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ADAPTOR FOR OPERATING D.-C. TIMING DEVICE ON A.-C. SUPPLY LINE

Filed July 10, 1957

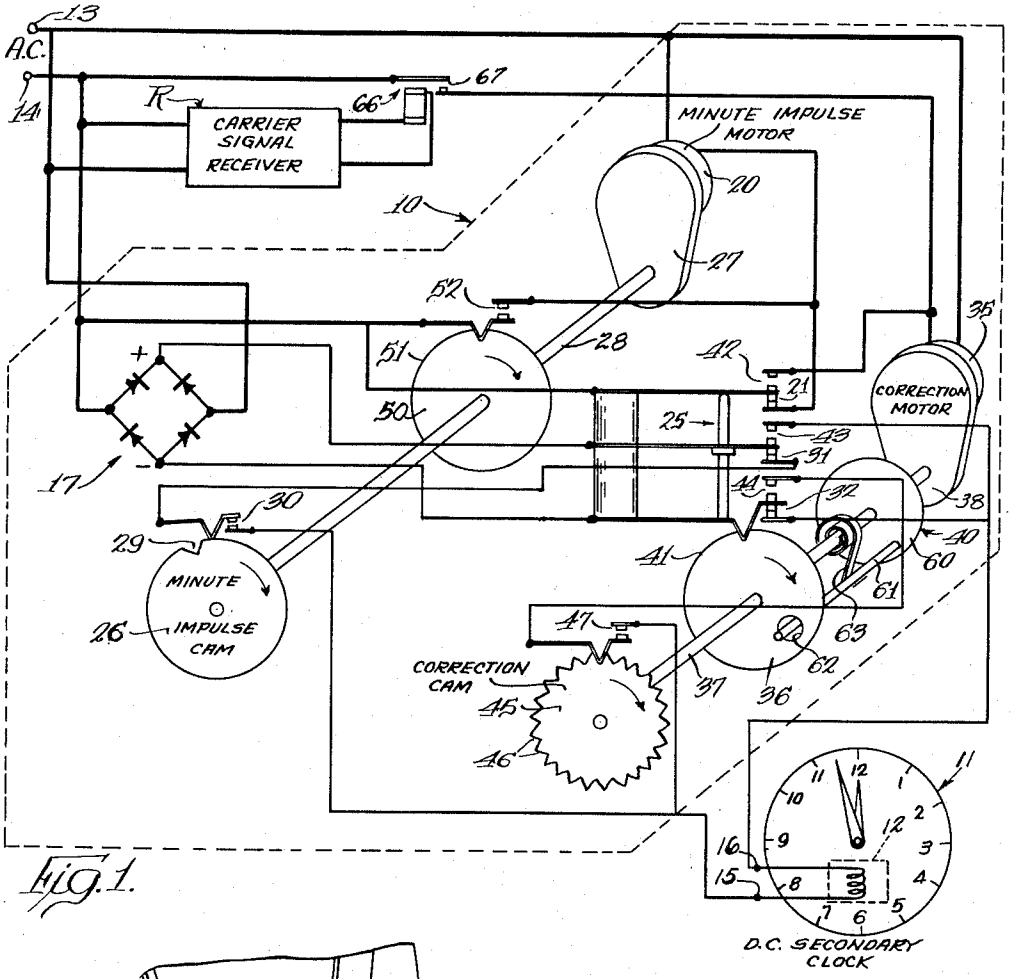


Fig. 1.

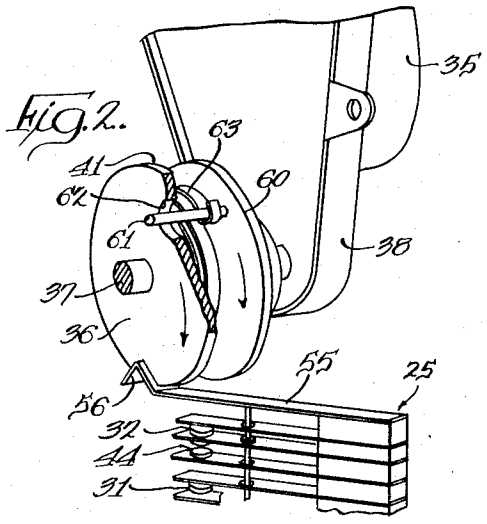


Fig. 2.

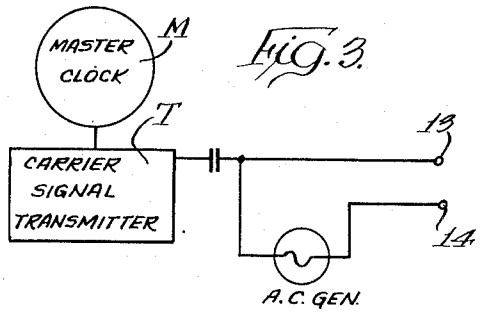


Fig. 3.

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ADAPTOR FOR OPERATING D.-C. TIMING DEVICE ON A.-C. SUPPLY LINE

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16 Claims. (Cl. 307—140)

The present invention relates primarily to an electrical control system for operating step-by-step D.-C. timing devices on a common A.-C. power system.

A typical master-secondary clock system employs a master clock and a plurality of secondary clocks, with each of the secondaries being automatically corrected at regular intervals to insure that they remain in synchronism with the master. Conventionally, the secondary clocks are step-by-step D.-C. devices, that is, they operate by advancing discrete increments usually minute by minute, in response to impulses received over a special D.-C. line. At the end of a predetermined interval, usually every hour, the master clock initiates a correcting signal which is received by the secondary clocks and operates to bring the latter into synchronism with the master.

A particular and commonly utilized operating and correcting device for a secondary clock in such a system is known as an autoset mechanism and is fully disclosed and described in U.S. Patent No. 2,332,828, issued October 26, 1943. For purposes of the present disclosure it will be sufficient to observe than an autoset mechanism of this type requires a rapid series of D.-C. corrective impulses, having a polarity which is the reverse of the normal minute impulses for resetting purposes, such impulses being supplied to the autoset mechanism from the master clock over a definite time interval toward the end of each hour.

Briefly, the autoset mechanism accomplishes its correcting function by locking its advancing solenoid if a current impulse of reverse polarity is received and the secondary clock is "on time." If the clock is slow when the master clock initiates the rapid corrective impulse series, the locking means is disabled and the rapid impulses quickly advance the clock setting until the clock has been corrected and the locking means rendered effective to lock the solenoid against the remaining corrective impulses in the series. With the next minute impulse of normal polarity, the clock advances normally.

Thus it can be seen that the autoset mechanism of a secondary clock must be provided both with regular minute, or other fixed interval, impulses of D.-C. current for normally advancing the clock setting, and with a series of rapid corrective impulses of reverse polarity initiated, and under the control of, the master clock for keeping the secondary in synchronism with the master. The advantages of reliable and precise synchronization provided by the autoset mechanism have not been conventionally available except at the cost of running the special D.-C. control lines mentioned above.

Accordingly, it is an object of this invention to provide a novel adaptor permitting an autoset equipped, step-by-step timing device to operate on a common A.-C. power supply line in synchronism with a master clock. More specifically, it is an object to provide such a device which will normally produce a D.-C. impulse at regular predetermined intervals, and will also produce, upon receiving an initiating signal, a rapid series of D.-C. impulses of reverse polarity over a predetermined time interval before resuming normal operation.

It is also an object to provide an adaptor of the type described above, which can be actuated to produce a rapid predetermined series of reverse polarity D.-C. impulses when desired without interrupting or varying the regular output of D.-C. impulses of normal polarity at predetermined time intervals.

It is another object to provide an adaptor of the type characterized above which has few parts and elements so as to permit compact construction for use within the narrow space limitations of clock housings. It is a related object to provide an adaptor of this type that is quick and convenient to install.

It is moreover an object to provide an adaptor of the above type which permits D.-C. operated master-secondary clock systems to be extended or converted to A.-C. operation without sacrificing existing equipment.

It is a further object to provide an adaptor of the type characterized above that is reliable and accurate, and which is of simple and straight-forward design so as to retain its reliability and accuracy throughout a long service life. It is a collateral object to provide an adaptor of this type that uses conventional motors and cams, and therefore is economical to manufacture and trouble-free to operate.

In one of its aspects it is an object of the invention to provide a signal controlled, motor driven device which cannot be unintentionally actuated by spurious, transient signals, even though a number of such signals are successively received. With more particularity, it is an object to provide an adaptor as described above having a simple and reliable device preventing unintentional actuation by transient, spurious signals.

Other objects and advantages of the invention will become apparent upon reading the attached detailed description and upon reference to the drawings in which:

FIGURE 1 is a schematic wiring diagram showing the adaptor of the present invention connected to operate a step-by-step device.

FIG. 2 is an enlarged fragmentary perspective view of the time delay device shown somewhat schematically in FIG. 1.

FIG. 3 is a block diagram of a typical control station.

While the invention will be described in connection with a preferred embodiment, it will be understood that I do not intend to limit the invention to that embodiment. On the contrary, I intend to cover all alterations, modifications and equivalents, as may be included within the spirit and scope of the invention as defined by the appended claims.

Turning first to FIG. 1, there is schematically shown an adaptor **10** installed between a step-by-step D.-C. clock or timing device **11** having an actuating solenoid **12**, and terminals **13** and **14** intended to be connected to a conventional A.-C. power system. In the timing device **11**, the solenoid **12** forms a part of an autoset mechanism of the type disclosed in the U.S. Patent 2,332,828 referred to above and is provided with two terminals **15** and **16**. For present purposes it will be sufficient to note that when the solenoid **12** is energized by a D.-C. current impulse making the terminal **15** positive and the opposite terminal **16** negative, normally once during each minute, the autoset mechanism is effective to advance the timing device **11** one step forwardly. And as more fully spelled out in the above patent, when the solenoid **12** is intermittently energized by a rapid series of D.-C. current impulses of reversed polarity, with terminal **15** negative and the terminal **16** positive, as normally occurs near the end of each hour, the autoset mechanism tends to correct the setting of the timing device **11** so that the latter remains in synchronism with a master clock.

Prior to discussing the present mechanism it will be helpful to have in mind the complete system to which the invention is applicable. A plurality of secondary clocks **11** are used, each capable of responding to D.-C. im-

pulses which are generated in an adaptor of the type to be described in synchronism with the cycles in the A.-C. supply line. At a central control station (FIG. 3) there is provided a master clock M and a high frequency carrier transmitter T suitably coupled to the line. At a predetermined instant toward the end of each hour, e.g., at the 59th minute, the master clock closes contacts for the sending out of a synchronizing signal by the transmitter to all of the clocks on the line, serving to bring them to an accurate reference position, for example the hour position, thereby taking care of slowness due to any power interruptions which may have occurred during the preceding hour. The carrier signal is received at each clock or timer location by a receiver R which is tuned to the transmitter. Obviously other carrier signals may be applied to the supply line for the control of other remote equipment without affecting the clocks, provided that different carrier frequencies are used. In lieu of the carrier signal receiver R, it is alternatively contemplated that a signal carrying conductor may be extended from the master clock to the adaptor **10** so that the master clock may transmit its correcting signal through the conductor directly to the adaptor without converting the correcting impulse to a carrier signal.

To provide a source of D.-C. current the adaptor **10** preferably includes a full-wave rectifier **17** of the conventional type which is connected, through the terminals **13, 14** to the A.-C. power system It will be understood that a storage battery or other source of D.-C. current can be utilized in lieu of the rectifier **17** without varying the operation of the adaptor **10**.

In accordance with the present invention, the adaptor **10** includes a first motor adapted to normally transmit intermittent D.-C. impulses, and a second motor adapted to be energized for a single cycle by the master clock and which is effective to interrupt operation of the first motor, reverse the polarity of the D.-C. current source, and transmit a rapid series of D.-C. impulses of reversed polarity until the end of its cycle, whereupon the first motor is reenergized and normal operation resumed. In the illustrated embodiment, the adaptor **10** includes a first self-starting, synchronius motor **20** connected to the A.-C. power system at terminals **13, 14** through normally closed contacts **21** forming a part of a three-pole, double-throw, switch **25**, to which later detailed reference will be made.

In order to transmit a regularly intermittent D.-C. impulse to the autoset solenoid **12**, the motor **20** drives a minute impulse cam **26** through a gear box **27** and a camshaft **28**. The cam **26** has a drop off portion **29** which is effective to intermittently close the contacts **30** as the cam **26** is rotated. Closing the contacts **30** completes a D.-C. circuit through the contact sets **31, 32** of the switch **25** and energizes the autoset solenoid **12**, the solenoid terminal **15** being made positive and the terminal **16** being made negative. In the preferred embodiment the minute impulse motor **20** drives the camshaft **28** at 1 r.p.m. and there is a single drop off portion **29** formed on the cam **26**. Thus, exactly once each minute, for a period of approximately two seconds, the contacts **30** are closed and the solenoid **12** energized for the purpose of advancing the step-by-step timing device **11**.

In order to respond to the correcting signals regularly transmitted by the master clock and to produce the required correcting impulses of reverse polarity for the solenoid **12**, the adaptor **10** is provided with a second self-starting synchronous motor **35**. To energize the motor **35**, the carrier signal receiver R is connected to a normally open relay **66** which closes the contacts **67** when a correcting signal is received from the master clock and thus connects the motor **35** to the A.-C. power system through the terminals **13, 14**.

The signal transmitted by the master clock and received by the carrier signal receiver R is only of a few seconds duration, and therefore, to insure that the motor **35** remains energized through a complete correcting cycle, a seal-in circuit is provided for the motor. To understand the seal-in circuit, attention must be first paid to the operation of the seal-in switch **25** referred to above. The switch **25** is operated by a seal-in cam **36** that is fixed to a rotatable camshaft **37** driven by the motor **35** through a gear box **38**. A time delay device **40** is interposed in the driving train and later detailed reference will be made to this structure. It will be sufficient at this point to note that as soon as the motor **35** remains energized for a brief period, the time delay device **40** will transmit the rotation of the motor to the cam **36**, whereupon the switch **25** is operated and remains operated throughout its engagement with the outer peripheral dwell portion **41** of the cam **36**.

Returning to the seal-in circuit for the motor **35**, operation of the switch **25** closes the contacts **42** and completes a circuit to maintain the motor **35** energized so long as the switch **25** remains operated. In the preferred embodiment, the motor **35** drives the cam **36** at 1 r.p.m. and the dwell portion **41** extends substantially entirely around the cam **36**, so that only in one position of the cam is the switch **25** not operated. In this way, once the motor **35** has been energized and the switch **25** operated to close the contacts **42**, the motor **35** remains energized for a period of one minute as the seal-in cam **36** makes one complete revolution.

When the motor **35** is energized and sealed-in for one complete revolution comprising a single cycle, the operation of the minute impulse motor **20** is interrupted for the full cycle interval, since the operation of the seal-in switch **25** will open the contacts **21** and de-energize the motor **20**. The operation of the switch **25** is also effective to reverse the polarity of the source of D.-C. current available to energize the autoset solenoid **12**. This is accomplished by opening the contact sets **31, 32** and closing the contact sets **43, 44** when the switch **25** is operated.

To produce the rapid series of reverse polarity current impulses for the solenoid **12**, a second cam **45** is mounted on the camshaft **37** so as to be driven by the motor **35**. The cam **45** has a plurality of switch actuating rise portions **46** formed about its periphery which are effective to repeatedly and intermittently close contacts **47** and complete a circuit energizing the autoset solenoid **12** with current impulses of reversed polarity, that is, each impulse making the terminal **15** negative and terminal **16** positive. In the preferred embodiment, the cam **45** is formed with twenty evenly spaced switch actuating rises **46** and thus the cam, making one complete revolution during the one minute cycle, will transmit twenty rapid corrective impulses to the autoset solenoid **12**, spacing them one every three seconds.

It will be appreciated that after the motor **35** completes one cycle of operation, the operation of the seal-in switch **25** will be interrupted, thus opening the contacts **42** to deenergize the motor **35** and closing the contacts **21** to energize the motor **20**. When the switch **25** is no longer operated, the contact sets **31, 32** are again closed to reestablish the circuit through the contacts **30** and thus permit the minute impulse cam **26** to resume its normal operation of transmitting one current impulse of normal polarity to the autoset solenoid **12** each minute.

So that the adaptor may be accurately phased to resume generation of the regular timing impulses following the completion of the rapid corrective impulse cycle and the return of control to the motor **20**, a fourth switch actuating cam **50** is fixed to the camshaft **28** to be driven by the motor **20**. The cam **50** has a dwell portion **51** extending substantially continuously about the periphery of the cam, and the dwell portion **51** is effective to close the contacts **52** which complete a circuit, by-passing the contacts **21**, energizing the motor **20**. The cams **50** and **26** are properly phased by being

relatively angularly fixed to the camshaft **28** so that the contacts **52** are open only when the dwell portion **29** of the cam **26** is poised to close the contacts **30**. Thus, it can be seen that no matter when a signal is received from the master clock causing the motor **35** to be energized, the switch **25** to be operated, and the contacts **21** to be opened, the motor **20** will continue to rotate, although its energizing circuit through contacts **21** has been broken, since the cam **50** will maintain the contacts **52** closed. The motor **20** will continue to rotate the camshaft **28** until the cam **50** has reached the angular position in which the contacts **52** open and the dwell portion **29** of the cam **26** is poised to close the contacts **30**.

The significance of the cam **50** can be appreciated when it is understood that the master clock initiates the cyclic operation of the motor **35** at a regular predetermined time, preferably at exactly 59 minutes past the hour. Since the single revolution cycle of the cams **36**, **45** operated by the motor **35**, lasts exactly one minute, the correct time when operation of the switch **25** is ceased and control of the autoset solenoid is returned to the minute impulse cam **26**, is exactly 60 minutes past the hour. Thus, the device **11** must be immediately advanced another one minute interval in order to maintain it in synchronism with the master clock. By utilizing the cam **50** to position the cam **26** so that the contacts **30** are closed immediately upon the reenergization of the motor **20**, the required impulse of normal polarity is transmitted at the proper time to the solenoid **12** and the device **11** is advanced in exact synchronism with the master clock.

Moreover, by angularly phasing the cams **26** and **50** so that the motor **20** is stopped, by the cam **50** opening the contacts **52**, just before the contacts **30** are closed, rather than at the instant when they do close, a complete, normal, operating cycle of the contacts **30** by the cam **26** is assured when the motor **20** is reenergized. Thus, the contacts **30** will remain closed for their full normal interval to energize the solenoid **12** and advance the device **11**. If the contacts **30** were allowed to remain closed during the interruption in operation of the motor **20**, the time needed to break the contacts when the motor **20** is again energized would be less than the full normal interval during which the contacts are closed, and the shorter period might well prevent normal operation of the autoset mechanism.

Further in accordance with the invention, the motor **35** is provided with a time delay device **40** so that the motor **35** will not be unintentionally cycled by spurious, transient signals received at the terminals **13**, **14** even though several such signals are successively received by the carrier signal receiver R. It will be understood that spurious, stray, high frequency signals are often induced in an A.-C. power system by various electrical devices, these signals being a form of "static" and possessing frequency components within a range which will cause a response from the carrier signal receiver R. These signals, however, are of short duration, and therefore a spurious, transient signal received by the carrier signal receiver R will cause only a momentary energization of the relay **66** which only briefly closes the contacts **67**. By providing the motor **35** with a time delay device, the brief closings of the contacts **67** caused by spurious, transient signals are of insufficient duration to seal-in the motor **35** and thus will not initiate a false operating cycle.

In the present embodiment, the time delay device **40** comprises a spring biased, lost-motion, driving connection between the output shaft of the motor **35** and the camshaft **37**, which is arranged so that when the motor starts rotating, it must first overcome the spring force and take up the lost-motion before the camshaft **37** is rotated. To provide the lost-motion connection, the gear box **38** associated with the motor **35** is connected to drive a disk **60** mounted concentrically with, but independently of,

the cam shaft **37**. The disk **60** rotates the camshaft **37**, and thus the cams **36**, **45**, by means of a pin **61** extending parallel to the camshaft **37** through a hole **62** formed in the cam **36**. It can be seen that when the pin is disposed at one edge of the hole **62**, the motor **35** must rotate the disk **60** through a distance approximately equal to the diameter of the hole **62** so that the pin **61** may engage the opposite side of the hole and impart a rotational force to the cam **36**.

To insure that the disk **60** and the motor **35** are properly "backed off" so that the pin **61** is adjacent the proper edge of the hole **62**, a torsion spring **63** is fixed to the camshaft **37** and is tensioned to exert a resilient force against the pin **61** in a direction opposite to that imparted by the motor **35**. It can thus be seen that momentary energization of the motor **35**, caused by briefly closing the contacts **67** as a result of spurious, transient signals being picked up by the carrier signal receiver R, will only cause the disk **60** to begin revolving and start to carry the pin **61** across the hole **62**. Upon the almost immediate deenergization of the motor **35** the torsion spring **63** will return the pin **61**, disk **60** and the gear train in gear box **38** back to their original starting positions. It will be apparent then that the operating cycle of cams **36**, **45** can be initiated only by energizing the motor **35** for a sustained, predetermined period, which will be the case when a signal of several seconds duration is transmitted by the master clock to be received by the carrier signal receiver R.

To hold the camshaft **37** and the cams **36**, **45** in their starting positions against the reaction force exerted by the torsion spring **63**, the inherent detenting effect exerted by the switch actuator for switch **25** is utilized. As can be seen in FIG. 2, the switch **25** is provided with a resilient actuator **55** having a detent portion **56** which drops into the notch-like interruption in the dwell portion **41** of the cam **36**. It will be understood that the engagement of the switch actuator **55** with the notch-like portion of the cam **36** will hold the cam **36**, the camshaft **37**, and the cam **45** in their respective starting positions with a detent action. When the motor **35** remains energized for a time sufficient to bring the pin **61** into engagement with the opposite side of the hole **62**, the cam **36** will be rotated so as to bring the detent portion **56** of the switch actuator **55** up onto the dwell portion **41** of the cam so that the switch **25** is operated and the correcting cycle initiated.

In order to minimize the resilient force required to be exerted by the torsion spring **63** while insuring that the force is sufficient to "back off" the disk **61** and the gear train in the gear box **38**, the motor **35** preferably includes an automatically operating clutch of a type which is commonly employed for such purposes. In clutch motors of this type, the motor armature is automatically engaged with the power output driving train upon energization of the motor winding, and is disengaged upon the deenergization of the motor winding. An example of a motor of this type having such an automatically operating clutch construction can be seen by reference to U.S. Patent No. 2,334,040, issued November 9, 1943. It will be sufficient for present purposes to observe that the armature in the motor **35** is connected to the driving train in the gear box **38** only when the motor is energized. When the motor is only briefly energized through the action of a spurious signal causing the contacts **37** to flutter momentarily, the gear train in the gear box **38** and the disk **60** are briefly advanced by the motor armature and then completely disconnected from the armature. Thus, the torsion spring **63** need rotate only the disk **60** and the gears within the gear box **38** back to their initial starting positions, and is not required to rotate the entire armature of the motor **35**.

It can be seen that the adaptor **10** may be compactly constructed, since it comprises only two small synchronous motors, each of which operates but two switches.

Also it can be seen that the components comprising the actuator 10 are conventional in nature, and therefore readily and economically available. Moreover, the adaptor 10 is completely reliable in operation since the time delay device 40 prevents inadvertent actuations of the adaptor in response to spurious, transient or stray signals in the A.-C. power system. It will be understood that the delay device 40 will continue to return the driving train extending from the motor 35 to its initial starting position after each spurious signal, even though a successive series of transient signals causes repeated intermittent operations of the relay 66.

Résumé of operation

Briefly recounting the normal sequence of switch operation when the adaptor 10 is used in a typical installation, it will be recalled that the motor 20 remains continuously energized, by means of a circuit through the contacts 21, for fifty-nine consecutive minutes. Each minute the motor 20 drives the camshaft 28 through one revolution, and therefore, once a minute, the cam 26 closes the contacts 30, energizing the solenoid 12 and thus advancing in one minute increment, the step-by-step timing mechanism 11.

At exactly fifty-nine minutes past the hour, the master clock M causes the carrier signal transmitter T to impose a suitable signal on the A.-C. lines to which the terminals 13, 14 are connected. The carrier signal receiver R responds to the signal and energizes the relay 66, which closes the contacts 67 and energizes the motor 35. Energization of the motor 35 causes rotation of the camshaft 37, after a suitable time delay imposed by the time delay mechanism 40, and operates the switch 25. Operation of the seal-in switch 25 opens the contacts 21, thus interrupting the normal circuit energizing the motor 20, and closes the contacts 42, thus maintaining energization of the motor 35. Operation of the switch 25 also opens the contacts 31, 32 and closes the contacts 43, 44, which has the effect of reversing the polarity of the D.-C. current obtainable from the rectifier 17. As the motor 35 rotates the camshaft 37, the cam 45 intermittently closes the contacts 47 to complete a circuit transmitting rapid, D.C., current impulses of reverse polarity to the solenoid 12 which causes the associated autoset mechanism to correct, if necessary, the reading of the timing device 11 by bringing that reading to fifty-nine minutes past the hour.

As the motor 35 is operating, the cam 50 on the camshaft 28 will hold the contacts 52 closed and thereby maintain energization of the motor 20 until the cam 50 allows the contacts 52 to open. The cam 50 is positioned to interrupt the operation of the motor 20 in a position where the dwell portion 29 of the cam 26 is poised to immediately close the contacts 30 when the motor 20 is reenergized.

After the camshaft 37, driven by the motor 35, completes a single revolution during the interval from fifty-nine minutes to sixty minutes past the hour, the seal-in cam 36 releases the seal-in switch 25 so that the contacts 42 open, deenergizing the motor 35, and the contacts 21 close, reenergizing the motor 20. At the same time, the contacts 43, 44 are opened and the contacts 31, 32 are again closed, so that as the motor 20 begins normal rotation of the camshaft 28, the cam 26 will close the contacts 30 and a current impulse of normal polarity will be transmitted to the timing device 11.

Since the motor 35 begins operating at fifty-nine minutes past the hour and since its cycle of operation is exactly one minute, the reenergization of the motor 20 and immediate closing of the contacts 30 will advance the timing device 11 from a position indicating fifty-nine minutes past the hour to a position indicating the new hour in almost exact synchronism with the master clock M.

I claim as my invention:

1. An adaptor for operating a D.-C. timing device on an A.-C. system and capable of producing regularly intermittent D.-C. impulses of desired polarity and a rapid predetermined series of D.-C. impulses of reverse polarity comprising, in combination, a rectifier connected to said A.-C. system to provide a source of D.-C. current, a first synchronous motor energized from said A.-C. system, means including a cam controlled switch operated by said motor for normally transmitting from said D.-C. source a regularly intermittent series of current impulses of desired polarity, a second synchronous motor energized from said A.-C. system, means responsive to a carrier signal on said A.-C. system to initiate energization of said second motor, means including a cam controlled switch for maintaining energization of said second motor through a predetermined time interval, means including cam controlled switches operated by said second motor when energized for interrupting operation of said first motor and reversing the polarity of said D.C. source, and means including a cam controlled switch operated by said second motor when energized for transmitting from said D.-C. source a rapid series of current impulses of reverse polarity.

2. An adaptor for operating a D.-C. timing device on an A.-C. system and capable of producing regularly intermittent D.-C. impulses of desired polarity and a rapid predetermined series of D.-C. impulses of reverse polarity comprising, in combination, a rectifier connected to said A.-C. system to provide a source of D.-C. current, a first synchronous motor energized from said A.-C. system, means including a cam controlled switch operated by said motor for normally transmitting from said D.-C. source a regularly intermittent series of current impulses of desired polarity, a second synchronous motor energized from said A.-C. system, means responsive to a carrier signal on said A.-C. system to initiate energization of said second motor, means including a cam controlled switch for maintaining energization of said second motor through a predetermined time interval, means including cam controlled switches operated by said second motor when energized for interrupting operation of said first motor and reversing the polarity of said D.C. source, means including a cam controlled switch operated by said second motor when energized for transmitting from said D.-C. source a rapid series of current impulses of reverse polarity, and a spring biased lost-motion connection between said second motor and its said cam controlled switches arranged so that the motor must overcome the spring force and take up the lost motion before operating said switches in order that spurious, transient signals will not unintentionally operate the switches.

3. In an adaptor for operating a D.-C. timing device on an A.-C. system and capable of producing regularly intermittent D.-C. impulses of desired polarity and a rapid predetermined series of D.-C. impulses of reverse polarity, the combination comprising, means for normally generating for said D.-C. timing device a regularly intermittent series of R.C. current impulses of desired polarity, a motor and means driven by said motor for interrupting said intermittent series and generating for said D.-C. timing device a rapid series of D.-C. current impulses of reverse polarity, means responsive to a remotely generated signal at a predetermined time for energizing said motor, and a spring-biased, lost motion connection between said motor and said driven means arranged so that the motor must overcome the spring force and take up the lost motion before operating said means in order that transient, spurious signals will not unintentionally operate said driven means.

4. An adaptor for operating a D.-C. timing device on an A.-C. system and capable of producing regularly intermittent D.-C. impulses of desired polarity and a rapid

predetermined series of D.-C. impulses of reverse polarity, comprising, in combination, a source of D.-C. current, a first synchronous motor energized from said A.-C. system, means operated by said first motor for transmitting from said D.-C. source, successive current impulses of desired polarity, each impulse being sent at a fixed predetermined time interval, a second synchronous motor energized from said A.-C. system, means responsive to a carrier signal on said A.-C. system for energizing said second motor and maintaining said energization through a period at least equal to said time interval, means operated by said second motor when energized for interrupting operation of said first motor and for reversing the polarity of said D.-C. source, means operated by said first motor for insuring that, when operation of that motor is interrupted, it will stop only in a position where the motor immediately upon energization operates said means for transmitting successive impulses of desired polarity, and means operated by said second motor when energized for transmitting from said D.-C. source a rapid series of current impulses of reverse polarity.

5. An adaptor for operating a direct current slave clock having an autoset mechanism on an alternating current power line comprising, in combination, a first synchronous motor energized from said power line, a cam operated time switch driven by said first motor, a source of direct current, said time switch connected in circuit with said autoset mechanism and said source of direct current, said time switch being closed at regularly spaced preselected time intervals by said first motor to provide said autoset mechanism with timed driving pulses of positive relative polarity, a second motor, relay means responsive to a correction signal from a remote master clock at preselected times to momentarily connect said second motor to said power line for energization thereof, seal-in switch means responsive to energization of said second motor for connecting said second motor to said power line for a preselected correction interval, a cam operated correction switch driven by said second motor, said seal-in switch means also connecting said correction switch in circuit with said autoset mechanism and said source of direct current, said correction switch being closed by said second motor a plurality of times at a more rapid rate than said time switch to provide said autoset mechanism with a rapid series of correcting pulses of negative relative polarity.

6. The combination of claim 5 and time delay means responsive to energization of said second motor and adapted to delay the response of said seal-in switch means for a predetermined interval, whereby said seal-in switch means is unresponsive to spurious signals received by said relay means.

7. The combination of claim 5 wherein said relay means is connected to said alternating current power line and responsive to a modulated correction signal transmitted over said power line.

8. The combination of claim 5 wherein said seal-in switch means disconnects said first motor from said power line when said second motor is energized.

9. The combination of claim 8 and an off normal cam switch driven by said first motor, said off normal switch connecting said first motor in circuit with said power line until a predetermined time prior to closure of said time switch, whereby when said first motor is disconnected from said power line by said seal-in switch means said first motor remains energized through said off normal switch until said predetermined time.

10. The combination of claim 9 wherein said relay means is connected to said alternating current power line and is responsive to a modulated correction signal transmitted over said power line.

11. The combination of claim 9 and time delay means responsive to energization of said second motor and adapted to delay the response of said seal-in switch means for a predetermined interval, whereby said seal-in switch means is unresponsive to spurious signals received by said relay means.

12. The combination of claim 11 wherein said relay means is connected to said alternating current power line and is responsive to a modulated correction signal transmitted over said power line.

13. An adaptor for operating a direct current secondary clock having an autoset mechanism on an alternating current power line comprising, in combination, a synchronous minute impulse motor normally energized from said power line, a minute impulse cam driven by said minute impulse motor, a minute impulse switch operated by said minute impulse cam, a source of direct current, said minute impulse switch connected in circuit with said autoset mechanism and said source of direct current, said minute impulse switch being closed at minute intervals by said minute impulse cam to provide said autoset mechanism with minute driving pulses of positive relative polarity, a synchronous correction motor, a relay responsive to an hourly correction signal from a remote master clock to momentarily connect said correction motor to said power line for energization thereof, a seal-in cam driven by said correction motor, a seal-in switch operated by said seal-in cam adapted to connect said correction motor to said alternating current power line independently of said relay for a preselected correction interval, said seal-in switch also adapted to disconnect said minute impulse motor from said alternating current supply line, a correction cam driven by said correction motor, a correction switch operated by said correction cam, said seal-in switch adapted to connect said correction switch in circuit with said autoset mechanism and said source of direct current, a plurality of teeth on said correction cam adapted to open and close said correction switch rapidly during said preselected interval to provide said autoset mechanism with a rapid series of correcting pulses of negative relative polarity, an off normal cam driven by said minute impulse motor, and an off normal switch operated by said off normal cam adapted to connect said minute impulse motor to said alternating current supply line independently of said seal-in switch, said off normal switch being closed by said off normal cam to energize said minute impulse motor until a moment in time just prior to closure of said minute impulse switch.

14. The combination defined in claim 13 and a carrier signal receiver connected to said alternating current power line and to said relay adapted to receive a remotely initiated modulated correction signal and, upon receipt thereof, to energize said relay momentarily.

15. The combination defined in claim 13 and spring biased time delay means interposed between said correction motor and said seal-in cam adapted to prevent operation of said seal-in switch by said seal-in cam unless said correction motor is energized for a predetermined time interval.

16. The combination of claim 15 and a carrier signal receiver connected to said power line responsive to a modulated correction signal thereon and adapted upon receipt of said modulated correction signal to energize said relay for said predetermined time interval.

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