated in a clockwise direction as shown in Figs. 1 and 4 by the gear train from the master clock. The

cam follower 66 which was normally resting in the depression in the plate will ride up on the inclined portion 81 causing the lever 61 to yield in a counterclockwise direction. The disk 58 continues to rotate while the power is interrupted and the gear ratio is such that said disk makes one complete revolution for each twelve hours of continuous interruption in the source of power. At the completion of the first revolution of the disk the cam follower 66 cooperates with the portion 68*a* so that as the disk 58 continues to rotate in a clockwise direction, the accumulator disk will turn one space in a counterclockwise direction carrying the cam follower 66 on its periphery between the projections 68*a* and 68*b*, thus not permitting said cam follower to drop into a depression of the disk 58 and therefore not permitting the contacts 79 to open. As the disk 58 proceeds to rotate on the second revolution, the projection 68*b* is left in a position to cooperate with the follower 66 at the completion of the second revolution so that at the completion of each revolution of the plate 58 the accumulator will be rotated in a clockwise direction one position and will be held in this position each time by the cooperation of the impositive stop spring 71 with the alining notches in the alining member 70.

In the illustration shown in Fig. 3, the accumulator has capacity for a power interruption of six days, there being twelve spaces equivalent to an elapsed time of twelve hours each. It can readily be seen that by increasing the diameter of the accumulator disk 67 and changing the location of its pivotal center, a much greater capacity can be attained or for that matter, additional accumulator wheels with the well known transfer mechanism could be used to attain increased capacity.

When the power is restored the magnet 51 receives rapid impulses in a manner to be described later which causes the bevel gear 39 to be rotated in an opposite direction to the bevel gears 34 and at a much greater angular velocity than the gear 34 is rotated. This will cause the disk 58 to reverse its direction and such reversal will be continuous until the disk has rotated as many revolutions in the opposite or clockwise direction as it had previously operated in a counterclockwise direction and until the cam follower 66 finally locates in its home position in the notch of the plate 58 and the depression 69 in the accumulator wheel.

As previously stated when the plate 58 starts to move in a clockwise direction (Fig. 4) the cam follower 66 moves the lever 61 in a counterclockwise direction as said cam follower rides up the incline 81 until it rides on the outside periphery of the plate at which time the lever 61 is moved clockwise by the spring 64 to its home position. When the plate 58 is next moved in a counterclockwise direction to be restored to its home position the cam wiper 66 rides over the end of the lever 61 and drops into its home slot thereby giving a quick break to the contact 79.

Fig. 6 shows the circuit wiring diagram in which the secondary unit system consists of a three wire system such as indicated at A, B and C and having a plurality of secondary units such as are generally indicated at 83. Description and operation of these units from a three wire system are given in detail in Patent No. 1,687,491 to James W. Bryce, previously mentioned in which transfer switches in the secondary units determine which one of the two circuits it shall receive impulses from and in which impulses are transmitted at all times over the A wire and for only a certain definite period over the B wire. The magnet driving unit which drives the bevel gear 39 of the differential shown in Fig. 2 constitutes one of the secondary units of this circuit and therefore receives the same impulses as do the secondary time indicating and recording units on the line.

The normal operation of the minute impulses are produced from the closing and opening once each minute of the contacts 19 thus establishing a circuit from the positive supply line through wires 85, 86, 87, contact 19, wire 88, wire 89, contact 90, wire 100, master relay magnet 101, wire 102, to the negative supply line. When this impulse occurs the master relay magnet 101 is energized attracting its armature and closing the relay contacts 103 thus establishing a circuit from the negative supply line through wire 102, relay contact 103, line A, contact 52, the secondary unit drive magnet 51, line C and back to the positive supply side which advances the secondary unit one step or the equivalent of an indicated time of one minute in the usual manner.

As has been explained in the patent to Bryce last mentioned, when the secondary unit reaches the fifty-ninth minute, contact 52 opens and the contacts 53 close thus connecting the drive magnet to the B wire, the contact 16 being open at this time, prevents any impulses from being transmitted over the B wire and therefore all secondary units connected on this wire cannot proceed further than the 59th minute position of said secondary until the contact 16 is again closed. Shortly thereafter the contact 17 closes for a duration of approximately forty seconds thus connecting the master relay magnet 101 into circuit with the contacts 20 which close every two seconds by virtue of being mounted on the verge. The circuit at this time is as follows: from the positive supply line through wires 85, 86 and 87, contact 20, wire 104, contact 17 now closed, wires 88, 89, contact 90, wire 100, master relay coil 101, wire 102 to the negative supply line. The master relay contacts 103 are therefore closed and opened through the energization of its magnet 101 at the same time as the contacts 20 are closed, thus sending a series of rapid impulses over line A as previously explained which will energize the drive magnets at rapid intervals of all secondary units which are slow or have not yet reached the fifty-ninth minute and will advance these units up to the fifty-ninth minute as indicated by them at which time the contact 52 will break and the contact 53 make connecting their respective drive magnets to the wire B which at this point is dead as previously explained. At the expiration of about forty seconds, the contacts 17 will open thus preventing any further rapid impulses from being sent over the wire A, and right after the opening of contacts 17 and before the sixtieth minute impulse the contacts 16 will close thereby connecting line B into circuit with line A.

This circuit is as follows: from the junction 105 on the A wire, to line 106, contacts 107, line 108, contact 16, line 109, junction 110, to the B wire. Thus when the sixtieth minute impulse is sent out over the A wire by the closure of the contact 19, this impulse will also be transmitted to the B wire and flow through the contacts 53 now closed of the secondary units and through the drive magnets 51 to the common return wire C, thus advancing the clocks together after having been brought into synchronism. The contact 16 remains closed until all secondary units have advanced far

enough to again close contacts 52 thus again connecting the secondary units with the A line, after which time the contact 16 opens.

In event of current failure lasting for several hours, it will be seen that the corrective features so far described would not suffice to bring the secondary units into synchronism with the master clock. The present invention provides the contact 79 which is closed as previously described when the secondary unit 83 becomes inoperative through the failure of the power supply. Assuming now that the power supply has failed for a matter of several hours and is again re-established, the contact 79 will be closed and a circuit will be established from the positive supply line through wires 85, 86 and 87, wire 112, contact 79, wire 113, wire 114, wire 115, relay magnet 116, resistance 117, wire 102 and back to the negative supply line. The relay magnet 116 being energized attracts its armatures 118, 119 thus opening contacts 107 and 90 and closing contacts 121 and 122.

The closing of contact 121 connects both the A and B wire together from junction 105 on the A line through wire 106, contact 118, junction 110 to the B wire. The closing of contacts 122 connects the master relay magnet 101 into circuit with the rapid impulse contacts 20 so that we have a circuit from the negative supply line to wire 102, master relay magnet 101, wire 100, relay contacts 122, wire 123, wire 124, contact 20, wire 87, wire 86, wire 85 and back to the positive supply line. The master relay magnet 101 is therefore energized at a rapid rate causing its contact 103 to send out rapid impulses over the wire A and also the wire B. Thus all secondary units on the line will receive these rapid impulses regardless of whether their drive magnets 51 are in circuit with the A or the B wire. These rapid impulses will continue as long as the contact 79 is closed and this contact will remain closed until the secondary units have been advanced at an indicated time equivalent to the duration of the time for which the power supply had failed, the contacts 79 being opened as previously explained when the cam follower 66 (Fig. 3) and the plate 58 return to the home position to permit said cam follower to drop into the groove in the plate.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims:

I claim:

1. In a clock system including a master unit and repeater units, circuits connected thereto adapted to transmit impulses for controlling said repeater units, means driven by the conjoint operation of the master unit and a repeater unit for controlling the transmission of repeater controlling impulses, said means comprising a rotatable member carrying thereon a second rotatable member adapted to indicate the number of rotations made by the first mentioned rotatable member.

2. In a clock system including a master unit and repeater units, a source of power for supplying impulses under control of said master unit, circuits connecting said master unit and repeater units adapted to transmit said impulses for controlling the repeater units, first means operated by the conjoint action of the master unit and a repeater unit, said first means being operated in one direction upon failure of the power supply and in a return direction upon the termination of said power failure, second means controlled by the operation of said first means for accumulating the number of cycles of operations of said first means and additional means controlled by the conjoint operation of said first and second means for effecting the return operation of the first means in accordance with the accumulation indicated by the second means.

3. An electric clock system including a master clock, secondary clock units, circuits connecting said master clock and secondary clock units and a source of power for operating said secondary clock units from the control of said master clock, an accumulating member operated by the conjoint action of the master clock and one secondary unit upon failure of said power supply, a second accumulating member carried on said first accumulating member and means for operating said second named accumulating member at each cycle of operation of said first mentioned accumulating member.

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