Feb. 23, 1943. G. P. COWLES 2,312,077

PROCESS TIMER

Filed Nov. 25, 1941

Fig. 1.

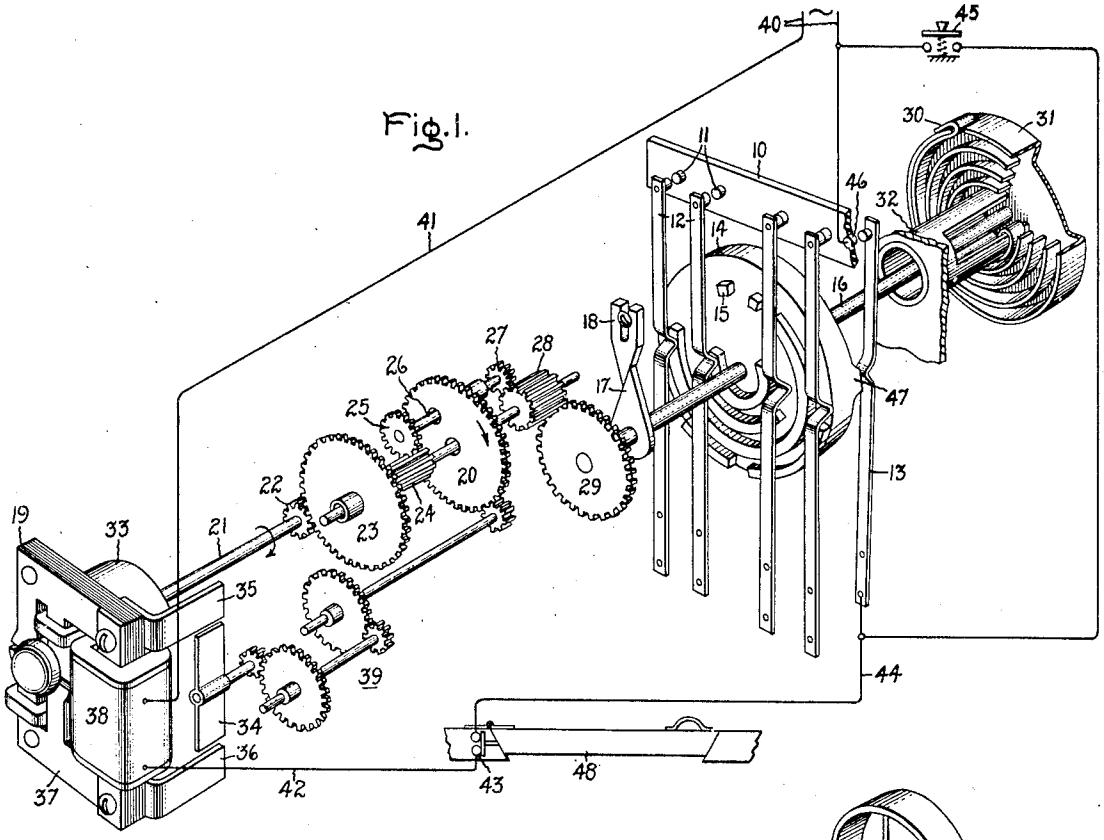


Fig. 3.

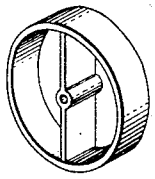


Fig. 2.

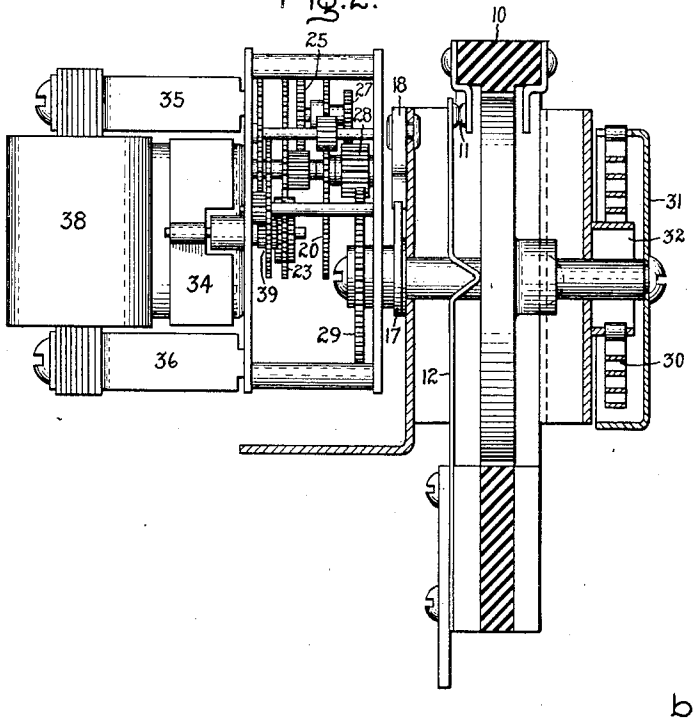


Fig. 4.

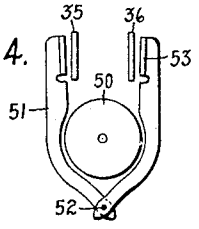
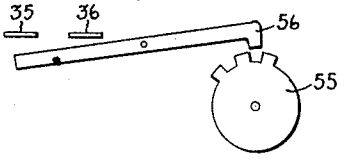


Fig. 5.



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His Attorney.

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2,312,077

PROCESS TIMER

George P. Cowles, Framingham, Mass., assignor to Warren Telechron Company, a corporation of Maine

Application November 25, 1941, Serial No. 420,365

6 Claims. (Cl. 161—1)

My invention relates to process timers and in particular to a process timer which, upon completion of its timing operation, resets or reconditions itself for a repeat operation.

The features of my invention which are believed to be novel and patentable will be pointed out in the claims appended hereto. For a better understanding of my invention, reference is made in the following description to the accompanying drawing in which Fig. 1 represents an exploded perspective view of a preferred form of my invention; Fig. 2 represents a side view, partially in section, of the mechanism of Fig. 1 but in a more compact assembly; and Figs. 3, 4 and 5 represent modified release mechanisms which may take the place of the magnetic release device 34 of Fig. 1.

Referring now to Fig. 1, at 10 I have represented a panel provided with a plurality of stationary contacts 11. Such stationary contacts may be provided both on the front and rear of the panel 10. Cooperating with such stationary contacts are a plurality of movable contact fingers 12. 13 designates a contact finger cooperating with a stationary contact on the rear of panel 10. 14 represents a rotary member of insulating material having a plurality of raised cam surfaces such as 15 and 47 adapted to be rotated beneath the various contact fingers to open and close the contacts at 11. The number and sequence operating arrangement of the various contacts and cam operating members will vary, depending upon the nature of the process to be controlled. For example, the controller may be arranged to control the various operations of an automatic electric dishwashing machine, the washing machine process being started by a push button or the like. It is intended that the rotary controller member 14 will make substantially one complete revolution in a clockwise direction between initial and final positions during a process timing operation in a certain prescribed time and at the end of such time rotate quickly in a counter-clockwise direction to its initial position and be ready to repeat the timing process.

The rotary controller is mounted on a shaft 16, which shaft also carries a stop finger 17 which, in the initial or zero position represented, rests against a stationary stop 18, which stop may be made adjustable for controlling the time of the total cycle. During a process timing operation the rotary controller 14 is rotated in a clockwise direction by a timing motor 19 which may be a synchronous motor of the unidirectional self-starting type. The motor is connected to drive shaft 16 through a gear train which includes differential gearing, the central member of which is designated 20. Thus, if member 20 is held from rotation, the motor drive comprises shaft 21, gears 22, 23, 24, 25, shaft 26, gears 27, 28 and 29. The shaft 26 has a bearing in and is carried by the differential member 20. Gears 24 and 28 have the same axis of rotation as differential member 20 but these three members are rotatable independently of each other on such axis.

It is now evident that when differential member 20 is held stationary and the motor 19 is operating in the direction indicated by the arrow adjacent its terminal shaft, controller member 14 will be rotated in a clockwise direction.

Also secured to shaft 16 of the rotary controller 14 is the outer end of a spiral spring 30, the connection being through a connecting drum 31 secured to shaft 16. The inner end of spring 30 is held by a stationary sleeve 32. Hence, when the controller member 14 is rotated in a clockwise direction by motor 19, the spring 30 is wound up. The purpose of spring 30 is to rotate controller member 14 in a counter-clockwise direction and return it to a zero or initial position at the end of a process timing operation.

The motor 19 may not have its rotor operated in the reverse direction by the spring even when the motor is deenergized primarily because of the high gear reduction contained within the gear casing at 33. Hence, in order for the controller member 14 to be rotated counter-clockwise by spring 30, the differential member 20 is released and allowed to rotate in the direction indicated by the arrow thereon.

Differential member 20 is controlled or normally held from rotation when the motor 19 is energized by a magnetic lock 34 which is magnetically held in the position shown when the motor 19 is energized by reason of the diversion of a portion of the motor field flux through auxiliary pole pieces 35 and 36 branched off from the motor field core 37 on opposite sides of its field coil 38. This magnetic lock or fly 34 is rotatively mounted between the auxiliary pole pieces 35 and 36 and is geared to the differential member 20 as shown through a suitable gear train 39. When the motor is deenergized, the magnetic bar lock 34 is no longer attracted to an aligned position between the auxiliary pole pieces 35 and 36 and is then free to turn.

A motor control circuit suitable for use with my process timer is shown in Fig. 1. 40 repre-

sents a suitable source of supply. The motor has one terminal connected thereto through the wire 41. The other motor terminal is connected by wire 42 through a safety switch 43 and wire 44 to the movable contact 13 of the process controller and also to one side of a push button switch 45. The corresponding stationary contact 46 of the controller and the other side of push button switch 45 are connected to the other side of supply source 40.

It will be noted that in the initial or zero position of the controller 14 shown, motor circuit contactor 13 is held open by a short cam projection 47 on the rear of the controller disk 14. Cam projection 47 is preferably of such length that the motor circuit will also be opened thereby at the end of the process timing cycle after the disk 14 has rotated nearly 360 degrees in a clockwise direction and before stop 17 has come against the rear side of stop 18.

To start the process timer into operation, normally open push button 45 is closed momentarily. The motor 19 starts and revolves controller 14 in a clockwise direction. Contact finger 13 very shortly closes on contact 46 after which push button switch 45, in parallel, may be released. Magnetic lock 34 is held from rotation by the motor field and hence controller disk 14 is rotated to operate the various other switches associated therewith to time the process to be controlled. At the end of the process timing period stop 17 approaches stop 18 and contactor 13 is lifted by the leading edge of cam projection 47. The motor 19 is therefore deenergized, magnetic latch 34 is released and spring 30, which was wound up during the timing operation, rotates controller 14 quickly in a counter-clockwise direction to its initial position. Preferably, when in the initial position, the spring 30 will be under sufficient initial tension to positively return the parts to such initial position with stop finger 17 against the front side of stop 18.

Now, it will be noted that very shortly after the controller 14 starts to return to initial position, the circuit of motor 19 will be closed again and will remain closed until the controller reaches its initial position. This means that the magnetic lock 34 will be energized. However, it does not relock itself from rotation during such return movement of the controller because its momentum prevents this. It is only when it is stationary or approximately so as when rotating very slowly that the flux across pole pieces 35 and 36 is strong enough to align bar 34 therewith and hold it from rotation. During the return movement of the controller the bar 34 acts as a fan brake to limit the return speed and prevent shock at the end of the return movement.

It will be observed that the armature member 34 with pole pieces 35 and 36, together with the field of the motor 37, has the structure of and may be considered a non-self-starting synchronous motor which is energized and deenergized simultaneously with the self-starting timer motor. In the above described operation only the locking action of such non-self-starting synchronous motor at standstill was utilized. It will be observed, however, if, in the initial starting up of the normal timing cycle of the controller mechanism, I synchronize rotor 34 with the flux pulsations across pole taps 35 and 36 as by spinning it by hand or otherwise, it will allow or cause the central member 20 of the differential to rotate at a definite speed corresponding to the synchronous speed of the non-self-starting motor or, in other words, will lock the central member of the differential at a fixed speed instead of at zero speed. The synchronous speed of such a motor is inversely proportional to the number of rotor poles and a rotor suitable for the synchronous speed desired will be selected. By such operation I may give to the controller a definite but quite different time cycle of operation. The pull-out torque of the non-self-starting synchronous motor is of essentially the same character whether utilized for locking in action at zero or synchronous speed. In either case it should exceed the maximum torque of the spring but be less than the blocked rotor torque of the self-starting motor as such torques are reflected through the drive to the shaft of the non-self-starting motor device.

Again, the stop 18 may be so adjusted to terminate the process timing operation before the motor is deenergized, or the motor switch may fail to open for some reason. In such case the motor will be blocked and the motor torque transmitted directly to the magnetic lock 34 will increase and be sufficient to break it from locking position or synchronous condition and the spring will then return the controller to initial position. In the same way any blocking of the motor due to defective apparatus at any stage of the process timing operation will result in stopping the operation and returning the timer to off or initial position, or, if desired, a slip-friction coupling may be suitably embodied in the main spring driving gear train to hold the timer at a maximum position without pulling out the magnetic fly lock until manually released by opening a switch to cut out the motor, or mechanically disengaging the fly from its magnetic lock thus starting its rotation and allowing the spring to return the mechanism to its initial position.

Failure of the source of supply or opening of the motor circuit for any reason at any stage of the timing operation will stop the timing operation and return the timer to off or initial position. Hence, various safety switches may be placed in the motor circuit to interrupt the process being timed, in case such switches are opened. The switch 43 is representative. Here 48 may represent a door of the dishwasher the operation of which is controlled by the process timer. The switch 43 is closed when the door is closed and opens when the door opens. Thus, if at any stage of the process the door 48 is accidentally or intentionally opened, the process is shut down and may not be restarted until such door is properly closed.

It will be evident that the magnetic locking device may be designed to have a variety of characteristics. For example, I may reduce its locking torque by reducing its polar effect by a design such as represented in Fig. 3 where a magnetic rim of desired thickness is added. I may employ a magnetically operated brake of the form shown in Fig. 4, where the wheel 50 is the rotary part geared to the differential member 20. 51 are brake shoes hinged at 52 and provided with magnetic pole extensions 53 adapted to be drawn together when flux exists between the auxiliary pole pieces 35 and 36. Fig. 5 shows another possible arrangement where a magnetically operated latch lever 56 engages a notched wheel 55 when the motor is energized to produce flux across the auxiliary pole pieces 35 and 36.

In accordance with the provisions of the patent statutes, I have described the principle of opera-

tion 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 may be carried out by other means.

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

1. Timing mechanism comprising a timer member, a self-starting electric timer motor for driving said timer member in one direction, a spring wound by said motor for driving said timer member in the opposite direction, driving mechanism including a differental having one part connected in driving relation with said motor, another part connected in driving relation with said timer member and spring, a non-self-starting synchronous motor, said self-starting and non-self-starting motors having a common energizing winding, and a driving connection between the third part of said differential and the rotor of said non-self-starting synchronous motor.

2. Timing mechanism comprising a self-starting synchronous motor, a non-self-starting synchronous motor, a common energizing winding for said motors, a timer member and spring, a differential having one part connected to be driven by said self-starting motor through an irreversible driving connection, another part connected in reversible driving relation with said timer member and spring and the third part connected in driving relation with said non-self-starting motor, the arrangement being such that when said energizing winding is energized the self-starting motor may drive said timer member in one direction and wind said spring, and when deenergized the spring may drive said timer member in the opposite direction and drive the rotor of the non-self-starting motor through the differential, said non-self-starting motor having a pull-out torque greater than the maximum torque of the spring thereon and less than the blocked rotor torque of the self-starting motor thereon.

3. A timer mechanism comprising a rotary timer part having initial and final rotary timing positions, an electric timer motor for driving said part forward from its initial to final position in a predetermined time, a spring which is wound with the aforesaid driving action for returning the timer part from its final to initial position, a differential through which said timer part and spring are driven by said timer motor for the purpose of allowing the return of the timer part to initial position without reverse driving action on the timer motor, and means for conditioning said differential for the forward and return movements of said timer member comprising a rotary member connected in driving relation with said differential and magnetized means energized by flux from said electric timer motor only when the motor is energized for holding said rotary member against rotation.

4. A timer mechanism comprising a rotary member adapted to be rotated in forward and reverse directions between initial and final timing positions, an electric timer motor for driving said member forward to final position, a spring wound by the aforesaid driving action for driving said member in the reverse direction to initial position, a differential having one rotary part connected to said timer motor and another rotary part connected to said rotary member and through which said timer motor drives said rotary part and winds said spring, said electric motor having auxiliary field poles between which a flux is produced when said motor is energized, and a magnetic bar rotatively mounted between said auxiliary field poles and connected in driving relation with the third rotary part of said differential, said magnetic bar rotor being capable of serving as a magnetic lock to hold the third rotary part of the differential against rotation when the motor is energized and to permit rotation thereof when the motor is not energized but being incapable of stopping such rotation when being driven by the spring with the motor energized.

5. Timing apparatus comprising a driven element to be moved from an initial to a final timing position, differential gearing for driving said element, an electric timer motor for driving said element from initial to final position through two members of said differential gearing, a non-self-starting synchronous motor connected in driving relation with the third member of said differential gearing for controlling the movement thereof, a spring for returning said driven element to initial position and means whereby both of said motors are energized and deenergized simultaneously.

6. A timer mechanism comprising a rotary member, a unidirectional self-starting electric timer motor for driving said rotary member from an initial to a final timing position, a spring for returning said rotary member to initial timing position, differential gearing through which said motor drives said member and winds said spring, a non-self-starting synchronous motor connected in driving relation with a gear of said differential gearing for controlling the differential driving action therethrough when the non-self-starting motor is energized, the rotor of said non-self-starting motor serving as a fan brake to limit the speed of return of said rotary member by the spring when the non-self-starting motor is deenergized and means whereby said self-starting timer motor and non-self-starting synchronous motor are energized and deenergized simultaneously.

GEORGE P. COVERT.