

Aug. 24, 1937.

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2,090,995

TIME DELAY RELAY

Filed Aug. 1, 1936

3 Sheets-Sheet 1

FIG. 1

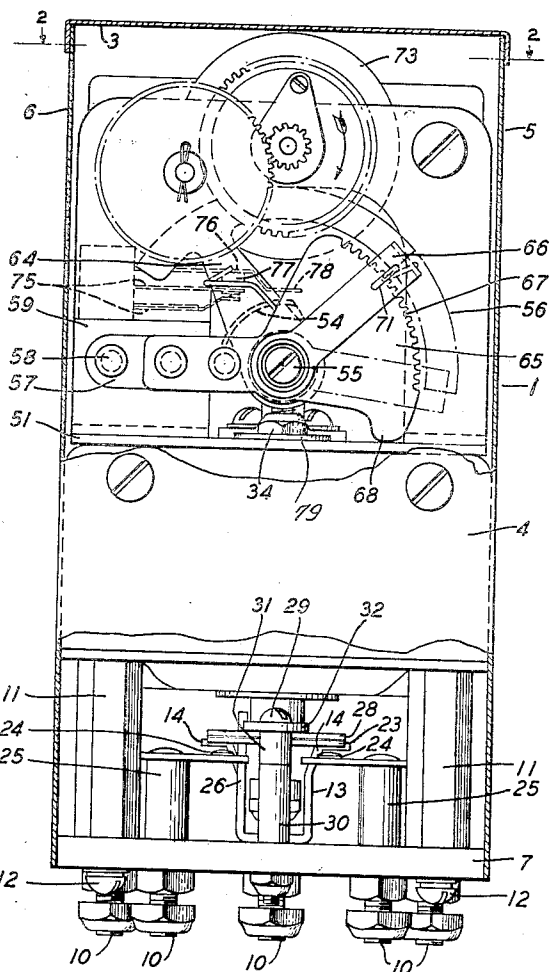


FIG. 2

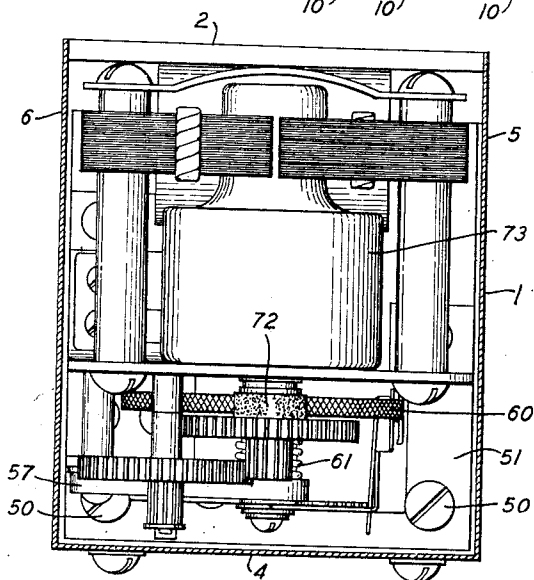
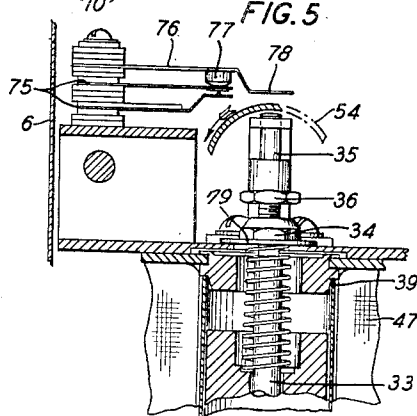


FIG. 5



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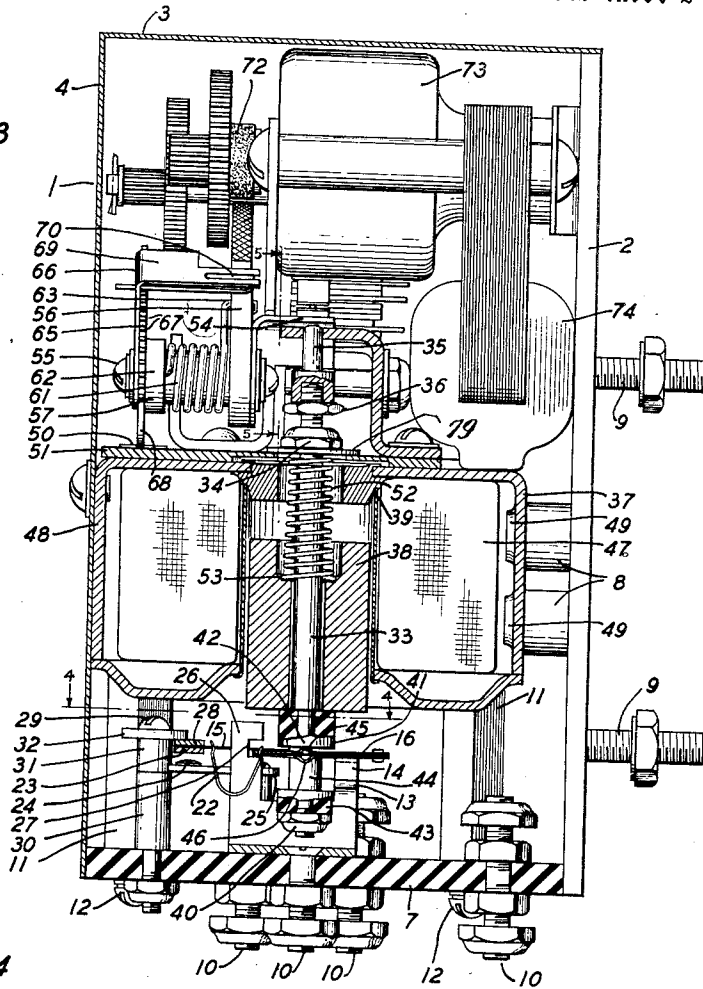
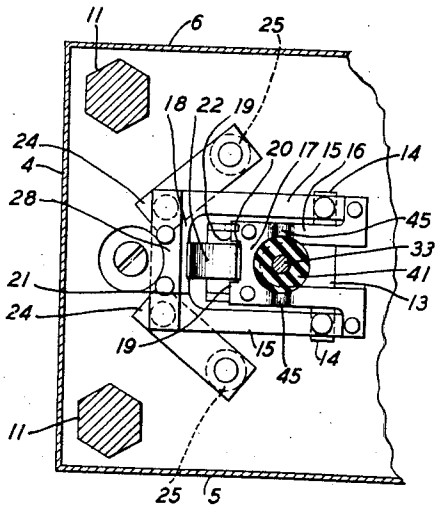


FIG. 4



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FIG. 6

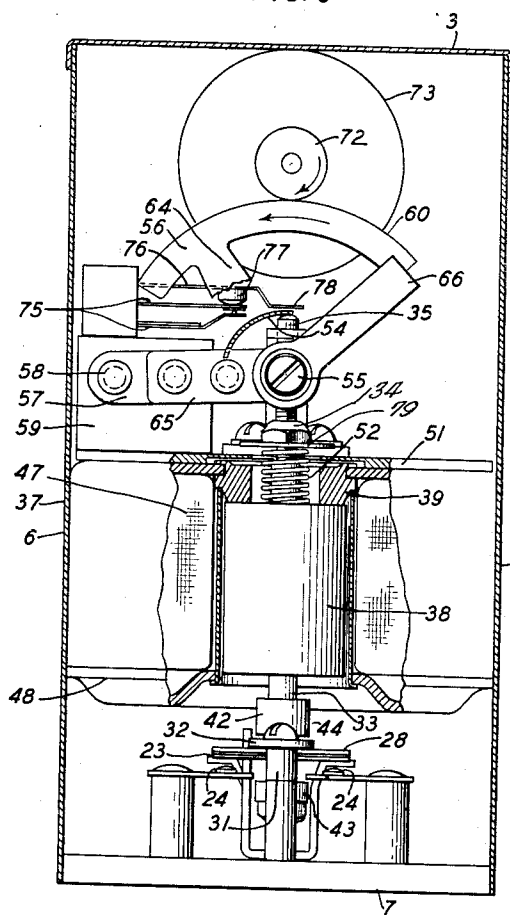


FIG. 7

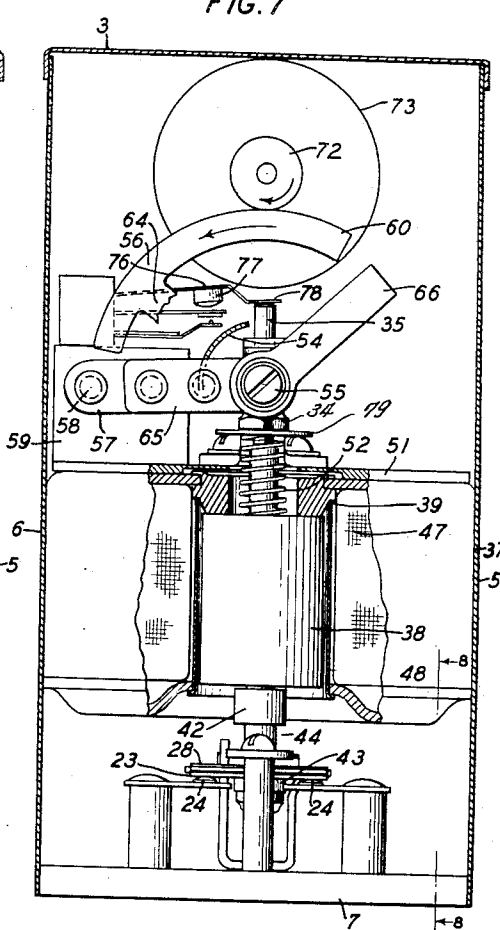
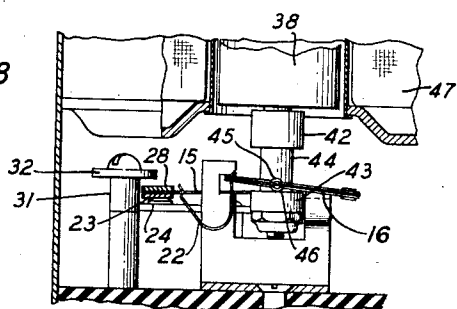


FIG. 8



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TIME DELAY RELAY

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Application August 1, 1936, Serial No. 93,803

10 Claims. (Cl. 260—97)

This invention relates to relays and more particularly to a delayed action relay.

The object of the invention is to provide circuit controlling means which will operate at the end of a predetermined period of time.

A feature of the invention resides in a guard member moved with time and operating in the path of movement of a contact controlling member.

Another feature resides in adjustable means for setting the relay so that it will complete its operation at the end of a predetermined period of time.

Another feature resides in means for driving the guard member.

Another feature resides in means for operating the contact controlling member.

In the drawings,

Fig. 1 is a rear elevational view, partly in section, of the relay and with part of the structure removed;

Fig. 2 is a top view, partly in section, taken on the line 2—2 in Fig. 1;

Fig. 3 is a side elevational view, partly in section, of the relay and viewed from the right of Fig. 1;

Fig. 4 is a top view of a portion of the structure and taken on the line 4—4 of Fig. 3;

Fig. 5 is a rear view, partly in section, of an upper central portion of the relay;

Figs. 6 and 7 are views corresponding to Fig. 1 but with certain portions removed and showing the relay operated in two positions, Fig. 6 being a first operated position and Fig. 7 a second operated position; and

Fig. 8 is a view, partly in section, of the lower portion of Fig. 7 and as viewed from the right of Fig. 7 on the line 8—8.

In electrical apparatus it is sometimes found necessary or desirable to provide circuit controlling means that will operate at the end of a predetermined period of time after certain other switching operations are performed. For instance in electrical apparatus in which vacuum tubes are employed, it is found necessary in some instances, in order to prevent breakdown of the elements, to delay the application of plate current to the tubes for a predetermined period of time after the filament current has been applied. In some cases a longer time period than in others is required. The invention provides means for performing the function above-mentioned.

The relay mechanism as shown in the drawings and with particular reference to Figs. 1, 2, and 3 is mounted in a casing 1 comprising a front plate

2, a top 3, a rear wall 4 and side walls 5 and 6. A base 7 is shown as being composed of insulating material. The base 7 is not attached to parts of the casing, but serves as a closure for an open end of the casing and as a base plate and terminal block for parts of the relay, the relay being held in place within the casing 1 by means of screws, not shown, but which pass through the front wall 2, then through spacers 8—8 and into a portion of the relay structure. Spaced studs 9 are provided on the front wall 2 so that the relay may be attached to a suitable support (not shown). Spaced binding post terminals 10 are secured in the base plate 7 and project below the lower surface of the base plate 7 to serve as means for connecting circuit wires to the relay. The relay structure is provided with spaced posts 11 which project downward into engagement with the upper surface of the base plate 7 and which receive machine screws 12 to hold the relay structure securely mounted on the base plate 7. Secured to the upper surface of the base plate 7 by means of one of the terminals 10 is a U-shaped support 13 and having two upwardly projecting arms 14 upon which are secured leg portions of a U-shaped spring 15 as shown in Fig. 4. The leg portions of the U-shaped spring 15 pass beyond their points of support on the arms 14 and have attached to their free ends a laminated U-shaped plate 16 having its closed end 17 extending between the leg portions of the U-shaped flat spring 15 and toward the closed end 18 of the spring 15. The laminated U-shaped plate 16 has projections 19—19 on its inner end and extending between the projections 19 and clamped between the laminations of the U-shaped plate 16 is a knife edge 20 which may be a separate member or a portion extending inward from the free ends of the legs of the flat U-shaped spring 15 and disposed between the laminations of the U-shaped plate 16. Between the knife edge 20 and an inner edge portion 21 of the closed end 18 of the flat U-shaped spring 15 is a bowed spring 22 which serves to snap the closed end of the U-shaped flat spring 15 upward or downward in a quick-operating snap action movement when the U-shaped laminated plate 16 is operated and in a direction opposite to the direction of movement of the laminated U-shaped plate 16. On the closed end of the U-shaped spring 15 and disposed on the lower surface thereof is a rectangular bar 23 of conducting material which serves to bridge two spaced contacts 24—24 when the closed end of the U-shaped spring 15 is moved downward. The spaced contacts are supported on posts 25—25

which rest against the upper surface of the base plate 7 and form a part of two of the binding posts 10 and to which wires of the circuit to be controlled may be attached. An arm 26 extending upwardly from one end of the U-shaped support 13 serves as a stop for the closed end of the laminated U-shaped plate 16, the arm 26 having a notch 27 on its upper end and forming an operating space in which the closed end of the laminated U-shaped plate 16 may operate upward and downward to a limited extent, the extent of movement being governed by the width of the notch 27. Across the upper surface of the closed end of the U-shaped spring 15 is a rectangular bar 28 corresponding to the bar 23 on the lower surface and which may be made of either conducting or insulating material. Extending upward from the upper surface of the base plate 7 and secured thereto is a machine screw 29. Surrounding the shank of the machine screw 29 and engaging the upper surface of the base plate 7 is a tubular member 30. Supported on the upper end of the tubular member 30 and engaged by the head of the machine screw 29 is a flanged insulating member 31, the insulating member 31 having a flange 32 directly under the head of the machine screw 29. The flange 32 is disposed adjacent the upper surface of the bar 28 and serves as a stop to limit the upward movement of the closed free end of the U-shaped spring 15 and thereby serving to limit upward movement of the movable contact of the snap switch.

The snap switch arrangement described is operated by means of a plunger 33 which is threaded on its upper end to receive a ring nut 34, a plunger pin 35 and a lock nut 36. The plunger 33 is operated by means of an electromagnetic device 37 and extends upward through a movable plug 38 of the electromagnetic device 37 and which operates within a cylindrical core 39. The plug 38 is made of magnetic material and is comparatively heavy and is longitudinally bored to freely receive the plunger 33, the bore being of sufficient diameter to permit free movement of the plunger 33 within the plug 38. The lowermost end of the plunger 33 is threaded to receive a ring nut 40 and is reduced in diameter to receive a tubular member 41 of insulating material, the tubular member 41 being made of some substantially strong and hard insulating material such for instance as porcelain or Isolantite. The tubular member 41 of insulating material is enlarged on each end to provide flanges 42 and 43 and a central portion 44 of smaller diameter than the flanged ends. The reduced central portion 44 on the tubular member 41 of insulating material passes upward between the leg portions of the laminated U-shaped plate 16. The flange 42 of the insulating member 41 engages embossings 45—45 on the upper lamination of the U-shaped plate 16 when the plunger 33 is in a down position. The flange 43 engages embossings 46—46, provided on the lower lamination of the laminated U-shaped plate 16, when the plunger 33 is moved to an up position. When the plunger 33 is in a down position as shown in Figs. 3 and 6, the closed end of the laminated U-shaped plate 16 is in a down position. When the closed end of the laminated U-shaped plate 16 is moving to a down position spring tension is developed in the bowed spring 22. When the U-shaped plate 16 is moved to its down position, the bowed spring 22 by reason of the spring action developed therein snaps the closed end portion of the U-shaped spring member 15 upwardly with a quick snap

action so that the rectangular bar 28 is moved upward against the flange 32 of the stop member 31. The downward movement of the laminated U-shaped plate 16 is limited by the slot 27 in the arm 26. In the positions above mentioned and as shown in Figs. 3 and 6, the rectangular bar 23 of conducting material is moved away from the spaced contacts 24—24. The circuit controlled by this portion of the relay, therefore, is opened.

The electromagnetic device 37 comprises an operating coil 47, a movable plug 38 and a hollow core 39. The operating coil 47 is enclosed in a casing 48 from which the posts 11 extend downwardly to the upper surface of the base plate 7. The screws, not shown, but which extend through the front plate 2 of the device and through the spacers 2—2 extend into threaded embossings 49 in the casing 48 of the electromagnetic device 37. Secured to the top of the casing 48 of the electromagnetic device by means of screws 50, shown in Fig. 2, is an apertured plate 51, the plate being apertured to permit extension therethrough of the plunger 33. The upper portion of the plug 38 of magnetic material is longitudinally bored to a sufficient diameter to accommodate a helical spring 52 which is loosely coiled around the plunger 33. The lower end of the spring 52 rests on an annular shoulder 53 in the plug 38. The upper end of the spring 52 bears against a washer 79 held in place on the plunger 33 by means of the ring nut 34. When the energizing coil 47 of the electromagnetic device 37 is energized, the plug 38 is drawn upward within the core 39 and compresses the spring 52. The spring 52 tends to move the plunger 33 upwardly. The extent of upward movement of the plunger 33, however, is limited by means of a movable guard 54 which is driven with time across the path of movement of the pin 35 on the upper end of the plunger 33. The guard 54, therefore, stops the upward movement of the plunger 33 after it has moved to a small extent. The plug 38, however, is moved upward against the spring 52 by the magnetic attraction developed in the electromagnetic device 37 through the energizing coil 47 and the core 39. The spring 52, therefore, is compressed to an extent determined by the magnetic pull of the electromagnetic device, and the spring pressure developed in the spring 52 is continually urging the plunger 33 upward against the guard 54. The guard 54 is a metal plate L-shaped in cross-section and one of the leg portions is attached to an arcuate skeleton frame 56 which is movably supported on a bolt 55. The other leg portion of the guard 54 is bowed transverse to the axis of the bolt 55 and extends across the top of the pin 35. The arcuate skeleton frame 56 with the guard 54 attached thereto is journaled on the bolt 55. The bolt 55 is supported on a pivoted arm 57, the arm 57 being pivotally supported at a point 58 on the stationary support 59. The outer edge of the arcuate skeleton frame 56 is knurled at 60 as shown in Figs. 2 and 3. A coil spring 61 supported on the journaled portion of the arcuate skeleton frame 56 on the bolt 55 is provided to continually urge the arcuate skeleton frame 56 in a clockwise direction, the spring 61 having one end 62 fastened in the free end of the arm 57 and the other end 63 being hooked around a leg portion 64 of the arcuate skeleton frame 56. Throughout this specification, when direction of movement of a part is stated as being in a clockwise or a counterclockwise direction the direction mentioned is to be considered as when the

relay is viewed from the back as shown in Figs. 1, 5, 6, and 7. An adjustable stop is provided to limit the extent of clockwise movement of the arcuate skeleton frame 56. The adjustable stop comprises a segmental plate 65 and an L-shaped arm 66. The segmental plate 65 is attached to the pivoted arm 57 and has teeth 67 formed on its outer edge and a heel 68, the heel 68 being adapted to rest on the plate 51. The L-shaped arm 66 is journaled on the bolt 55 and has a leg portion 69 extending above the teeth 67 on the segmental plate 65 and into the path of return movement of the skeleton frame 56. A wire spring 70 as shown in Fig. 3 is provided on the free end of the leg portion 69 of the L-shaped arm 66. The wire spring 70 extends backward from this point beneath the leg portion 69 and through a slot 71 in the arm 66 and extends beyond the surface of the arm 66 a sufficient distance to be readily engaged by a person desiring to adjust the apparatus. The free portion of the wire spring 70 adjacent the point where it passes through the slot 71 normally rests between the teeth 67 of the segmental plate 65 to retain the L-shaped arm 66 in a required position. The spring 70 may be released from engagement with the teeth 67 by manually pressing the free end upward in the slot 71 and the arm 56 may then be swung in a required direction and the free end of the spring 70 released again so that the spring sets into engagement with the teeth 67 in the required position. Since the arcuate skeleton frame 56 is continually being urged by the spring 61 in a clockwise direction and, therefore, against the leg portion 69 of the L-shaped arm 66 movement of the arm 66 results in a corresponding movement of the arcuate skeleton frame 56. Since the guard 54 is carried by the frame 56 a corresponding movement of the guard 54 is also obtained. Movement of the arm 66, therefore, results in changing the effective length of the skeleton frame 56 and the effective length of the guard 54 and consequently results in a change in the time characteristic of the relay.

When the electromagnet 37 is energized to raise the plunger 33 the pin 35 is brought upward against the guard 54 and the upward pressure of the pin 35 against the guard 54 swings the arm 57 upwardly about its pivot point 58. In this movement the arcuate skeleton frame 56 is raised so that the knurled portion 60 is brought into engagement with a frictional drive wheel 72 driven by and forming part of a synchronous motor 73. The synchronous motor 73, preferably, is a self-starting type synchronous motor and is controlled by means of a switch not shown but located at some remote point. One of the lead wires for the field winding 74 of the motor 73 is connected to a pair of contact springs 75 which are normally closed. The springs 75 are normally held closed by means of a spring 76 having a button 77 serving to press the contact springs 75 together. A free end 78 of the spring 76 extends downward to a point directly above the line of travel of the pin 35 on the plunger 33 so that when the plunger 33 is raised to full extent the pin 35 will engage the free end 78 and raise the spring 76 sufficient to allow separation of the spring contacts 75.

When the device is to be operated, circuits are closed for the electromagnet 37 and the synchronous motor 73. This might be for instance when current is applied to the filament of a vacuum tube. The motor 73 then begins to operate and rotates the frictional driving member 72 in a

clockwise direction. When the electromagnet 37 is energized, the plug 38 is raised within the core against the spring 52, compressing the spring. By this action the plunger 33 is raised so that the pin 35 is brought into engagement with the guard 54. Pressure against the guard 54 causes the arm 57 to swing upward about its pivot point 58 and the arcuate shaped skeleton frame 56 is brought into engagement with the frictional driving member 72. The arcuate shaped skeleton frame 56, therefore, is rotated in a counter-clockwise direction by means of the synchronous motor 73. The arcuate skeleton frame 56, therefore, carries the guard 54, beyond the path of movement of the pin 35 on the plunger 33. When the guard 54 is moved beyond the path of movement of the pin 35, the spring 52 forces the plunger 33 upward to full extent of its traverse. In this upward movement the pin 35 engages the free end 78 of the spring 76 and moves the spring 76 upward so that the contact springs 75 are permitted to open. Opening of the spring contacts 75 breaks the circuit of the synchronous motor 73 and the motor stops. When the plunger 33 is rising to full extent of its traverse, the flange 43 of the insulating member 41 engages the embossings 46 of the U-shaped plate 16 and swings the U-shaped plate 16 upwardly. Upward movement of the U-shaped plate 16 as it passes over dead center develops spring tension in the bowed spring 22 and the tension developed in this bowed spring 22 forces the free end of the U-shaped member 15 downwardly with a quick snap action so that the rectangular bar 23 of conducting material is brought down into engagement with the spaced contacts 24—24. The spaced contacts 24—24 may be connected in a circuit leading to a plate of a vacuum tube. The plate circuit of the tube, therefore, is closed with a quick snap action by the bridging of the contacts 24—24 by the rectangular plate 23 of conducting material. It is obvious that the contacts 24—24 might be included in any circuit desired to be controlled by the time delay device of this invention.

To open the circuit in which the contacts 24—24 are included, it is only necessary to cut off the supply of current to the operating coil 47 of the electromagnetic device 37. When the electromagnetic device 37 is deenergized, the plug 38 is released and drops downwardly against the upper surface of the flange 42 of the insulating member 41 and carries the plunger 33 downward so that the lower surface of the flange 42 strikes against the embossings 45 of the U-shaped plate 16. This action forces the U-shaped plate 16 downwardly and as the U-shaped plate 16 passes across dead center position it develops spring tension in the bowed spring 22 and this spring tension in the bowed spring 22 forces the free end of the U-shaped member 15 upwardly with a quick snap action so that the rectangular bar 23 of conducting material is quickly moved away from the spaced contacts 24—24. The circuit controlled by the device, therefore, is quickly opened. When the free end of the U-shaped member 15 moves upwardly, the rectangular plate 28 on the upper surface of the U-shaped member 15 strikes against the flange 32 of the insulating member 31. The flange 32 of the insulating member 31, therefore, serves as a stop to limit upward movement of the closed end of the U-shaped member 15.

The length of the time period between the time of starting of the device and the bridging of the contacts 24—24 is determined by the speed of

the motor 73, the driving ratio between the frictional driving member 72 and the arcuate shaped skeleton frame 56 and the effective lengths of the arcuate shaped skeleton frame 56 and the guard 54. The effective lengths of the arcuate shaped skeleton frame 56 and the guard 54 may be changed by moving the stop arm 66 against the end of the arcuate shaped skeleton frame 56 and moving the skeleton frame 56 so that the guard 54 is moved across the path of movement of the pin 35. For instance the guard 54 may be moved so that the central or any other predetermined portion of the guard 54 is in the line of movement of the pin 35. When the synchronous motor 73, therefore, is operated and the electromagnetic device 37 is energized, the pin 35 is brought upward into engagement with the guard 54 at the predetermined point and the motor 73 drives the arcuate skeleton frame 56 and the guard 54 is carried from the predetermined point in a counter-clockwise direction until it moves out of the path of movement of the pin 35. When the guard 54 is moved out of the path of movement of the pin 35, the contacts 24—24 are quickly bridged by the rectangular bar 23 of conducting material. When the guard 54 is moved beyond the path of movement of the pin 35 the upward pressure serving to hold the arcuate shaped skeleton frame 56 against the frictional driving member 72 is no longer effective to hold these elements in engagement and the assembly of elements carried by the pivoted arm 57 drops by gravity to normal position with the heel 68 resting on the plate 51. The arcuate shaped skeleton frame 56 and the guard 54, however, are prevented by the pin 35 from returning to normal or starting position, the pin 35 being across the path of return movement of the guard 54. De-energization of the electromagnet 37 results in release of the plunger 33. Upon release of the plunger 33, the pin 35 is carried downward out of the path of return movement of the guard 54. The spring pressure developed in the coil spring 61 during the rotation of the arcuate skeleton frame 56 then returns the skeleton frame 56 and the guard 54 to starting position, the extent of return movement being the extent permitted by the stop arm 66. If the stop arm 66 has been set part way upward of the segmental plate 65, for instance, the guard 54 will be moved to about half its length across the path of movement of the pin 35. With this setting of the stop arm 66, the device will have a comparatively short time delay characteristic. To lengthen the time delay characteristic of the device it is only necessary to release the wire spring 70 from engagement with the teeth 67 of the segmental plate 65 and then swing the stop arm 66 downward to a predetermined point and release the wire spring 70 so that it engages teeth 67 at a lower point on the segmental plate 65. In this position the guard 54 will have a greater effective length than when the stop arm 66 is in the full line position shown in Fig. 1. The stop arm 66 for instance may be set in the dotted line position shown in Fig. 1 so that the time delay characteristic of the relay will be at the maximum obtainable in the structure. To shorten the characteristic it is only necessary to release the spring 70 from engagement with the teeth 67 and swing the stop arm 66 upward along the curved edge of the segmental plate 65 and release the spring 70 to set into the teeth 67 in a required position.

What is claimed is:

1. A time delay relay comprising a movable contact operating member, a movable guard operating in the path of movement of said contact operating member and driving means to move said guard from the path of movement of said contact operating member at a predetermined time, characterized in this, that an electromagnet moves said movable contact operating member against said guard, lifts said guard into engagement with said driving means and compresses a spring against said movable contact operating member, to further move said contact operating member when said guard is driven by said driving means out of the path of movement of said contact operating member.
2. A time delay relay, in accordance with claim 1, and in which said guard comprises an arcuate frame carrying a curved guard portion operating in the path of movement of said contact operating member.
3. A time delay relay, in accordance with claim 1, and in which said contact operating member comprises a longitudinally movable plunger having an end brought into engagement with said guard.
4. A time delay relay comprising in combination, a fixed contact, a movable contact, a contact operating member engaging said movable contact, a guard operating in the path of movement of said contact operating member, driving means for said guard, and electromagnetic means to move said contact operating member against said guard and to move said guard into engagement with said driving means.
5. A time delay relay comprising in combination, a fixed contact, a movable contact, a contact operating plunger operating to move said movable contact, a guard operating in the path of movement of said contact operating plunger, driving means for said guard, a coil spring on said plunger and a solenoid operated to move said plunger against said guard to move said guard into engagement with said driving means and compress said spring, said spring operating to further move said plunger when said guard is moved by said driving means out of the path of movement of said plunger.
6. A time delay relay comprising a solenoid, a spring compressed by means of said solenoid, a contact operating plunger carrying said spring and operated by means of said spring, a guard operating in the path of movement of said contact operating plunger, driving means operating with time to drive said guard out of the path of movement of said contact operating plunger and contacts controlled by means of said contact operating plunger.
7. A time delay relay comprising an electromagnetic device, a tubular armature operated by means of said electromagnetic device, a plunger loosely carrying said armature, said plunger extending axially through said armature, a spring supported on said plunger and bearing against said armature and said plunger to move said plunger relative to said armature, said armature when attracted operating to compress said spring, a movable guard operated across the path of movement of said plunger, driving means to drive said guard out of the path of movement of said plunger and contacts operated by means of said plunger when said guard is removed from the path of movement of said plunger.
8. A time delay relay comprising an electro-

magnet, a plunger, an armature operated on said plunger by means of said electromagnet, a spring on said plunger compressed by means of said armature and operating to apply driving pressure to said plunger, a snap switch operated by means of said plunger, contact springs controlled by said plunger, a movable guard operating in the path of movement of said plunger and driving means for said guard, said driving means operating with time to drive said guard out of the path of movement of said plunger.

9. A time delay relay comprising an electromagnet, a plunger, switch elements controlled by means of said plunger, an armature operated on said plunger by means of said electromagnet, a compressible spring on said plunger and operating said plunger, said spring being compressed by means of said armature when the electromag-

net is energized, a movable guard operating in the path of movement of said plunger, a synchronous motor operating to drive said guard out of the path of movement of said plunger and an adjustable stop member to control the effective length of said guard.

10. A time delay relay comprising a plunger, switch elements operated by means of said plunger, a spring on said plunger to operate said plunger, a movable guard operating in the path of movement of said plunger, a movable frame carrying said guard, driving means for said frame, an electromagnetic device operating to lift said frame into engagement with said driving means and an adjustable stop arm engaging said frame and manually operated to change the effective lengths of said frame and said guard.

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