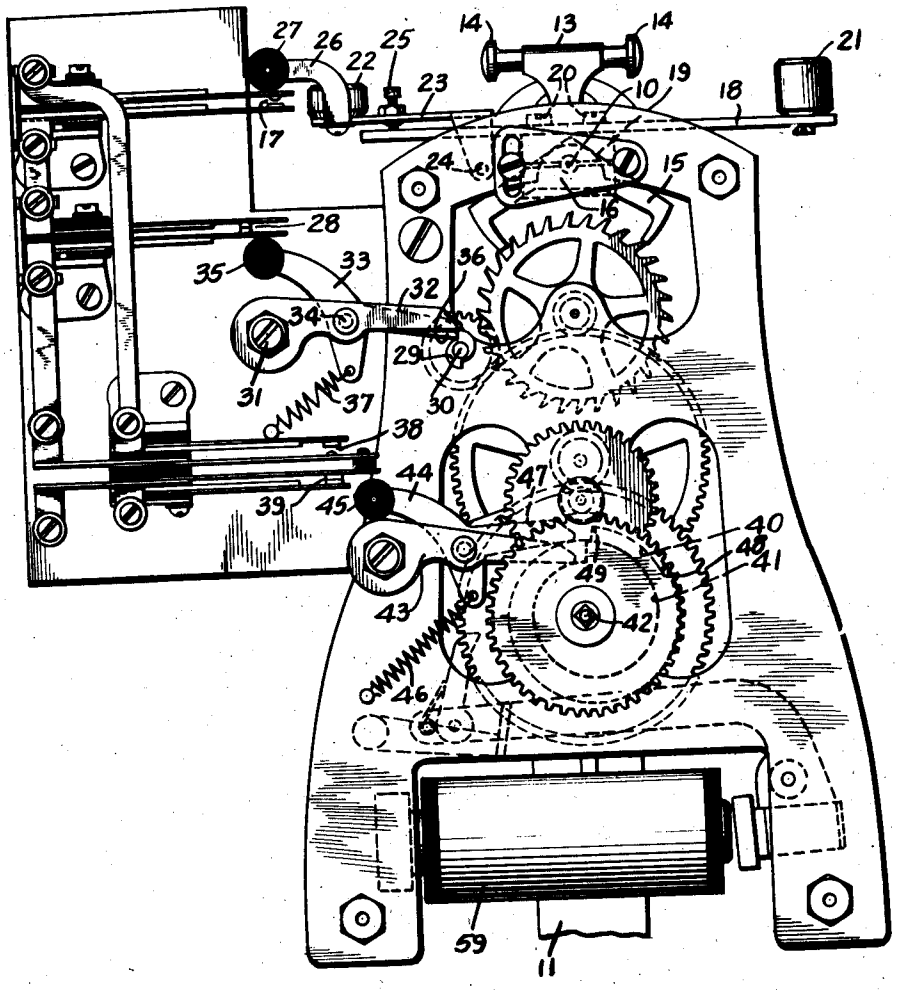
Sept. 20, 1932. C. E. LARRABEE 1,878,931

MASTER CLOCK

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FIG. 1.



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FIG.2.

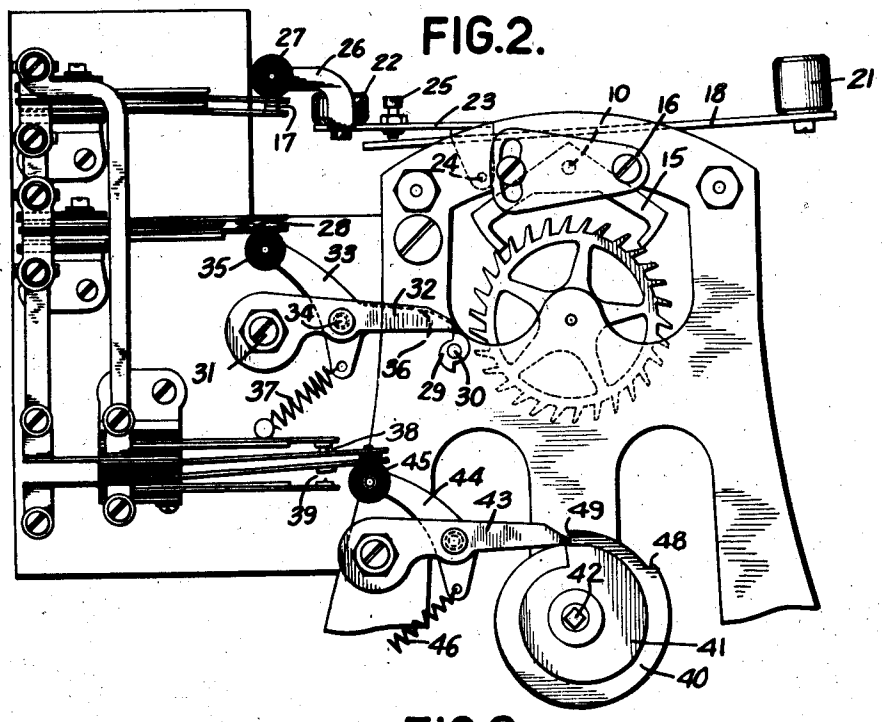
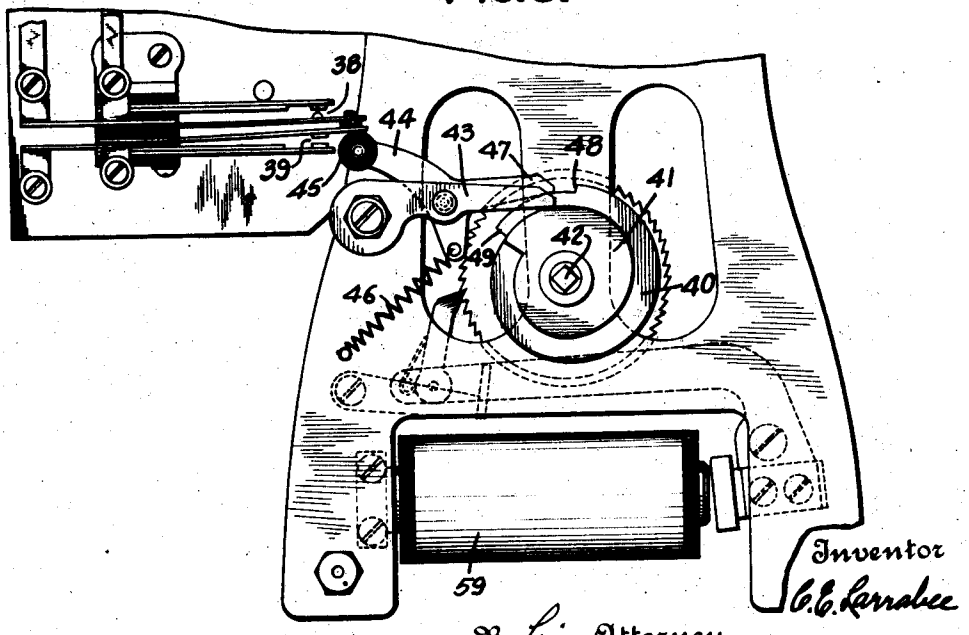


FIG.3.



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FIG. 4.

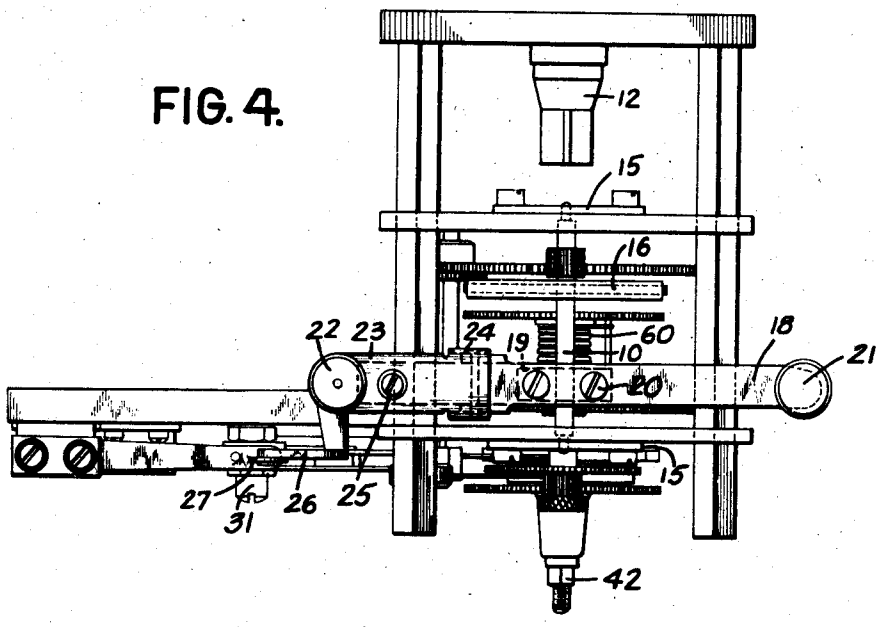
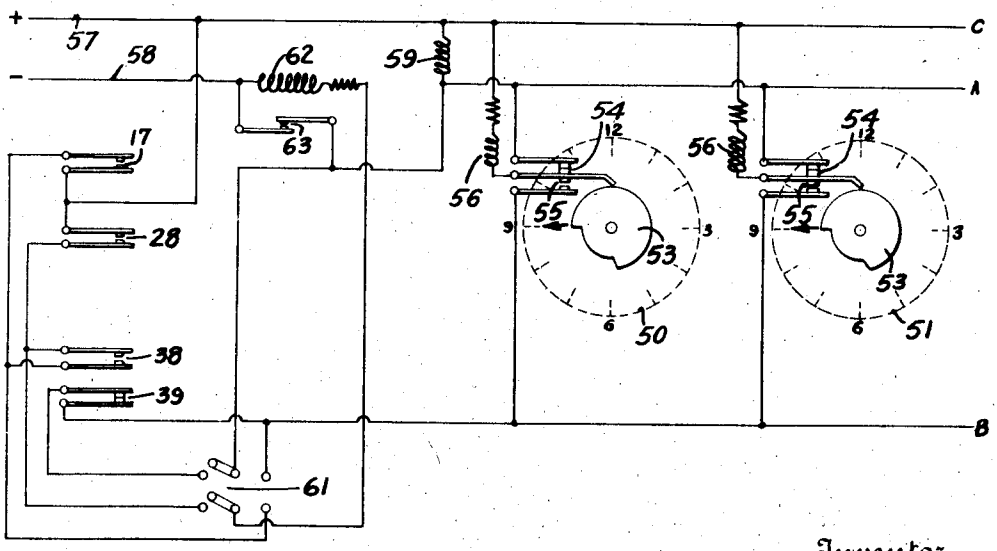


FIG. 5.



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UNITED STATES PATENT OFFICE

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MASTER CLOCK

Application filed April 26, 1930. Serial No. 447,611.

The present invention relates to clock systems in general and particularly to improvements in the construction of master clocks commonly used in connection with systems wherein the secondary clocks are automatically synchronized with the master clock at regular intervals of time.

It has been the practice heretofore to equip master clocks with certain contacts cooperating with the clock movements whereby impulses of electric current are transmitted to the secondary clocks at regular periods of time for the purpose of driving the secondary clocks and also at predetermined intervals of time for effecting synchronization of any of the secondary clocks which may be fast or slow with respect to the master clock. Such synchronizing and impulse contacts are commonly actuated by cams driven by the gearing of the clock train of the master clock and usually include a rapid impulse contact which heretofore has been directly actuated by means mounted upon the verge staff of the escapement mechanism.

The cam actuated contacts have usually consisted of a pair of contacts each of which was borne by and insulated from an arm actuated by a separate cam, both cams being adapted to cooperate to produce a rapid closure and interruption in the circuit. The contacts themselves, being movable, were connected by means of a spirally arranged length of wire to a fixed binding post or contact stud in order to provide for the passage of current through the contacts to the clock circuits and at the same time permit the contacts to be operatively controlled by their respective cams.

The rapid impulse contact commonly consists of a contact member carried by the verge staff and adapted to make contact with a stationary contact carried by the main frame of the clock once each time the verge staff oscillates under the influence of the pendulum.

Letters Patent No. 1,687,491, granted October 16, 1928 to James W. Bryce, illustrates a master clock including contacts of the type described above, the minute impulse contacts and certain of the synchronizing contacts being cam actuated while the rapid impulse contacts are actuated by the verge staff in the manner mentioned.

It has been found in practice that the types of contact illustrated in the patent mentioned have certain defects in practice which interfere with the proper action of the master clock. The flexible coiled conductor wire comprising the electrical connection between the cam operated contacts and the binding posts or contact studs causes trouble owing to the fact that a very light spring tension must be used to hold the cam follower arms against the periphery of the cam in order to reduce the friction load on the clock train to a minimum. It has been found that the usual flexible coil of conductor wire is apt to exert a spring effect upon the cam follower arms in addition to the springs holding the cam follower arms against the cams with the result that the action of the contacts is uncertain since the follower arm springs may be either completely neutralized or augmented in tension. The former condition may render the contacts inoperative while the latter condition increases the friction load on the clock train and has an adverse effect on the accuracy of the clock.

When the contact operated by the oscillation of the verge staff is of the type shown in the above patent there is a tendency to retard the pendulum of the clock and shorten its swing in one direction thereby adversely effecting the accuracy of the clock. The spring tension in the contact finger carried by the verge is extremely difficult to adjust satisfactorily and furthermore fatigue tends to cause the spring tension to vary so that the contacts tend to get out of adjustment after a time. The gradual weakening of the spring contact carried by the verge tends to make the swing of the pendulum greater on one side as time goes on thereby effecting the accuracy of the clock.

It is the primary object of the present invention to improve the construction and arrangement of the various contacts involved in the construction of a master clock thereby in-

creasing the reliability of the contacts and eliminating the defects already pointed out.

Other objects and advantages of the present invention will be pointed out in greater detail in the accompanying specification and claims and shown in the drawings, which, by way of illustration, show what, for the present at least, may be considered a preferred embodiment of the invention.

In said drawings:

Fig. 1 is a vertical elevation of a master clock illustrating the construction and arrangement of the various contacts, the rapid impulse contacts and the thirty-second contacts being shown in open position.

Fig. 2 is a view similar to Fig. 1, the rapid impulse contacts and the thirty-second contacts being shown in closed position.

Fig. 3 is a view of the thirty-second and fifty-minute contacts and their actuating mechanism, both contacts being open;

Fig. 4 is a top plan view illustrating the construction and arrangement of the rapid impulse contacts;

Fig. 5 is a circuit diagram showing a self synchronizing clock system controlled by a master clock embodying the present invention.

Fig. 1 illustrates the general arrangement of a master clock. Since the clock itself is of a well known construction, it will not be described in great detail herein. The numeral 10 represents the usual verge staff which is oscillated by the pendulum 11 of the clock. The verge staff is given one complete oscillation in two seconds thereby controlling the escapement wheel so as to produce one complete revolution of the escapement wheel in one minute. The pendulum 11 as customary is supported by a post 12 and is coupled to the verge staff by a member 13 to which the verge is adjustably connected. The usual screws 14 provide for the adjustment of the verge 15 in a well known manner. The plates 16 further provide for adjustably raising or lowering the verge staff.

The master clock is provided with rapid impulse contacts 17 which are normally open but are adapted to be closed once every two seconds in the present instance through the medium of mechanism now to be described in detail. The rapid impulse contacts 17 are actuated in a novel manner by means carried by the verge staff 10 comprising a member 18 which is firmly fastened to the verge staff by means of clamping blocks 19 and screws 20. A weight 21 carried by the right end, Figs. 1, 2 and 4, of the member 18 acts as a counterbalance for a similar weight 22 carried by a member 23 pivoted at 24, upon the member 18.

The member 23 may be adjusted relative to the member 18 by means of a screw 25 provided with a suitable locknut and is provided with an extension 26 bearing an insulation disc 27 adapted to bear at times upon the upper contact spring of the contacts 17.

It will be clear from the foregoing description that the swinging of the pendulum of the clock will oscillate the verge staff and consequently the member 18 so as to alternately raise and lower the weighted member 23 thereby actuating the contacts 17. The weight 22 is just heavy enough to close the contacts 17 whenever the pendulum swings far enough to the right, Fig. 2, to permit the insulated disc 27 to come into contact with the upper contact spring of the contacts 17. By varying the adjustment of the screw 25 the time at which closure of the contacts 17 is effected may be readily adjusted. It will be clearly seen that the closure of the contacts 17 is effected solely by the weight of member 23 and therefore the pendulum is relieved of the work of closing the contacts. It will be obvious that the inertia of the weight 22 and member 23 will prevent the upper contact spring of contacts 17 from reversing the motion of the member 18 too rapidly thereby eliminating the "kick" which results when one of the contacts 17 is carried by the verge staff as was formerly the case. Furthermore, the screw 25 makes it possible to readily adjust the time of closure of the contacts so that the slight unbalancing of the member 18 and the verge staff near the end of the swing of the pendulum is reduced to a minimum thereby increasing the accuracy of the clock.

It is true that the pendulum will be effected slightly when the weighted arm 23 is arrested by the closing of the contacts; however, the effect on the pendulum will be constant since the weight of said arm is constant and always takes effect at the same point in the swing of the pendulum. By making the upper contact member of contacts 17 of a very weak spring having just sufficient resiliency to open said contacts, the effect of said spring contact member on the accuracy of the clock may be made constant and so slight as to be scarcely noticeable even over a long period of time. While the pendulum is slightly retarded by the relative lifting of the greater part of the weight of arm 23 from member 18, the effect is to shorten by a small amount the distance traveled by the pendulum to the right (Fig. 1) and lengthen its swing to the left by the same amount.

It will be clear that the whole effect will be to cause the pendulum to swing slightly off the center of gravity of the pendulum system without actually affecting its regularity by increasing or decreasing its period of oscillation. By suitable adjustment of the verge in a well known manner the slight angular displacement of the path of movement of the pendulum may be fully compensated. It will be obvious that the only duty required of the pendulum is to swing regularly and this result is secured in the present arrange-

ment although the pendulum may not swing equal distances from a vertical axis through the center of gravity of the system.

The resiliency of the spring contact members carrying contacts 17 will vary as time goes on, however, this variation will be slight since said contacts have little work to do and the upper one may be very weak, so that once adjusted, the mechanism will function over a long period of time without noticeably affecting the accuracy of the clock.

The minute impulse contacts 28 are normally open but are adapted to be closed once each minute for a few seconds through the medium of a two point cam 29 carried by a shaft 30 geared to the clock train so as to complete one revolution every two minutes. Pivoted at 31 is a cam follower 32 normally bearing on the periphery of the cam 29 and actuated thereby. A three armed member 33 is pivoted at 34 upon the follower 32 and one arm is provided with an insulated disc 35 underlying the lower member of the spring contacts 28. An arm 36 is adapted to bear on the periphery of the cam 29 and is held in contact therewith by a spring 37 which is tensioned between a fixed stud and the third arm of the member 33. It will be clear that the spring 37 also holds the member 32 in contact with the cam 29. The arm 36 is of sufficient length to permit it to drop off the high points on the cam 29 a few seconds before the follower 32 drops off the high points and for this reason the follower 32 extends slightly farther to the right, Fig. 1, than the arm 36. When the follower 32 and the arm 36 both rest upon either of the high points of the cam 29 the contacts 28 will be open as illustrated in Fig. 2. The same will be true when both rest upon a low point in the cam. In order to effect closure of the contacts 28 it is necessary that the arm 36 move downwardly relative to the follower 32. This relative movement is accomplished in the following manner: As the cam 29 revolves in a clockwise direction the follower 32 and arm 36 will be gradually raised until eventually the arm 36 will drop off the high point in the cam before the follower 32 drops off the high point. The tension of the spring 37 will now cause the three armed member to rock clockwise to the position shown in Fig. 1 thereby effecting closure of the contacts 28. A few seconds later the follower 32 will drop off the high point in the cam 29 with the result that both the members 32 and 33 will be pulled down by the spring thereby opening the contacts 28.

The contacts 38 and 39 are actuated by a pair of cams 40, 41 carried by the minute arbor 42 which makes one complete revolution per hour. Co-operating with the cam 41 is a cam follower 43 substantially similar in construction to the follower 32. A three arm lever 44 similar to the three arm member 33 is pivoted upon the follower 43 and has an arm bearing on the periphery of the cam 40. Another of the arms of the three arm member 44 carries an insulating disc 45 which bears on the underside of the lower of the two central spring contact members of contacts 38, 39. The two central members are biased downwardly as to their spring tension so that when all restraint on the members is removed the lower contacts 39 will close. A spring 46 interposed between a fixed stud and the third arm of three arm levers 44 holds the arm 47 and follower 43 in contact with the periphery of cams 40 and 41 at all times.

It is necessary that the lever 44 be actuated by the cams 40, 41 in such a manner that either the upper contact 38 or the lower contact 39 may be held closed or both held open and to accomplish that result the cam 40 is provided with two steps of different heights while the cam 41 is provided with only one step. When the follower 43 and the arm 47 rest on the highest points in their cams 40, 41 the contacts 39 are closed which is also the case when both rest on the lowest points in the cams, the position of the parts for the latter situation being illustrated in Fig. 1. The upper contacts 38 are closed when the follower 43 is on the highest point in cam 41 while the arm 47 is on the lowest point in cam 40 as shown in Fig. 2. Neither of the contacts 38, 39 are closed when the follower 43 is on the high point of cam 41 and the arm 47 is resting upon the intermediate step in cam 40, as shown in Fig. 3.

The cam 40 is timed so that the arm 47 drops from the high point 48 in the cam to the intermediate step at about 49 minutes and 30 seconds after the even hour while the intermediate point 49 is positioned to permit the arm 47 to drop still further at about 59 minutes and thirty seconds after the hour. The high point in cam 41 is timed to become effective to release the follower 43 just before the minute impulse contact 28 closes for the 60 minute thereby closing contacts 39. The contacts 39 remain closed for nearly fifty minutes of the hour.

The clockwise rotation, Fig. 1 of the minutes arbor 42 and consequently cams 40, 41 causes both the follower 43 and lever 44 to rise without, however, opening the contacts 39 since this movement merely moves the insulated disc 45 to the left a slight amount. At about 49 minutes and 30 seconds after the hour the arm 47 drops from the high point 48 on cam 40 to the intermediate step under the influence of spring 46 which rocks the lever 44 clockwise relative to follower 43 thereby opening contacts 39. Both of the contacts 38, 39 remain open until about 30 seconds after the 59th minute when the arm 47 drops from the intermediate point 49 to the lowest point in cam 40 thereby permitting

the spring 46 to further rock the lever 44 clockwise relative to follower 43 and causing the closure of contacts 38. The contacts 38 remain closed until just before the cam 29 permits contacts 28 to close for the 60th minute impulse prior to which the follower 43 will drop off the high point in cam 41 and again close contacts 39.

Fig. 5 illustrates a circuit diagram which explains the function of the various contacts just described. The principle of operation is substantially the same as in the patent to Bryce hereinbefore mentioned, certain parts having been eliminated. Only a brief description of the system will be given herein since the system itself forms no part of the present invention.

The letters A, B and C represent the three well known circuit wires of a system to which the secondary clocks 50, 51 are connected as in the patent to Bryce already mentioned. Each secondary clock is provided with a cam 53 adapted to close one or the other of contacts 54, 55. The driving magnet 56 of each secondary clock is connected to the "C" wire and also to the central common contact member of the contacts 54, 55. The cams 53 are proportioned so that contacts 54 are opened and contacts 55 are closed during a period of time from about 30 seconds of the hour to about 14 minutes and thirty seconds after the hour. At all other times contacts 54 are closed. The function of the cams 53 and contacts 54, 55 is to transfer the circuit through the driving magnet 56 from the "A" wire to the "B" wire during the synchronization period. The "C" wire may be considered as an extension of one of the line wires 57, 58 supplying the system with electrical current.

The master clock is provided with a winding magnet 59 adapted to wind up the power spring 60 periodically, in the present case once each minute, the magnet being connected between the "A" and "C" wires. The double pole switch 61 is normally thrown to the left, Fig. 5 so as to connect the minute impulse contacts 28 across the line wires 57, 58 in series with the master relay 62. Each time the master relay 62 is actuated by the closure of contacts 28 the contacts 63 of the master relay connect the "A" wire with line wire 58 thereby delivering an electrical impulse to the driving magnets 56 and advancing the secondary clocks one minute and at the same time energizing winding magnet 59. As long as contacts 39 are closed the impulses may travel over either the "A" or the "B" wires but during the time the contacts 39 are open the "B" wire is disconnected and any of the secondary clocks which may be connected to the "B" wire will not receive an impulse and will stop until the contacts 39 are again closed after the synchronization period is complete.

If clocks 50 and 51 are both on time with the master clock they will be both transferred to the "B" wire simultaneously about thirty seconds before the hour and, since contacts 39 close a few seconds prior to the closing of contacts 28 both of the secondary clocks will receive the 60th impulse simultaneously.

If clock 50 is on time and clock 51 fast by, say ten minutes, clock 50 will continue to receive the minute impulses over the "C" wire while the clock 51 will reach the 59th minute first and will stop until the contacts 39 are reclosed which will not take place until clock 50 receives the 60th impulse just after contacts 39 are closed by the master clock, the 60th impulse being returned over the "B" wire. All secondary clocks which are on time remain connected to the "B" wire for a period of fifteen minutes before the cams 53 connect the "A" wire to the clocks.

If the clock 51 happens to be slow by, say ten minutes, it will be ten minutes behind the other clocks when they receive the 59th impulse and will still be connected to the "A" wire after all of the other clocks have been transferred to the dead "B" wire. As stated hereinbefore contacts 38 are closed for about 30 seconds between the 59th and 60th impulses thereby connecting the relay 62 in series with the rapid impulse contacts 17 across the line wires 57, 58. The result is that a rapid succession of impulses will be delivered to the clock 51 which is slow and still connected to the "A" wire. The rapid succession of impulses sent over the "C" wire advances the minutes hand of clock 51 until the operation of its cam 53 automatically transfers the clock 51 to the dead "B" wire which will occur when the clock 51 reaches the 59th minute. All of the clocks have now been transferred to the "B" wire so that when the 60th minute impulse is sent over the "C" wire all of the clocks will be advanced to the hour position and will be in synchronism.

The double pole switch is provided for the purpose of connecting the rapid impulse contact 17 directly in series with the relay 62 when it is desired to advance all clocks simultaneously one hour when correcting the system to daylight saving time or when the clocks have been stopped by an interruption in the power supply for a longer period of time than can be taken care of by the synchronization period. The entire system can be entirely disconnected by means of switch 61 when it is necessary to turn the clocks back an hour at the end of the daylight saving period.

It is thought that the foregoing explanation will clearly explain the function and mode of operation of the various contacts and

for present purposes may be considered sufficient.

The principal advantages of the improved contacts is the greater reliability and efficiency obtained through the more positive action. The reduction in the friction load on the clock train and the elimination of the uncertainty of operation of the contacts which was formerly found in practice results in an improved operation of the system as a whole and an increase in the accuracy of the master clock. The adjustable feature of the rapid impulse contacts is a very decided advantage brought about by the present construction.

The present invention, for sake of convenience in description and to assist in a clear understanding of the principles involved, has been shown as embodied in a master clock for the purpose of actuating certain specific contacts, however, it is not desired to limit the invention to the precise embodiment shown and described as it is capable of modification and adaptation to other types of clocks or apparatus as well, all such modifications and adaptation falling within the scope of the claims which follow.

I claim:

1. In a circuit controlling device, a frame, contacts mounted in said frame, a member pivotally mounted in said frame adjacent said contacts, an arm mounted on said member intermediate the ends of the latter and adapted to operate said contacts by a pivotal movement relative to said member, means for periodically permitting pivotal movement of the arm to operate said contacts and thereafter a second pivotal movement of said member to restore said contacts to their former condition, and means connected to said arm for effecting both pivotal movements of said arm and member under control of the first named means.

2. In combination with a master clock, a frame, a pair of normally open spring contacts fixedly mounted in the frame, a member rockably mounted in the frame and having pivoted intermediate its ends a rock arm provided with an extension adapted to close said contacts when the arm is rocked relative to said member, a cam driven by the master clock for permitting periodical rocking of said arm to close said contacts, a second cam movable with the first cam for permitting a rocking movement of said member to open said contacts, and means connected to said arm for effecting both rocking of said arm and said member to first close and then open said contacts under control of said cams.

3. In a circuit closing device, a frame, a pair of spring contact members fixedly mounted in said frame and adapted to be operated at regular intervals, a pair of operating members one being pivotally mounted on the other and adapted to have a movement relative to each other to close said contacts, and means for periodically effecting said relative movement.

In testimony whereof I hereto affix my signature.

CLINTON E. LARRABEE.