Feb. 24, 1942. L. B. STONE 2,274,221

SYNCHRONIZED MOTOR CLOCK MOVEMENT

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FIG. 1.

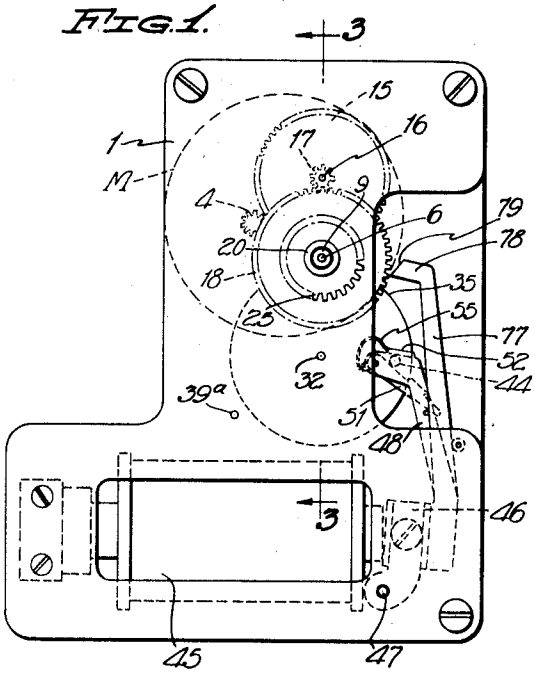


FIG. 2.

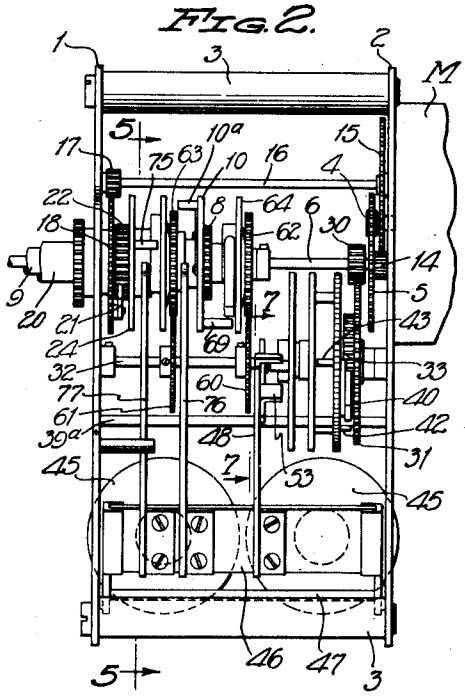


FIG. 3.

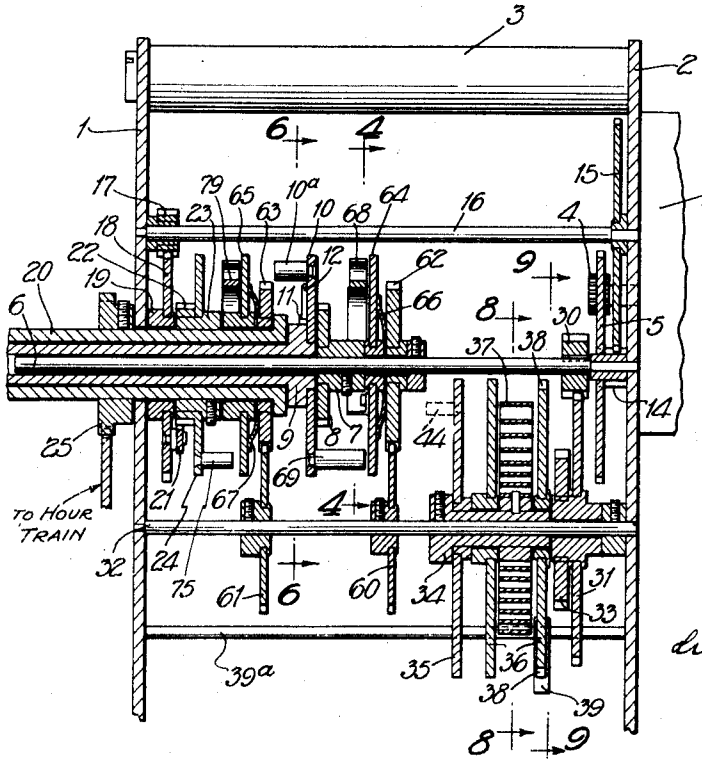
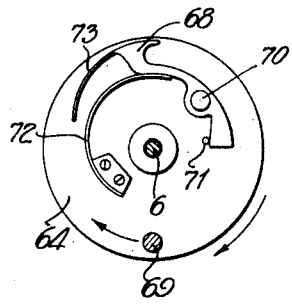


FIG. 4.



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FIG. 5.

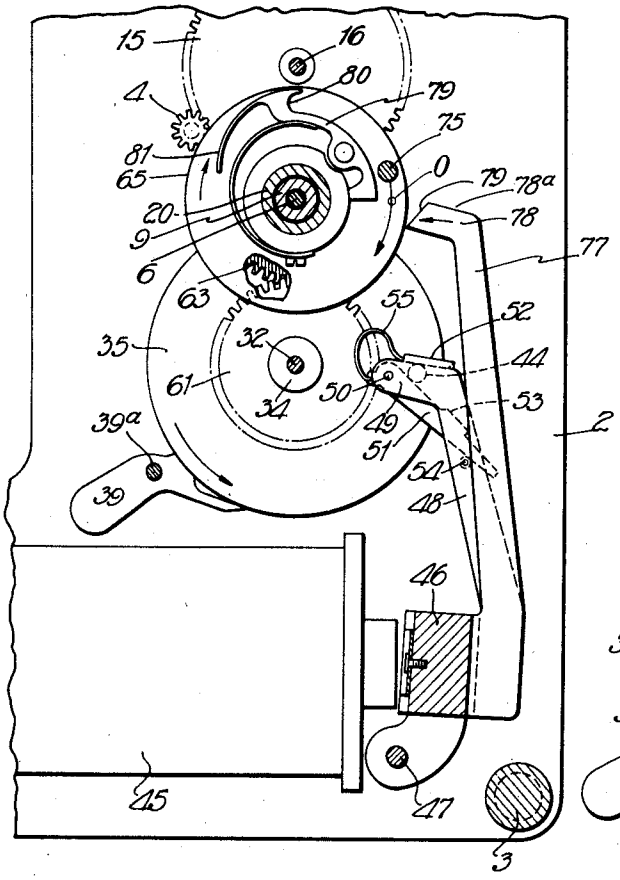


FIG. 6.

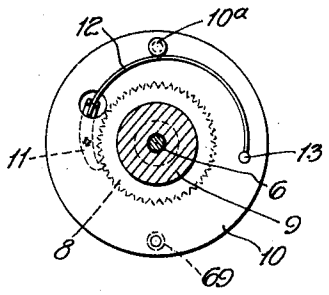


FIG. 8.

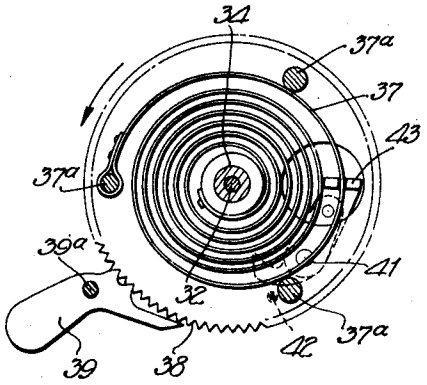


FIG. 7.

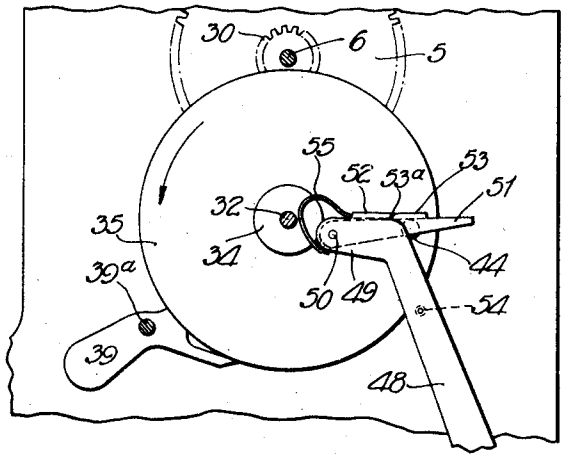
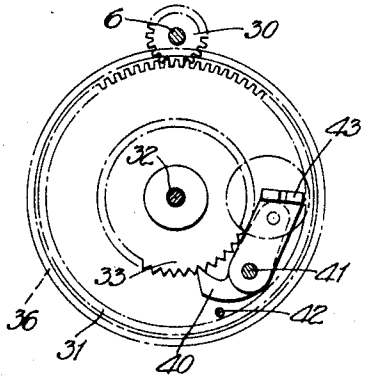


FIG. 9.



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UNITED STATES PATENT OFFICE

2,274,221

SYNCHRONIZED MOTOR CLOCK MOVEMENT

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Application October 3, 1939, Serial No. 297,649

4 Claims. (Cl. 58—34)

My invention relates to synchronized motor clock movements and has the purpose of synchronizing the clock movement by the motor power as soon as the distinct synchronizing impulse is received in the conventional manner. It is an object of the invention to effect the synchronization by the motor power indirectly by means of the power of a spring which is kept wound to a certain extent by the motor. A clock movement in which the synchronizing action is performed directly by the motor power is shown in my divisional application, Ser. No. 363,818, filed November 1, 1940.

My invention is illustrated in the accompanying drawings, in which—

Fig. 1 is a front elevation of the clock movement in which the synchronizing power is supplied from the synchronous motor indirectly through a clock spring.

Fig. 2 is a side elevation of Fig. 1.

Fig. 3 is an enlarged sectional elevation of Fig. 1, substantially on line 3—3 of Fig. 1.

Fig. 4 is a section of a portion of Fig. 3 taken substantially on line 4—4 of Fig. 3.

Fig. 5 is an enlarged section of Fig. 2 taken substantially on line 5—5 of Fig. 2, some of the elements unessential for the purpose of Fig. 5 being omitted.

Fig. 6 is a section of a portion of Fig. 3 taken on the line 6—6 of Fig. 3.

Fig. 7 is an enlarged section of a portion of Fig. 2 taken substantially on line 7—7 of Fig. 2, showing the stop arm in position to stop the synchronizing operation of the synchronizing spring.

Fig. 8 is a section through the spring barrel substantially on line 8—8 of Fig. 3, and

Fig. 9 is a section outside of the spring barrel taken on the line 9—9 of Fig. 3.

Referring first to Figs. 1, 2 and 3, 1 and 2 represent respectively the front and rear plates of the clock movement held apart by spacing rods 3. Between these plates the clock trains are mounted in conventional manner. The power for driving the clock trains is supplied by the motor M mounted on the rear plate 2 of the movement and is shown only diagrammatically in Figs. 2 and 3. The motor drives the normal clock trains by means of a pinion 4 by way of a gear 5 which is fixed on the central drive arbor 6 on which the other tubular clock arbors are disposed. On central arbor 6 is fixed a hub 7 which carries a ratchet drive wheel 8 for the purpose of driving the seconds arbor sleeve 9 by way of a sliding coupling, not shown in detail in Fig. 3, and a disc 10 fixed on the hub of seconds arbor 9. The sliding coupling is of a conventional type and is shown in detail in Fig. 6. It consists of a pawl 11 pivotally attached to disc 10, the pawl being held in engagement with the aforementioned ratchet wheel 8 by means of a spring 12. This permits freedom of motion between the seconds arbor 9 and the driving ratchet wheel 8 to a limited extent, sufficient friction being introduced between the elements by means of the aforementioned pawl 11 to normally drive the seconds arbor from central arbor 6 while the clock runs in the normal way.

The minute arbor 20 is driven from central arbor 6 by means of the back gears 15, 16, 17, the latter being a pinion which meshes with a gear 18 loosely mounted on minute arbor 20. This gear is provided with a spring-controlled pawl similar to the one illustrated in Fig. 6, which pawl engages a ratchet wheel 22 fixed on a hub 23 which is in turn fixed on minute arbor 20. Thus in a manner similar to that described with reference to the seconds arbor, the minute arbor retains a restricted freedom of motion for adjustment purposes with respect to its drive, but is normally driven by the aforementioned back gear from central arbor 6. The hour arbor is not shown in the drawings. It is assumed to be mounted loosely in conventional manner on the minute arbor 20 and is driven from a pinion 25 fixed on the minute arbor. This pinion meshes with the hour train and is indicated in Fig. 3 only by the legend "To hour train."

For the purpose of synchronizing the minute and seconds arbors jointly when the conventional hourly synchronizing impulse is received, a spring power motor is provided which is kept wound to a limited extent by the synchronous motor and released to perform the synchronizing action in the following manner:

On an arbor 32 journalled between the front and rear plates 1 and 2 is fixed a hub 34. This hub carries fixed to it a disc 35 provided near its periphery with a stop pin 44 which appears in Fig. 3 only in dotted lines. On hub 34 is loosely mounted the spring barrel 36 within which the drive spring 37 is disposed. The inner end of this spring is fixed to hub 34, and the outer end, as shown in Fig. 8, is fixed to one of the spacing pins 37a between the two spring barrel plates. The right-hand plate 36 in Fig. 3 is provided with ratchet teeth 38 which engage a retaining pawl 39 pivoted on an axle 39a mounted between the two clock movement plates 1 and 2. Retaining pawl 39 is more clearly shown in

Fig. 8. It is assumed in Fig. 8 that the spring barrel is wound in the direction of the curved arrow in that figure, and retaining pawl 39, overbalancing on the left-hand end, engages the ratchet teeth 38 and prevents the spring barrel from rotating in the opposite direction but permits the barrel to rotate in the direction of the arrow.

On arbor 32 and adjacent to the spring barrel is loosely mounted a ratchet wheel 33 which is driven from central arbor 6 by way of gears 31 and 30. On the spring barrel, as shown in Figs. 8 and 9, is pivotally mounted at 41 a coupling pawl 40 so that it normally engages the ratchet wheel 33. The movement of pawl 40 away from ratchet wheel 33 is limited by a stop pin 42. The rear end 43 of pawl 40 is bent at right angles to the plane of the pawl and protrudes into the first turn of the drive spring 37, as shown in Fig. 8. This pawl end is for this purpose bifurcated, as shown in Fig. 8. Normally, when the spring is unwound, the position of the pawl is as shown in Fig. 9, in which its end 40 engages ratchet wheel 33. Thus a coupling is established between ratchet wheel 33 and the spring barrel through the pawl and thus by the running of the motor the spring is being wound. During the winding, the spring contracts and thus moves the rear end 43 of pawl 40 inwardly. After the spring has thus contracted and is wound to a certain extent, the rear end 43 of the pawl has been moved sufficiently radially inwardly to disengage pawl 40 from ratchet wheel 33 and thus uncouples the spring barrel from the motor drive. In order to hold the inner end of spring 37 while the spring is wound, the aforementioned pin 44 on disc 35 is arrested in the following manner: The clock movement contains, for the purpose of exerting the synchronizing impulse, an impulse magnet 45 having an armature 46 pivoted in the clock casing at 47 in conventional manner. This armature carries an upwardly extending arm 48 which is shown in detail in Figs. 5 and 7. Normally, that is to say, when no impulse is received, the armature 46 stands in the position shown in Fig. 5. Arm 48 is provided at its upper end with an inwardly extending nose 49 which carries at its upper portion a latch plate 52 which extends at right angles to the plane of lever 43 and directly into the path of the aforementioned pin 44 of disc 35. This pin is shown in dotted lines in Fig. 5. Thus, normally, that is to say, when the electromagnet 45 is not energized, pin 44 rests against the underside of latch plate 52 and thus prevents the disc 35 and in turn spring arbor 32 from rotating when the clock spring 37 is wound in the manner described. Nose 49 of spring release arm 48 further carries another latch 51 which is pivotally mounted at 50 (see Figs. 5 and 7) and normally rests under the influence of a curved spring 55 against a stop pin 54 provided on arm 48. This latch 51 carries a latch plate 53 similarly disposed to latch plate 52, that is to say, it extends toward disc 35 and into the path of pin 44. Assuming now that the spring is wound and an energizing impulse is received at magnet 45 and armature 46 is thereby attracted, arm 48 is pulled inwardly into the position shown in Fig. 7. This has two results. First of all, with latch 51 in its normal position shown in Fig. 5, the inward motion of arm 48 will permit pin 44 to slide off the right-hand end of latch plate 52, which thus releases pin 44 and allows the disc 35 to rotate in the direction of the arrow, Figs. 5 and 7, by the power delivered by the wound spring 37. However, as soon as pin 44 has come around again and approaches nose 49 of arm 48, this nose has been moved by the attraction of armature 46 sufficiently far inwardly to present the latch plate 53 into the path of pin 44. The latter throws latch 53 upwardly into the position shown in Fig. 7 in which it is held by virtue of the inclined edges 53*a* of the two latch plates which thus serve as a stop for the further upward movement of latch plate 53. This arrangement thus permits the resetting arbor 32 of the spring to perform only one revolution for each energizing impulse. As soon as the energizing impulse ceases, the armature 46 falls off and returns into the position shown in Fig. 5 in which arm 48 has moved sufficiently far to the right to shift latch plate 52 over pin 44, thus retaining the pin in arrested position so long as the armature is deenergized. As soon as pin 44 is moved off latch plate 53, latch 51 is thrown downwardly again by spring 55 into the position shown in Fig. 5.

If the spring 37 becomes sufficiently unwound to move the rear end 43 of pawl 40 in Figs. 8 and 9 outwardly, pawl 40 reengages driving ratchet wheel 33 which is being continually driven by the motor, and thus the rewinding of the clock commences until the spring is sufficiently wound to again disengage pawl 40 in the manner aforedescribed.

On spring arbor 32 are fixed two gears 60 and 61. Gear 60 meshes with a gear 62 loosely mounted on central arbor 6, and gear 61 meshes with a gear 63 loosely mounted on minute arbor 20. On central arbor 6 is also loosely mounted a resetting disc 64 which is frictionally coupled with gear 62 by means of a spring 66 in conventional manner. Likewise, on minute arbor 20 is loosely mounted a resetting disc 65 which is frictionally coupled with gear 63 by a conventional coupling spring 67. On disc 64, as shown more clearly in Fig. 4, is pivoted at 70 a resetting pawl 68 which is curved as shown in Fig. 4 so that it can engage a pin 69 fixed on the aforedescribed disc 10 fixed on the seconds arbor 9. Pawl 68 is held in the position shown against a stop pin 71 by means of a spring 72. This pawl is provided with a slightly inwardly curved tail 73 which extends sufficiently rearwardly at its outer end so as to permit normally, that is to say, when disc 64 is standing still, pin 69 of the minute arbor to ride onto this tail when the pin revolves in the direction of the arrow, Fig. 4. Thereby pawl 68 is tilted inwardly and permits pin 69 to pass. With the assumption that normally the resetting mechanism including the spring 37 and the two driving gears 60, 61, and gears 62 and 63, and discs 64 and 65, stands still, the seconds arbor is free to be rotated in the normal clockwise direction by the motor M, and every time pin 69 passes pawl 68 the latter is tilted back and allows the pin to pass. A similar arrangement is provided for the minute arbor, namely, the aforementioned resetting disc 65 is provided with a resetting pawl 79, shown in detail in Fig. 5, and constructed similar to pawl 68 shown in Fig. 4. It is provided with a tail 81 which permits pin 75 of disc 24 attached to ratchet wheel 22 (see Fig. 3) to pass when the pin rotates in the normal clockwise direction during the operation of the minute arbor.

Armature 46 is provided with two further arms 76 and 77. In the sectional elevation, Fig. 5, only arm 77 is shown. This is the arm for controlling the resetting of the minute arbor. The other

arm 76 which controls the resetting of the seconds arbor, is directly behind arm 77 in Fig. 5. The operation of both arms is alike and occurs simultaneously so that only the operation of arm 77 with respect to the minute setting will be described with reference to Fig. 5. Arm 77 is provided with a nose 78 extending toward central arbor 6 and bevelled as shown at 79 at its outer end. When armature 46 is attracted, nose 78 is moved inwardly in the direction of the arrow into the path of pin 75 of disc 24 aforementioned.

The operation of the mechanism is as follows: Let us assume that the resetting spring 37 has been wound by the motor and that the spring drive is locked by pin 44 and latch 52 in Fig. 5 in the manner aforedescribed. Let us further assume that the position of the upper edge 78*a* of nose 78, in case the armature is attracted, represents a zero or full hour position of the minute hand. Let us further assume that the clock is say 5 minutes slow, which may be indicated in Fig. 5 by the position of pin 75 with relation to the upper edge 78*a* of nose 78 when the armature is attracted. Now, as soon as the synchronizing impulse is received at electromagnet 45 at the full hour, armature 46 is attracted thereby and arms 48, 76 and 77 are moved inwardly. The inward movement of arm 48 as aforedescribed temporarily releases pin 44, and thereby permits the resetting spring 37 to drive the disc 35 one revolution, after which it is locked again in the manner shown in Fig. 7, as aforedescribed. At the same time, arms 76 and 77 have moved inwardly and, for instance, arm 77 has moved its nose 78 and its surface 78*a* into the path of pin 75. The release of the spring power at the reception of the impulse and the rotation of disc 35 rotates spring arbor 32 and thus rotates disc 65 with its resetting pawl 79. The latter engages with its curved portion 80, pin 75 which is in its path and picks up this pin and moves it forward in the direction of the arrow, that is to say, in the normal clockwise direction. Edge 78*a* of nose 78 standing in the path of the pin, the latter is stopped by this edge and the resetting motion is completed. If it should happen that pin 75 is stopped before pin 44 of spring motor 37 is arrested, i. e. before it has made its complete revolution, the coupling spring 67 permits the spring drive to continue until pin 44 is stopped. This coupling spring arrangement for the minute as well as for the seconds arbor is also of advantage in case the two arbors fail to reach the synchronized position simultaneously. In that case the arbor which is behind can still be moved ahead to its stop position by the resetting train, while the other arbor, due to its spring coupling, allows the resetting drive to slide. It is understood of course that the rotation of disc 35 and spring arbor 32 is quite fast so that pin 75 and thus the minute arbor 20 is thrown quickly into the correct full hour position, practically at the moment when electromagnet 45 is energized. The same occurs with respect to the seconds arbor, the pin 69 of which is picked up by the resetting pawl 68 (see Fig. 3) and thrown against the appertaining armature arm 76 so that also the seconds arbor is thereby reset in case it should not be on time.

This resetting arrangement so far operates only in case the clock is slow. In most of the synchronous motor drives, the clocks if out of time are slow and not fast, and the arrangement is made in such manner that the full revolution of the resetting spring arbor 32, as described hereinbefore, suffices to synchronize a clock which is as much as fifty minutes slow. It may happen, however, that the clock is fast. This amounts generally at most to not more than a few minutes. In order to reset the clock movement described when it is slightly fast, the noses of arms 76 and 77 are bevelled at their outer ends as shown in Fig. 5 at 79 with respect to the nose of arm 77. If the clock should be fast, pin 75 would in that case stand slightly below the zero position, which is marked by "0" in Fig. 5, so that when the resetting impulse is received at the electromagnet 45, the inclined end 79 of nose 78 will pick up pin 75 and push it upwardly counterclockwise into the zero position. This occurs in similar manner with respect to the seconds arbor. After the synchronizing impulse ceases, arms 77, 76 and 48 fall off and the pin 44 of the resetting mechanism slides onto latch plate 52 of arm 48 and thus the resetting spring drive is again locked.

While I have shown and described a particular form of spring power device for accumulating a certain amount of energy delivered by the motor in the course of its normal operation for the purpose of releasing this accumulated power during the resetting period, it is obvious that other spring power devices well known in the art may be substituted.

I claim:

1. In a clock mechanism, a hand arbor, a motor, a clock train connecting said hand arbor with said motor and including a slip friction coupling, an element connected to said hand arbor, a resetting member having a driving movement and disposed to engage said element in the course of its driving movement to impart a continuous movement thereto sufficient to rotate said hand arbor from any angular position to a predetermined synchronizing position, spring-operated driving means for said resetting member, arresting means normally restraining said driving means, means driven by said motor to wind the spring of said driving means, means adapted to respond to a synchronizing impulse to operate said arresting means to release said driving means, and stop means including a positioning element connected to said hand arbor and an abutment member movable simultaneously with said impulse responsive means into the path of said positioning element.

2. In a mechanism for synchronizing motor driven clocks by the driving motor power, a clock train and means for continuously driving said train from the motor, a resetting gear train geared to move said clock train at a speed higher than its normal speed for advancing the clock hands when slow, a spring power accumulator disposed to operate said resetting train and means connected with said driving motor for storing a limited amount of energy in said accumulator during the normal operation of said motor, means for arresting the operation of said accumulator during the normal operation of the clock, means for delivering a synchronizing impulse at the desired time intervals, means controlled by said impulse for releasing said accumulator to operate said resetting train and for re-arresting said accumulator after the completion of the resetting operation, a pawl connected with said resetting train and disposed to engage the clock train during the forward motion of the resetting train, but to permit normally free operation of the clock train when the resetting

train is not in operation, whereby the clock train if slow is advanced by the resetting train, and means controlled by said synchronizing impulse for arresting the clock train in its advance for the duration of the impulse when the clock train has arrived at the required time position.

3. In a mechanism for synchronizing motor driven clocks by the driving motor power, a clock train and means for continuously driving said train from the motor, a resetting gear train geared to move said clock train at a speed higher than its normal speed for advancing the clock hands when slow, a spring power accumulator disposed to operate said resetting train and means connected with said driving motor for storing a limited amount of energy in said accumulator during the normal operation of said motor, means for arresting the operation of said accumulator during the normal operation of the clock, means for delivering a synchronizing impulse at the desired time intervals, means controlled by said impulse for releasing said accumulator to operate said resetting train and for re-arresting said accumulator after the completion of the resetting operation, a dog pin on said clock train and a pawl connected with said resetting train and disposed to engage said pin during the forward motion of the resetting train but arranged to yield when overtaken by said pin while the resetting train is not in operation to permit normally free operation of the clock train, whereby the clock train if slow is advanced by the resetting train, and a stop arm controlled by said synchronizing impulse for arresting the clock train in its advance for the duration of the impulse when the clock train has arrived at the required time position.

4. In a mechanism for synchronizing motor driven clocks by the driving motor power, a clock train and means for continuously driving said train from the motor, a resetting train disposed to advance the clock train when slow and a spring power accumulator for driving said resetting train, means connected with said driving motor for storing a limited amount of energy in said accumulator during the normal operation of said motor, a latch pin on said accumulator and a locking arm having a latch plate disposed in the path of said pin for normally locking said accumulator in energy storing position, means connected with said arm for producing a synchronizing impulse at the desired time intervals whereby said arm is actuated to move said latch plate off said pin to permit the operation of said accumulator, and a second latch plate on said arm movably disposed in the path of said latch pin when said arm is in actuated position to catch said pin and arrest the accumulator after one revolution in position for the pin to be locked by said first latch plate when said arm returns to normal position after cessation of the impulse.

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