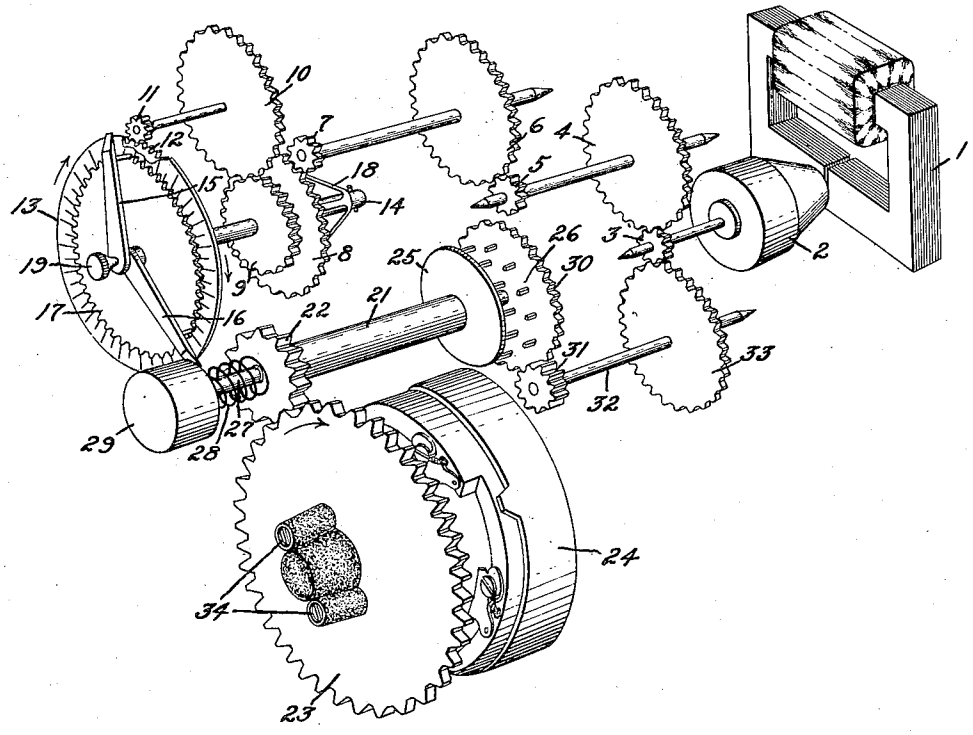
April 14, 1925. 1,533,677

H. E. WARREN

MOTOR OPERATED TIME SWITCH

Filed Oct. 25, 1921 2 Sheets-Sheet 1

Fig. 1.



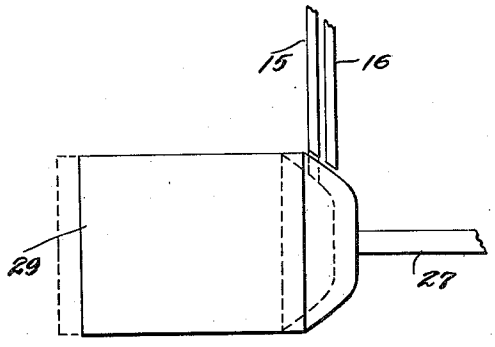


Fig. 5.

Inventor:
Henry E. Warren,
by Albert G. Davis
His Attorney.

April 14, 1925. 1,533,677

H. E. WARREN

MOTOR OPERATED TIME SWITCH

Filed Oct. 25, 1921 2 Sheets-Sheet 2

Fig. 2.

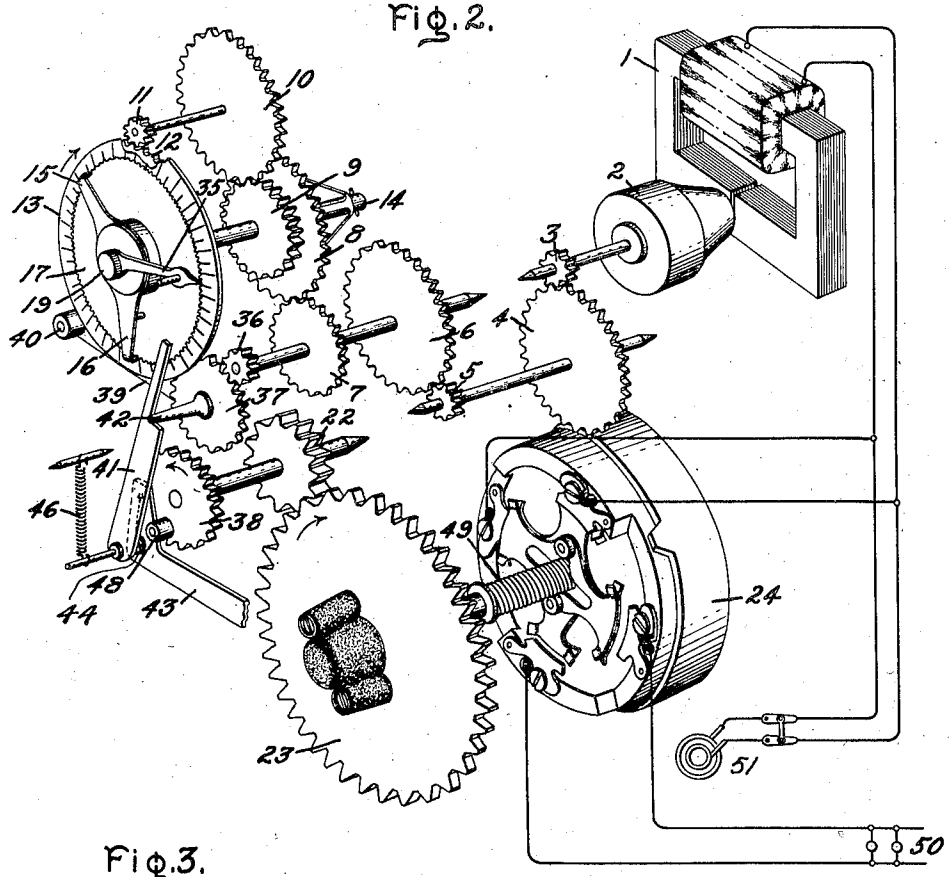


Fig. 3.

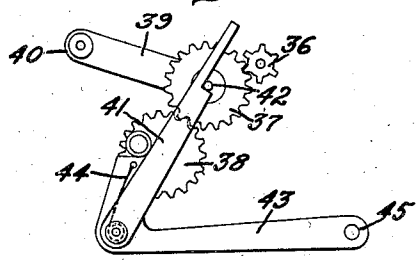
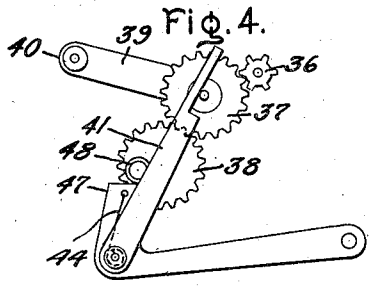


Fig. 4.



Inventor:
Henry E. Warren,
by Allen & Davis
His Attorney.

Patented Apr. 14, 1925. 1,533,677

UNITED STATES PATENT OFFICE.

HENRY E. WARREN, OF ASHLAND, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MOTOR-OPERATED TIME SWITCH.

Application filed October 25, 1921. Serial No. 510,232.

To all whom it may concern:

Be it known that I, HENRY E. WARREN, a citizen of the United States, residing at Ashland, in the county of Middlesex, State of Massachusetts, have invented certain new and useful Improvements in Motor-Operated Time Switches, of which the following is a specification.

This invention relates to time switches particularly for electric current although the device can be used equally well for controlling other fluids such as gas or water or in fact for any purpose where sudden movement is required at certain predetermined intervals.

My invention will be better understood from the following description taken in connection with the drawings and its scope will be pointed out in the appended claims.

Fig. 1 is a drawing in perspective of the various elements making up one form of my invention. Fig. 2 is a similar drawing showing a modification of my invention. Figs. 3 and 4 show different operating positions of part of the mechanism shown in Fig. 2 and Fig. 5 shows a detail of Fig. 1.

Referring to Fig. 1 of the drawings, 1 indicates an alternating current synchronous motor such as described in my U. S. Patent 1,283,432, although I do not wish to be limited to any particular type of synchronous motor. The rotating element 2 of this motor is connected through a chain of reduction gears numbered 3 to 12 inclusive, to a disk 13 which is rotatively mounted on the same shaft 14 which carries gears 8 and 9. The peripheral face of the disk 13 carries a uniformly graduated scale which may be suitably divided to represent time. The relative speed of rotation between rotor 2 and disk 13 is such that when the synchronous motor is connected to a source of constant frequency alternating current, the disk 13 will make one revolution in 24 hours or any other desired length of time depending upon the purpose for which the device is to be used. In the present case, I have shown the scale as representing 24 hours, the half-hour points also being indicated, and therefore arrange the gearing so that the disk 13 makes one complete revolution every 24 hours. Rotatively mounted on the outer end of shaft 14 adjacent the face of the dial 13 are two arms 15, 16. A notched disk 17 is provided integral with disk 13 which cooperates with inwardly projecting pins on the arms 15, 16, to securely hold the arms in any desired position. The notches in disk 17 are equally spaced and correspond to the 48 divisions in the time scale. The arms 15, 16 are made of spring material in order that they may be outwardly flexed to disengage their inwardly projecting pins from the notched disk and rotated to any other desired position. Gear wheel 9 is secured to shaft 14. Gear wheel 8 is rotatively mounted on shaft 14, but is held in frictional engagement with gear wheel 9 by means of the spring member 18 so that normally they will be driven together by gear 7. On the outer end of shaft 14 is secured a knurled head 19 by means of which the shaft 14 and gear 9 may be rotated independently of gear 8 in order to set the dial 13 in any desired position. Gears 8 and 9 form the two parts of a slip friction clutch which permits this adjustment to be made. For the sake of convenience in setting the dial arms, I prefer to have the dial suitably marked with two sets of numerals from 1 to 12 inclusive, respectively representing the hours of day and night. The parts already described are secured in a suitable framework (not shown) for holding the parts in operative engagement. Rotatively secured in the same framework is a hollow shaft 21 aranged parallel with shaft 14. The outer end of shaft 21 carries a gear 22 which meshes with a gear 23. Gear 23 is in driving connection with the device which is to be operated at predetermined intervals. In the present case, I have shown this device to be an ordinary snap switch 24 for switching electric current on and off. However, it is apparent that the gear 23 might operate any other device, for example, a valve. The other end of shaft 21 carries one member 25 of a clutch which is illustrated in the disengaged position with respect to the other clutch member 26. The clutch member 26 is mounted on the end of a shaft 27 which passes freely through hollow shaft 21 and is normally held in the disengaged position by a coiled spring 28 secured to the gear 22 and shaft 27. On the outer end of the slidable shaft 27 is an enlarged portion 29, the inner end of which is ball shaped. This ball shaped portion is located adjacent the dial 13 and in the path of movement of the arms 15, 16. The outer ends of arms 15, 16

are beveled so that when they come in contact with the ball shaped portion of member 29, they will move the same outward together with the shaft 27 and clutch member 26. In the outer edge of clutch member 26 is cut a gear 30 which is in operative engagement with a gear 31 when the clutch member 26 is moved to engage its cooperating member 25. The gear 31 is continuously driven through shaft 32, gears 33 and 3 from the synchronous motor so that when the beveled edge of one of the arms 15 or 16 passes under the ball shaped member 29, the clutch members 25, 26 and the gears 30, 31 will be moved into operative engagement and driving connection will be established between the synchronous motor, rotor 2 and the movable member of switch 24. As soon as the arm passes out from under the ball shaped portion 29, spring 28 will return the clutch member 26 together with its gear 30 to the inoperative position. Fig. 5 shows the positions of arms 15 and 16 just before contacting with the rounded surface of member 29 and the dotted line position represents the member 29 as moved outward by arm 15. The gear ratio between the synchronous motor and the movable switch member is such that during the interval of time the movable switch member is being driven, it will move a sufficient distance to perform one of the operations of closing or opening the switch, but never long enough to perform both of these operations. In this way when the arm passes from under the ball shaped surface of member 29, the spring of the snap switch shaft is released and rotates the switch member and the attached gearing backward a slight amount until the next time that the switch is operated.

The operation of the time switch just described is as follows:

It is assumed that the synchronous motor is connected to an alternating current system of standard frequency and continuously drives the dial 13 together with arms 15, 16 in a clockwise direction so that they make one revolution in 24 hours. For a clockwise rotation of dial 13, the hour divisions should be numbered in a counter-clockwise direction. Let us assume that the switch 24 is open and that it is desired to set the arms to close the switch at 4 p. m. and open the switch at 5 a. m. and that it is now 3 p. m. The dial is turned by means of the knurled knob 19 thru gears 9, 10, 11 and 12 so that 3 p. m. on the dial is opposite the point at which one of the arms would cause the switch to operate. One arm is then moved opposite the point on the dial corresponding to 4 p. m. so that in one hour it will cause the switch to operate to closed position. The other arm is moved to the point on the dial corresponding to 3 a. m. so that it will come in contact with the ball shaped surface of member 29 and cause the switch to be operated to open position at 3 a. m. The two arms will then take up some such position as illustrated in Fig. 1, arm 16 being opposite the point on the dial corresponding to 4 p. m. and arm 15 being opposite the point corresponding to 3 a. m. It is obvious that it is not necessary to have the dial numbered or to move the same relative to the synchronous motor in setting the arms, but it lessens the liability to make a mistake if the dial is numbered and set as described. Arm 16 is shown just starting to move into contact with the ball shaped surface of member 29. During the next hour of its movement, it will have brought the clutch members 25, 26 and the gears 30, 31 into operative engagement and the synchronous motor will have driven the switch operating gear 23 a sufficient distance to close the switch contacts. Shortly thereafter the arm 16 will have passed from under the ball shaped surface of member 29 and the clutch with its gear will be returned to the inactive position shown in Fig. 1 by means of the spring 28. As soon as the clutch member is released the spring (not shown) contained in the snap switch 24 will rotate the switch gear 23 and the shaft 21 backward a slight amount so that the switch parts are always in the same relative position at the beginning of each closing or opening operation thus ensuring an accurate setting of the time switch. The opening of the switch 24 is accomplished in the same manner when arm 15 passes under the member 29.

In Fig. 2, I have illustrated a modification in the manner of establishing driving connections between the synchronous motor and the switch. The dial 13 of Fig. 2 is driven in substantially the same manner as previously described in connection with Fig. 1. Arms 15, 16 perform the same function as previously described. In Fig. 2 I have shown the arms bent over at their extremities, the bent over portions cooperating with the notched disk 17 for accomplishing the same purpose as the inwardly projecting pins illustrated in Fig. 1. The notched disk 17 is provided with 96 notches so that the arms 15, 16 may be set at one-quarter hour intervals. In addition to the knurled head 19, I provide a crank 35 keyed to shaft 14 to facilitate in setting the dial. The gear ratio between shaft 14 and dial 13 is such that crank 35 makes 24 revolutions for each revolution of the dial. It may therefore serve as a time indicator and the outer end terminates in a pointer for that purpose.

The manner of connecting and disconnecting the driving connection between the synchronous motor and the switch will now

be explained. The switch gear 23 is driven by the synchronous motor thru the following train of gears, starting from the motor end, 3, 4, 5, 6, 36, 37, 38, 22 to 23 on the shaft of the snap switch, 24. Normally, this train of gears is interrupted between gears 37 and 38 as illustrated in Fig. 2. The gear 37 is rotatively secured in the free end of a pivoted arm 39. The other end of this arm is pivoted to the framework at 40 in such a position with respect to gears 36 and 38 that gear 37 may be lowered into engagement with gear 38 while maintaining engagement with gear 36. The relative position of the pivoted arm with respect to the gears is better illustrated in Figs. 3 and 4. The gear 37 is normally held out of engagement with gear 38 by a stepped member 41 which engages the extended end of the shaft 42 upon which the gear 37 rotates. The member 41 is pivoted at its lower end to an arm 43 and is biased toward shaft 42 by means of a spring 44. The upper end of the stepped member 41 normally stands in the path of movement of the arms 15, 16 which rotate in a clockwise direction. When one of the arms comes in contact with member 41, the latter will be moved to the left a sufficient amount to cause the step to disengage the shaft 42 and allow gear 37 to drop into engagement with gear 38 thus completing the driving connection to the switch 24. To the end that the driving connection may be broken after the desired movement has been imparted to the switch 24, I pivot the arm 43 to the framework at 45 and provide means for momentarily lowering this arm together with stepped member 41 so that it will again engage the shaft 42 and raise the gear 37 out of contact with gear 38. Arm 43 is normally held up in the position shown in Fig. 2 by a spring 46. A stop (not shown) is provided to limit the upward movement of arm 43. The free end of arm 43 carries an upwardly extending portion 47 which cooperates with a roller 48 fastened to the gear wheel 38 to form a cam which makes one revolution for each operation of the switch. In the present case, a quarter of a revolution of the switch operating gear 23 will open or close the switch so that the gear ratio between gears 23 and 22 is 4 to 1. When the driving connection between the motor and switch is broken, the roller 48 will stand in the position shown in Fig. 2 because there is sufficient tension in the switch spring 49 to rotate the gears backwardly a slight amount after the switch has operated. Thus the upwardly projecting portion of arm 43 also cooperates with roller 48 to provide a stop to prevent further backward rotation of the switch gears 22 and 23. This feature ensures that the switch will always be operated in the same length of time after the driving connection is made and therefore ensures an accurate time setting of the switch. The purpose of the cam is to lower the arm 43 together with stepped member 41 after the latter has been moved to the left by one of the arms 15 or 16 and the gear 37 has been moved into driving connection so that the member 41 will again engage shaft 42 and lift gear 37 out of driving connection at the proper time after the switch has operated. As soon as gear 37 drops into engagement with gear 38, the latter will be driven in a counterclockwise direction to operate the switch. After about three-quarters of a revolution has been made by gear 38, roller 48 comes into contact with the upper surface of projection 47 on arm 43. The arm 43 will then be moved downward together with member 41 until the stepped portion again engages the shaft 42. This position is illustrated in Fig. 3. Fig. 4 illustrates the position of member 41 just before roller 48 releases the arm 43. When the roller 48 passes out of engagement with the upper surface 47, spring 46 will cause a quick upward movement of member 41, the gear 37 will be positively disengaged from the gear 38 and the parts will be in proper position for another operation. From an inspection of Figs. 3 and 4, it will be evident that during the time gear 37 is in driving connection with gear 38, the former will positively drive the latter in a counterclockwise direction, but that if it were attempted to drive gear 37 in a clockwise direction by gear 38, for example, by the manual operation of the switch, gear 37 would be lifted a sufficient distance to allow the teeth of the two gears to slip over each other and no motion would be transmitted to gear 37. This feature allows the switch to be manually operated at all times without interfering with the setting of the timing mechanism or the operation of the synchronous motor. It is also evident that the switch might be set to operate in any given fraction of the time required for gear 38 to normally operate the switch after it is set in motion without interfering with the normal setting of the timing device. This feature is especially valuable for testing purposes. Suppose, for example, that the switch is installed in a basement and that it controls lights in front of the building which cannot be seen from the basement. An inspector arrives during the time the lights are off and he desires to ascertain the condition of the lights. After going to the basement and inspecting the time switch, he turns the lights on by the manual snap switch 24 without disturbing the setting of the arms 15, 16. He then turns the switch towards

the off position until the gear 38 takes up some such position as shown in Fig. 3. He may then return to the street, inspect the lights and go on his way without making another trip to the basement with the knowledge that in a few minutes the lights will be turned off by the synchronous motor 1.

The setting of the timing device and the operation of the arrangement shown in Fig. 2 is in other respects similar to that of Fig. 1. It will be noted that in both Figs. 1 and 2 the switch 24 is normally disengaged from the timing mechanism and may be turned off and on at will for testing purposes if desired without interfering in any way with the setting of the timing device or the operation of the synchronous motor. It will also be noticed that the switch 24 may be a standard snap switch, the only change necessary to convert it into a time switch being the addition of the gear 23. The gear 23 is here shown secured to the switch stem by means of two screws 34.

In Fig. 2, I show a source of alternating current 51 adapted to supply the synchronous motor 1. The same source is shown arranged to supply a load 50 thru the motor operated time switch 24. The motor, gearing and timing device may be nestled together in a frame in a very compact manner, the switch may be mounted on the same framework and the whole device enclosed in a suitable casing.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A time switch comprising in combination a continuously rotating motor, a time element driven thereby, a circuit controller, operating means for said controller adapted to be driven by said motor through a train of gears, one of said gears being movable to a position to interrupt said train, means controlled by said time element for allowing said movable gear to move into driving position at predetermined different times, and means dependent upon the subsequent operation of said controller for moving said gear out of said driving position.

2. A time switch comprising in combination an electric clock, the motor element of which is a synchronous motor, a circuit controller, means manually operable at all times for operating said controller, a normally disengaged driving connection between said motor and controller operating means whereby said controller may be operated by said motor when said connection is established, means controlled by said clock for establishing said driving connection at predetermined times, and means operated by said motor for disengaging said driving connection after each motor operated operation of said controller.

3. A motor operated time switch comprising in combination a synchronous electric motor, a time element driven by said motor, a standard snap switch, a driving connection between said motor and switch which is normally disengaged so as to permit said switch to be operated independently of said motor, and means controlled by said time element for establishing said driving connection at predetermined adjustable times.

4. A motor operated time switch comprising in combination a synchronous motor, a time element driven thereby, a circuit controller, a normally incomplete mechanical driving connection between said motor and said circuit controller and means controlled by said time element for completing said driving connection at predetermined adjustable intervals.

5. A motor operated time switch comprising in combination a synchronous electric motor, a time element driven thereby, a circuit controller adapted to be operated by said motor, a normally incomplete mechanical driving connection between said motor and said controller, means controlled by said time element for completing said driving connection at predetermined intervals and means operated by said motor for interrupting said driving connection.

6. A motor operated time switch comprising in combination a synchronous electric motor, a time element driven thereby, a circuit controller adapted to be operated by said motor thru a train of gears, said gear train being normally interrupted, means controlled by said time element for completing said gear train at predetermined adjustable intervals and means in the normally inactive portion of said gear train for interrupting said gear train after said controller has been operated by said motor.

7. A motor operated time switch comprising in combination a synchronous electric motor, a timed dial driven thereby, a circuit controller, a movable gear wheel adapted to be moved to establish driving connections between said motor and said switch, a pivoted member adapted to normally hold said gear out of driving connection with said switch, rotatively adjustable arms on said dial adapted to cause said member to release said gear and establish said driving connections at predetermined intervals, a normally inactive gear

in said driving connection adapted to make one revolution for each operation of the switch and a cam associated with said inactive gear adapted to cause said pivoted member to move said movable gear out of driving connection with said switch after said switch has operated.

8. A motor operated time switch comprising in combination a synchronous electric motor, a timed dial driven thereby, a manually operatable snap switch, a movable gear wheel adapted to be moved to establish driving connections between said motor and said switch, means associated with said timed dial adapted to establish said driving connections at predetermined adjustable intervals, a normally inactive gear in said driving connections geared to make one revolution for each operation of the switch and a cam associated with said normally inactive gear adapted to disengage said driving connection and to limit the backward rotation of said switch after each operation.

9. A time switch comprising in combination a synchronous motor, a timing device driven by said motor, a manually operatable circuit controller adapted to be placed in driving connection and operated by said motor at predetermined adjustable intervals controlled by said timing device, means for establishing said driving connection which permits said controller to be operated independently of said motor when said driving connection is established and normally inactive means for interrupting said driving connection after said circuit controller has been operated.

In witness whereof, I have hereunto set my hand this 17th day of Oct., 1921.

HENRY E. WARREN.