March 26, 1946. W. R. TALIAFERRO 2,397,219

TIMING DEVICE

Filed March 18, 1944

Fig. 1.

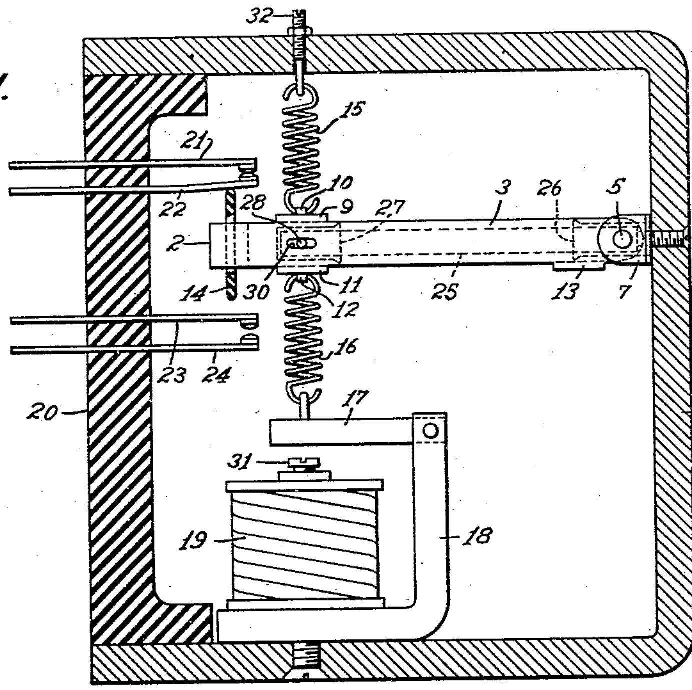


Fig. 2.

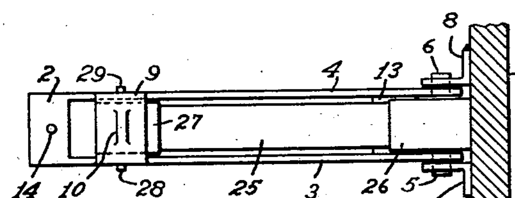
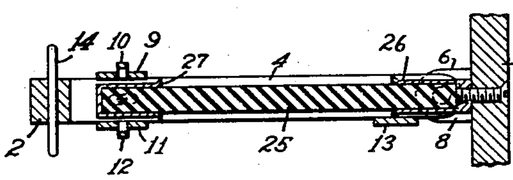


Fig. 3.



WITNESSES:

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Patented Mar. 26, 1946

2,397,219

UNITED STATES PATENT OFFICE

2,397,219

TIMING DEVICE

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Application March 18, 1944, Serial No. 527,116

8 Claims. (Cl. 200—97)

My invention relates to timing devices and particularly to timing relays to be used in electric circuits.

The known and customary timing devices contain as a rule a timing mechanism such as a clockwork, escapement or flywheel device, or the delay between the actuation of the device and the desired function performed thereby is obtained by electromagnetic means such as a short circuited winding on a magnet core. Devices equipped with an escapement or the like mechanism are rather intricate and space consuming, while short-circuited windings, as a rule, require alternating current excitation and permit obtaining only limited timing periods. In cases when direct-current excitation is to be employed, only very short timing periods are obtainable with the known devices of simple design, and the timing is as a rule effective only when the excitation is switched on or off but not under both conditions of operation.

It is an object of my invention to provide a timing device which permits obtaining a period of delay within wider limits than those possible by direct current relays with short circuited windings and other means of producing a delayed magnetic flux decay. More particularly, my invention aims at obtaining devices of long timing periods which do not require the use of an escapement or the like mechanism.

Another object of the invention is to devise a timing relay which is applicable for both alternating current and direct current excitation.

Still another object is to provide an electromagnetic timing device or relay which operates upon energization as well as on deenergization of its control magnet, or which secures a desired timing period under both control conditions.

In order to achieve these objects my invention takes advantage of the so-called cold-flow properties of plastic materials, in particular compositions of resinous nature. It is well known that when such a material is subjected to steady deforming stress it will gradually yield and assume a deformed position or shape only after the elapse of a flow period whose duration depends on the composition of the material, its dimensions and the conditions of the deforming stress applied thereto. I have found that these cold-flow properties can be utilized for providing in relays and the like timing devices, a timing period ranging from fractions of a second up to several seconds or even longer periods. Thermoplastic resins and compositions thereof are applicable for the just mentioned purpose. Resinous thermosetting materials can also be used, provided the material is in a relatively low state of polymerization or contains plasticizers or modifiers in a sufficient amount to secure the necessary cold-flow deformation.

The stress produced by the actuating or control means of a relay or timing device according to the invention may act in compression or expansion or produce torsional or bending stress on the cold-flowing plastic material, and the shape and dimensions of this material are chosen with respect to the stress so that the resulting deformation assumes a given magnitude within the desired timing period. The configuration of the body of cold-flowing material may be chosen according to the needs of each intended application, for instance, it may form a spiral, helix, diaphragm, rod or bar.

The invention will be more fully understood from the following description of the embodiment illustrated in the drawing in which Figure 1 shows a partly sectional view of an electromagnetic timing relay, while Figs. 2 and 3 represent a top view and a lateral sectional view of the cold-flowing body and some elements of the appertaining assembly.

According to the drawing, a substantially U-shaped support 1 of rigid material, for instance iron or brass, carries a movable arm structure 2 which forms two parallel legs 3 and 4 each provided with outwardly extending studs 5 and 6, respectively. These studs are pivoted in angular journals 7 and 8 which are rigidly secured to the support 1.

A transversely extending brazing section 9 of the arm structure 2 forms an eye at 10, and a similar section 11 is provided with an eye 12. A third transverse section 13 serves to render the arm structure sufficiently rigid.

An insulating pin 14 is firmly mounted on the peripheral end of the arm structure 2 and serves to actuate the contact means mentioned hereinafter.

An extension spring 15 of helical shape is attached to support 1 and engages eye 10. A second helical extension spring 16 connects eye 12 with the armature 17 of an electromagnet whose magnet frame 18 is firmly secured to the support 1. The magnet coil is denoted by 19.

An insulating member 20 is firmly secured between the legs of the support 1 so as to form a rigid supporting structure for two pairs of contacts denoted by 21, 22 and 23, 24, respectively.

The above-mentioned body of cold-flowing plastic material consists of a bar 25 of rectangular cross section. This bar is clamped to the support 1 by means of a sleeve 26. The other end of bar 25 engages a similar sleeve 27. Sleeve 27 is provided with studs 28 and 29 which engage elongated holes of the legs 3 and 4 such as the hole denoted by 30 in Fig. 1. Due to this design, the bar 25 is subjected essentially only to bending stress during the operation of the relay.

When the coil 19 is deenergized the spring 15, acting as a return or biasing device, holds the arm structure 2 in the position shown in Fig. 1. In this position the insulating pin 14 rests against contact 22 and thereby closes the circuit between contacts 21 and 22. When coil 19 is energized it attracts the armature 17 immediately and thus puts the spring 16 under tension. The force of spring 16 is so chosen that it exceeds the biasing force of spring 15 and hence tends to move the arm structure 2 downwardly. However, the cold-flowing body 25 prevents an immediate motion of the arm structure, but, under the continuous force produced by the electromagnet, yields gradually so that at first the engagement between contacts 21 and 22 is opened. Upon elapse of a timing period, the engagement between contacts 23 and 24 is closed. The latter contacts provide a stop which limits the motion of the arm structure 2 as well as the bending deformation of body 25.

When the magnet coil 19 is deenergized the spring 16 is released so that now the return spring 16 tends to turn the arm structure 2 upwardly. As a result, contacts 23 and 24 are separated and, upon elapse of a timing period, contacts 21 and 22 are closed.

It will be apparent from the above described example of my invention that the timing period provided by the cold-flowing body 25 can be varied within wide limits by selecting the distance between the contacts or stops and thereby the degree of deformation necessary for obtaining the intended control operation. It will further be recognized from the example that the timing period is also dependent on the force of the biasing means and the force produced by the electromagnetic actuating device. Consequently the timing period can also be varied by a proper selection or adjustment of the actuating and biasing means. In order to permit such an adjustment two adjusting screws 31 and 32 are provided. The screw 31 permits varying the travel of the armature 17 and hence the force exerted by spring 16 on arm structure 2 when the coil 19 is energized. The screw 32 permits varying the biasing force exerted on the arm structure by the spring 15.

A third way of varying or adjusting the time period consists in selecting the dimensions of the body 25. For instance, a smaller cross section and a greater length of the bar result in a reduced timing period while an increase in cross section or reduction in length has the opposite effect.

As mentioned previously, the timing period is also determined by the selected composition of the cold-flowing material. A large number of such substances are known and available. Applicable for the purpose of my invention are, for instance, vinyl chloride resins, polystyrene resins, copolymers of vinyl acetate and vinyl chloride, methyl methacrylate, cellulose acetate, nylon resins, copolymers of styrene and modified glycolmaleate esters.

Timing devices according to my invention have also the advantage that they are inherently shockproof. For instance, when a relay as illustrated in the drawing is subjected to impact shock, for instance, on board of ship or on vehicles, the shock forces and vibrations caused by the impact are either of short duration or of high frequency as compared with the normal operation of the relay by the continuous force produced by the electromagnetic or other actuating device, or by the biasing effect of the return spring. The cold-flowing body offers an extremely high resistance to short-lasting or high-frequency stresses. Consequently, the movable assembly of the device, even if not dynamically balanced, tends to retain its preshock position but permits the actuating magnet to perform its normal function even during the persistence of shock forces or vibrations. In this respect, devices according to my invention are simpler and more effective than many of those heretofore proposed for use under conditions where impact shocks are to be expected.

In view of the fact that timing devices according to my invention can be modified in various respects by those skilled in the art without departing from the objects, advantages and principles of my invention, I wish this specification to be understood as illustrative rather than in a limiting sense.

I claim as my invention:

1. A timing relay comprising a body of resinous cold-flowing thermoplastic material, an electromagnetic actuating device having a movable armature connected with said body for subjecting it to cold-flow deformation, and contact means disposed on said structure relative to said body so as to be controlled thereby upon occurrence of a given cold-flow deformation of said body.

2. A timing device comprising a stationary structure, a body of cold-flowing resinous plastic material having one end secured to said structure, an electric actuating device having a movable actuating member connected with the other end of said body for subjecting it to cold-flow deformation when operative, and contact means controlled by said body in dependence upon its deformation for controlling a circuit upon elapse of a period of given cold flow deformation.

3. A timing relay comprising a stationary structure, a body of cold-flowing resinous plastic material having one end secured to said structure, an electromagnetic actuating device having an armature connected to the other end of said body for subjecting it to bending deformation when operative, and contact means disposed on said structure in the path of the deforming motion of said body so as to be actuated thereby upon a given deformation thereof.

4. A timing relay comprising a stationary structure, an elongated body of cold-flowing thermoplastic material having one end secured to said structure, a controllable source of mechanical power connected to the other end of said body for subjecting it to cold-flow deformation in a given direction, biasing means connected with said body for subjecting it to cold-flow deformation in the opposite direction, and contact means time-controlled by said body so as to be actuated in dependence upon a given deformation thereof.

5. A timing relay comprising a stationary structure, a body of cold-flowing resinous plastic material having one end secured to said structure, an electromagnetic actuating device having an armature connected to the other end of said body for subjecting it to cold-flow deformation in a given direction, a biasing spring connected with said body for subjecting it to cold-flow deformation in the opposite direction, and contact means

time-controlled by said body so as to be actuated in dependence upon a given deformation thereof.

6. A timing relay comprising a stationary structure, a body of cold-flowing resinous plastic material having one end secured to said structure, an electromagnetic actuating device having an armature and a spring connecting said armature with said body for subjecting it to cold-flow deformation in a given direction, a biasing spring connected with said body for subjecting it to cold-flow deformation in the opposite direction, and contact means time-controlled by said body so as to be actuated in dependence upon a given deformation thereof.

7. A timing relay comprising a stationary structure, a rigid member having one end pivoted to said structure, means for biasing said member towards a given pivotal position, a controllable source of mechanical power connected with said member for moving it in opposition to said biasing means, a body of cold flowing plastic material disposed between said structure and said member so as to retard the angular motion of said member produced by one of said biasing means and said source respectively, and contact means disposed relatively to said member so as to be actuated thereby upon occurrence of a given pivotal travel thereof.

8. A timing relay comprising a stationary structure, a rigid member having one end pivoted to said structure, means for biasing said member towards a given pivotal position, an electromagnetic actuating device having an armature and a spring connecting said armature with said member for moving it in opposition to said biasing means, a body of resinous thermoplastic material disposed between said structure and said member so as tc retard the angular motion of said member produced by one of said biasing means and said source respectively, and contact means disposed relatively to said member so as to be actuated thereby upon occurrence of a given pivotal travel thereof.

WILLIAM R. TALIAFERRO.