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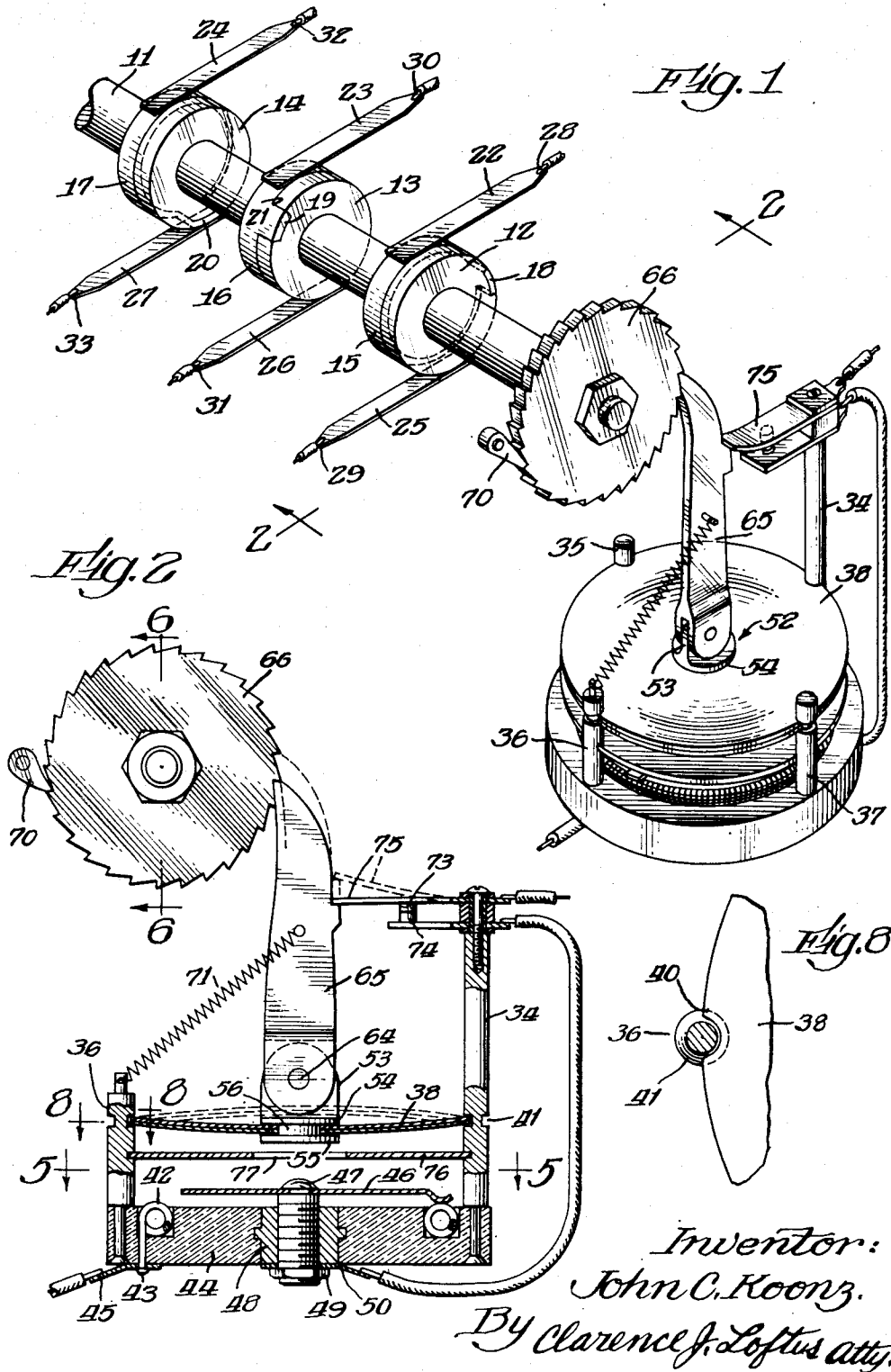
J. C. KOONZ

2,572,162

THERMOELECTRIC TIMER MOTOR

Filed March 8, 1947

2 SHEETS—SHEET 1



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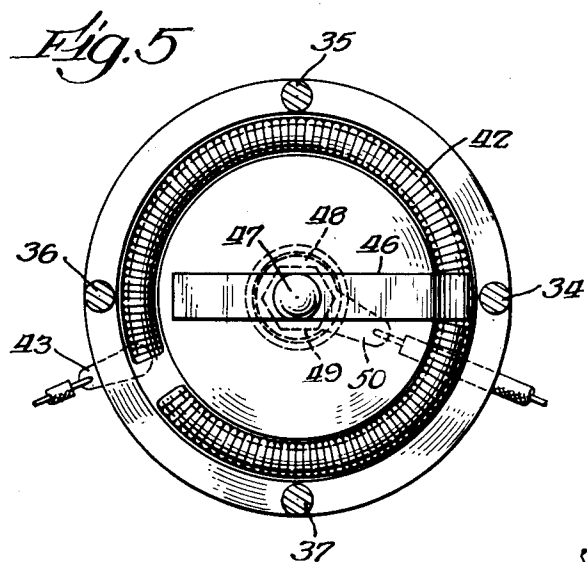
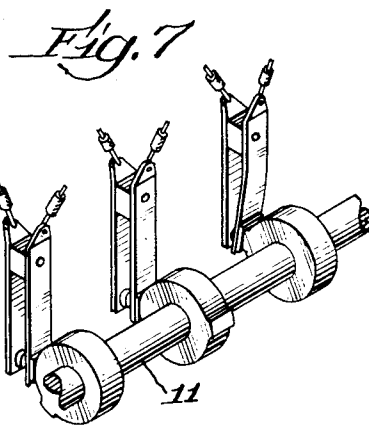
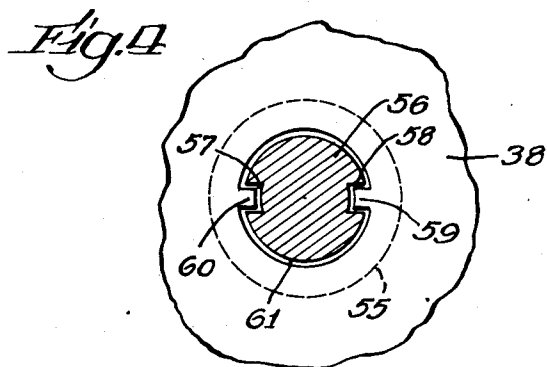
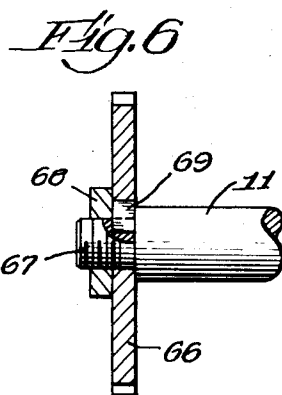
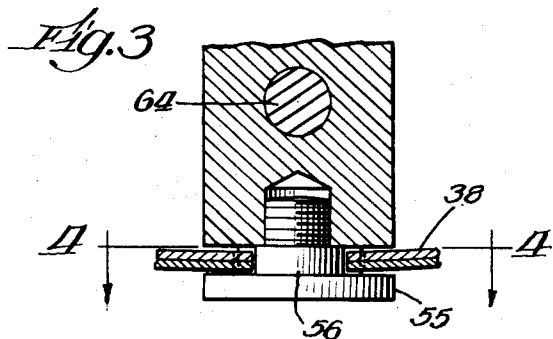
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THERMOELECTRIC TIMER MOTOR

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2 SHEETS—SHEET 2



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UNITED STATES PATENT OFFICE

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THERMOELECTRIC TIMER MOTOR

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3 Claims. (Cl. 172-126)

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The present invention relates to timing devices for intermittently performing a control function or sequence of control functions. Devices of this class are employed in washing machines for periodically closing electrical circuits which in turn control electromagnetic devices governing the intake and drainage of water. They are also used in a wide variety of other industrial, commercial laboratory and domestic applications to electrical equipment, wherever a circuit must be closed or opened at a predetermined time or whenever one circuit must be closed or opened at a predetermined time following the application of power to another circuit, for example.

Typical of the prior art are the rotary timer employed in internal combustion engines and the various modifications of that timer. Such a timer consists of a series of contacts, a rotating contact arm, and a motor for driving the arm whereby the arm touches the contacts in sequence and closes various circuits associated with them. This device has been found adequate for high-speed operation when each circuit is closed hundreds of times each minute but is not suitable for slow-speed operation even when reduction gearing is provided. Such gearing renders the continuously motor-driven type of timer expensive, complex and inefficient, especially when the control functions to be performed are time-spaced by periods of several seconds, for example. These limitations are aggravated when the particular application requires adjustment or variation of the timer speed or time-spacing between control functions.

Electronic timers have been developed in an effort to provide a suitable timer for slow-speed or intermittent operation. They are premised on the vacuum tube which not only requires a space-current source and suitable sources of heating current and biasing potential but also is inherently delicate and subject to frequent replacement.

In the operation of certain machines, such as domestic washing machines of the automatic type, it is desired to provide a relatively simple, inexpensive and yet reliable timing device for controlling the sequence operation mechanism. The sequence operation mechanism controls electrically actuated valves which govern the intake and drainage of cleaning fluid or water. The sequential operations performed by the mechanism are spaced apart by substantial intervals of time.

In the past attempts have been made to use an electric clock motor for this purpose, but such

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arrangements are relatively expensive. In some cases mechanically-wound clock mechanisms have been employed, but such arrangements have been found to be unsatisfactory since they frequently require service due to the effects of humidity and temperature.

It is therefore an important object of the present invention to provide an improved electrical timing device which is relatively simple, economical and reliable in operation.

The primary object of the present invention is to provide an impulse-operated, variable-speed timer for intermittently performing circuit-control functions.

Another object is to provide a timer characterized by efficiency, simplicity, low operating cost, reliability and a minimum of parts.

A further object is to provide a timer having a simple variable-speed adjustment.

Other and further objects and advantages of the present invention subsequently will become apparent by reference to the following description taken in conjunction with the accompanying drawings, wherein there is shown an illustrative timer in accordance with the invention.

In the drawings: Fig. 1 is a schematic and perspective view of a variable-speed timer in accordance with the present invention. Figs. 2, 4, 5, 6 and 8 are sectional views taken on line 2-2 of Fig. 1, line 4-4 of Fig. 3, line 5-5 of Fig. 2, line 6-6 of Fig. 2, and line 8-8 of Fig. 2, respectively; Fig. 3 is a sectional view of the bimetallic element and pawl mounting; and Fig. 7 shows an arrangement of cam switches suitable for use with the Fig. 1 embodiment.

Referring now to Fig. 1 there is shown a suitably mounted shaft 11 carrying for rotation three insulated contact carriers 12, 13 and 14 of three rotary switches. Mounted on each carrier are a peripheral contact 15, 16 or 17 and a conductive segment 18, 19 or 20. Each conductive segment is integrally connected to its associated peripheral contact, as shown at 21. Spring contacts 22, 23, 24 continuously bear on contacts 15, 16 and 17 and spring contacts 25, 26 and 27 bear intermittently on segments 18, 19 and 20 as shaft 11 rotates, closing and opening circuits 28-29, 30-31, and 32-33 in order. These switches are here shown for the purpose of illustrating one control function for which the invention is suitable. The invention is capable of performing many other control functions.

In accordance with one of the important features of the invention, there is mounted on posts 34, 35, 36, 37 a dished bimetallic element 38 ini-

tially and integrally formed of layers of suitable thermoacting dissimilar materials or metals having different linear coefficients of thermal expansion such as stainless steel or bass, for example. Such a member is generally referred to as a bimetallic element. Such elements are used in Klixon switches, for example. I employ this element to perform the timing effect.

In order to secure the bimetallic element to the post and at the same time to provide for flexure four semi-circular notches 40 (Fig. 8) are formed in the bimetallic element and spaced in quadrature and the posts are formed with annular grooves 41 (Fig. 2). The edges of the notches are disposed within these grooves, whereby the bimetallic element is secured against undesired angular and linear displacements without interference with its desired flexure.

The bimetallic member is intermittently heated by electric currents flowing through a resistor 42. This resistor is generally circular in shape and is helically wound. It has a lead 43 which projects through an insulating base 44 and is soldered to a terminal 45. It is also provided with a rotary contact arm 46 mounted for rotation by a screw 47, projecting through a collar 48. Lock nut 49 is carried by the threads on screw 47 in order to secure contact arm 46 in any desired angular position. Disposed between the lock nut and the collar is a terminal 50. The terminals 45, 50 are coupled to a suitable source of heating current (not shown), terminal 50 being connected to the source through contacts 73, 74 for a purpose hereinafter explained. This variable resistor performs an important function in varying the periodicity of the timing, as will hereinafter be pointed out.

The insulating base 44 also provides support for the metallic posts 34, 35, 36 and 37, the latter being screwed into the base or otherwise suitably secured thereto.

The bimetallic element is used to actuate a pawl-and-ratchet mechanism, which is employed to turn shaft 11.

Secured to the bimetallic element 38 is a pawl-mounting member 52. This member comprises an integral upstanding lug 53 and an integral base. The base is formed with spaced upper and lower flanges 54 and 55 and an intermediate reduced portion 56. Portion 56 is formed with integral diametrically opposed notches 57 and 58, adapted to receive complementary tongues 59 and 60 of the bimetallic member and to secure the latter against angular displacement. Flanges 54 and 55 overlie the generally circular aperture 61 in the bimetallic element through which the reduced portion 56 of the pawl-mounting projects. This construction has the advantage that it secures the pawl mounting in place with respect to the bimetallic element and at the same time permits flexure of the bimetallic element.

Pivotaly mounted on the pawl mounting 52 by a pin 64 is a pawl 65, formed with bifurcations embracing the upstanding lug 53. The other end of pawl 65 engages a tooth on a ratchet wheel 66. The ratchet wheel is secured to a screw-threaded extension 67 of shaft 11 by a nut 68 and a key 69. A pawl 70 prevents undesired rotation of wheel 66 in a reverse direction. The wheel is driven in the desired direction by upward movement of pawl 65, in response to the generation of impulses by the bimetallic element. The ends of a tension spring 71 are secured to pawl 65 and post 36 to keep the pawl in engagement with the ratchet wheel.

This pawl-and-ratchet construction has the advantage that the ratchet wheel may be removed and replaced by another wheel having a greater or lesser number of teeth. This provides a second adjustment means cooperating with the first-mentioned adjustment means whereby the periodicity of the device may be varied, as desired.

I also provide means for causing successive impulses to be generated. The circuit from the source to terminal 50 passes through a pair of contacts 73, 74, suitably insulated and mounted on the top end of post 34. These contacts are normally closed. Contact 73 is carried by a spring blade 75 which, when pawl 65 moves upwardly, is forced upwardly by a projection on the pawl, breaking the circuit between contacts 73 and 74 and deenergizing the resistor 42.

In order to achieve uniformity of cyclical operation there is provided, in accordance with another feature of the invention, a heat storage function. Specifically, a mica diaphragm 76, having a central opening 77 is interposed between the heater 42 and the bimetallic element 38. This diaphragm is preferably secured in position by slots on the posts 34—37. Diaphragm 76 acts as a heat insulator which prevents the bimetallic element 38 from absorbing heat directly from the heating element. The rate of heat absorption by element 38 is decreased compared to that rate if diaphragm 76 were absent. Because of this lower rate of absorption of heat, heating element 42 necessarily heats to a higher temperature than it would in the absence of diaphragm 76. Therefore, heating element 42 stores more heat than it would in the absence of diaphragm 76 and radiates heat to the bimetallic element for a longer period of time after contacts 73 and 74 are opened than would be the case if diaphragm 76 were absent. The diaphragm 76 also intercepts the flow of heated air to bimetallic element 38 so that heat conducted by air from heater 42 is delayed and the temperature of the air flowing through aperture 77 is higher than would be the case if diaphragm 76 were absent. The temperature of the surrounding structure is also increased as a result of the higher temperature of the heating element 42 so that the overall effect of diaphragm 76 is to prolong the effective heating period during which bimetallic element 38 is flexed into its dotted line position. The result is that when small changes in line voltage occur, the cycle of operation is leveled off to compensate for these small changes. Additionally, fluctuations in heat from the heater are smoothed out, so that the heat is uniformly and consistently applied to the bimetallic element during corresponding portions of successive cycles. By providing this diaphragm I have been able to render the periodicity of the timing operation precise and uniform.

During each cycle of operation the following events occur. Bimetallic element 38 is heated and upon attaining a critical degree of heat and at a predetermined time it snaps from the normal contour shown in full lines in Fig. 2 to the position shown in dashed lines, raising pawl 65 and turning wheel 66 by one or more teeth.

At the same time the pawl pushes blade 75 upwardly and breaks the circuit between contacts 73, 74, so that resistor 42 is deenergized, whereby the bimetallic element begins to cool. My construction of pawl mounting, bimetallic element and posts permits free flexure of the bimetallic element while it is performing its impulsing function. It will be seen that a bimetallic ele-

ment is employed to perform the basic timing function by periodically generating mechanical impulses.

After the contacts 73, 74 are broken and at a predetermined time the bimetallic element snaps back to the full-line position shown in Fig. 2 and places the pawl in the position of readiness to turn wheel 66 when the next mechanical impulse is generated. It will be seen that in accordance with this invention I not only use a bimetallic element to generate an impulse, but I also use it to open a switch and to disable the heater that causes the bimetallic element to generate the impulse.

When the bimetallic element snaps back to its normal position the contacts 73, 74 again close and the resistor is again energized, with the result that the cycle is repeated.

In accordance with still another feature of the invention I vary the amount of heat applied to the bimetallic element and accordingly vary the periodicity of the cycle by adjusting the position of contact arm 46 on resistor 42. Further adjustment is provided by the combination of the rheostat and the interchangeable ratchet wheel 66. Thus it will be seen that I have provided a timer which will satisfy wide ranges of timing requirements, and possesses the advantages of simplicity and reliability.

In Fig. 7 there is illustrated a suitable arrangement of cam-actuated switches suitable for use with my timer. Suitable cams may be mounted on shaft 11 and employed to close spring-blade switch contacts in sequence.

While there has been shown and described what is at present considered to be the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and substitutions of equivalents may be made without departing from the true scope of the invention and it is, accordingly, intended in the appended claims to cover all such changes and modifications as fall within the true and proper scope of the invention and to obtain protection appropriate to my contribution to the art.

Having thus described my invention, I claim:

1. A thermally actuated timing device comprising a dish-shaped snap-impulse bimetallic operating element, a radiant heater for supplying heat to said element positioned in proximity to said element but spaced therefrom with a substantial air gap therebetween, switch means in operative relation to said element and connected to said heater, said heater being energized when said switch means is in closed position, said element being adapted when heated a sufficient amount to snap to a flexed position to open said switch means and thereby deenergize said heater, heat insulating means positioned in said air gap and spaced from said element and said heater, said last named means serving to trap heat and prolong heating of said element after said heater is deenergized to hold said element in said flexed position a predetermined time after said heater is deenergized, said insulating means comprising an insulating baffle having an opening therein.

2. In a heat motor, in combination, a pre-formed dish-shaped bimetallic element, a radiant heater for supplying heat to said element positioned in proximity to said element but spaced therefrom with a substantial air gap therebetween, means for adjusting said heater to vary the amount of heat supplied to said element, switch means operatively associated with said heater and said element, said heater being energized when said switch means is in closed position, said element being adapted when heated a sufficient amount to snap to a flexed position to open said switch means and thereby deenergize said heater, thermal delay means consisting of an insulating baffle positioned in said air gap in spaced relation to said element and said heater, said last named means serving to trap heat and prolong heating of said element after said heater is deenergized to hold said element in said flexed position a predetermined time after said heater is deenergized.

3. In combination, a pawl and ratchet mechanism, a bimetallic element having a self-displaceable portion for actuating said mechanism, adjustable heater means for heating said element to cause self-displacement of said portion, switch means normally to energize said heater and to deenergize said heater means upon displacement of said portion and means to retain said portion in its displaced position for a predetermined time after said heater means is deenergized, said last named means comprising a heat insulating diaphragm having an opening therein positioned between said portion and said heater means.

JOHN C. KOONZ.

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Certificate of Correction

Patent No. 2,572,162

October 23, 1951

JOHN C. KOONZ

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 3, line 4, for "bass" read *brass*; line 40, for "into" read *onto*; column 4, line 59, for "percise" read *precise*; column 5, line 13, for "causes" read *caused*;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 12th day of February, A. D. 1952.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.