Aug. 7, 1945. K. MAHNKE 2,381,300

TIMING RELAY

Filed March 13, 1943 2 Sheets-Sheet 1

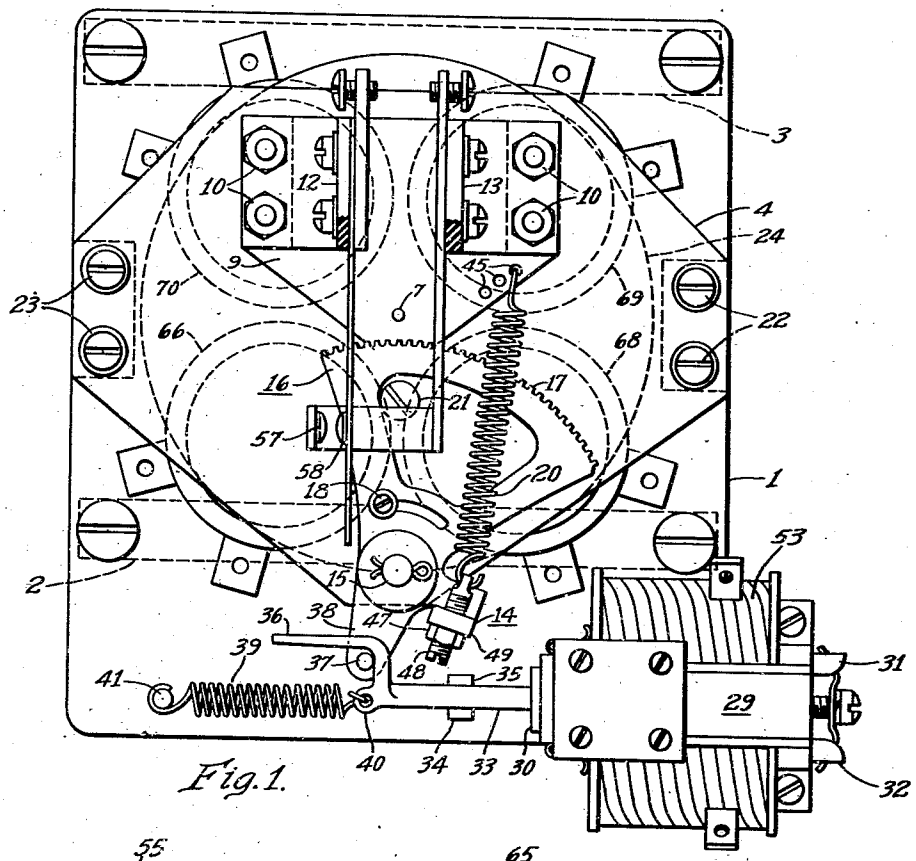


Fig. 1.

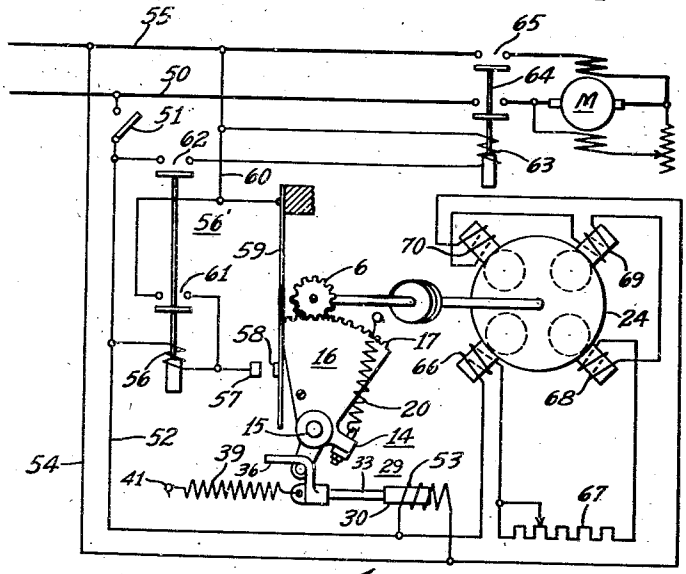


Fig. 3.

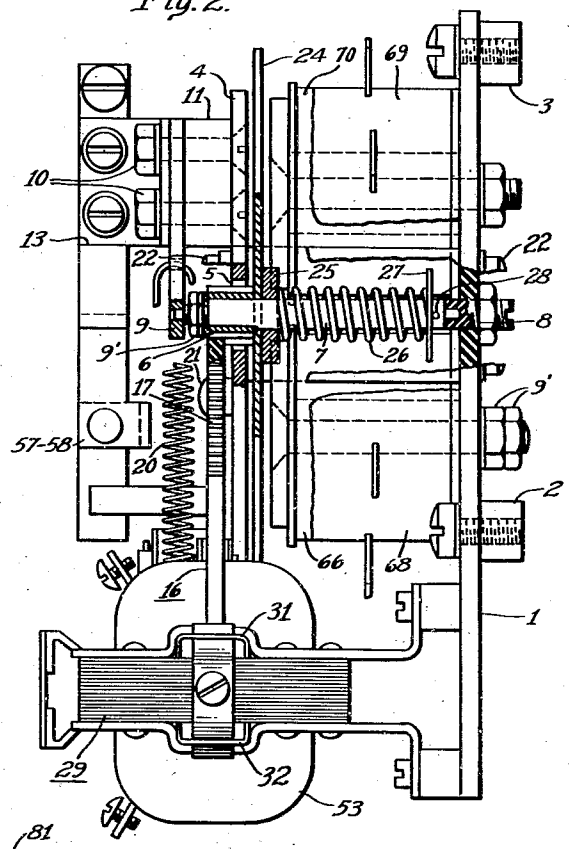
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Fig. 2.



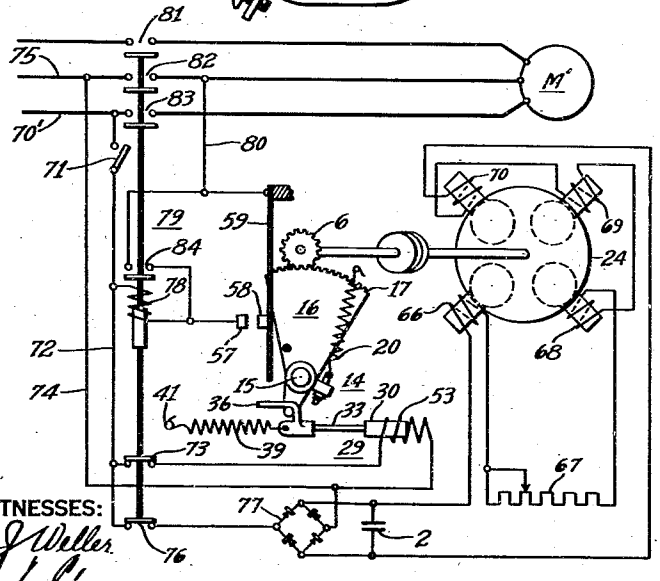


Fig. 4.

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Patented Aug. 7, 1945 2,381,300

UNITED STATES PATENT OFFICE

2,381,300

TIMING RELAY

Kurt Mahnke, Forest Hills, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application March 13, 1943, Serial No. 479,073

7 Claims. (Cl. 175—320)

My invention relates to electromagnetic devices and more particularly to electromagnetic time limit devices of the direct current type.

Electromagnetic time limit devices are well known in the electrical art. Those depending on alternating current are usually expensive synchronous devices and are quite accurate but those depending on direct current if of the inductive type have only a short variable time constant and if of the motor operated type are expensive and also are not reliable as to the time constant obtained.

One object of my invention is the provision of a direct current time limit device having a relatively long time constant and a device that shall be cheap and easily manufactured.

Another object of my invention is the provision of a direct current time limit relay that shall include means for adjusting the length of the time constant and which shall have a relatively long time constant.

These objects specifically stated are merely illustrative because many other and more specific objects will become apparent from a study of the following specification and the accompanying drawings, in which:

Figure 1 is a front view of my relay;

Fig. 2 is a side view, with certain parts broken away to show some details, of the subject-matter shown in Fig. 1;

Fig. 3 is a circuit diagram showing my invention schematically as used with a direct current motor; and

Fig. 4 is a circuit diagram showing my invention schematically as used with an alternating current motor.

In Figures 1 and 2 of the drawings, 1 designates the base upon which all the elements of my novel device are mounted. This base 1 is, as shown, suitably connected to the cross bars 2 and 3 for mounting the base in a vertical position on a control panel board, or other structure. My device has general utility but was devised with particular reference to the needs of the United States Navy. This novel structure, in addition to being inexpensive, simple and reliable, is compact and is not materially affected by shocks to which war vessels, on which my device finds use, are often subjected.

A face plate 4 is disposed in spaced relation to the base 1 and is, as shown, rigidly secured to the base 1. This face plate has an opening 5 through which the pinion 6 projects. This pinion 6 is keyed to shaft 7 to rotate with shaft 7 but may be axially adjusted on this shaft. The purpose of this adjustment is to obtain proper positioning of the disc relative to the other parts of my device and to obtain some slight variation in the time constant of my device.

Shaft 7 is freely rotatable in members 8 and 9. Member 8 is adjustably mounted in the base 1 and held to its adjusted position by the lock nuts 9'. Member 9 is rigidly secured to the face plate 4 by the bolts 10 and is held in spaced relation to face plate 4 by the spacers 11. The spacing and adjustment of members 8 and 9 are such that shaft 7 is very freely rotatable in the members 8 and 9.

The bolts 10 also hold a pair of brackets 12 and 13 of insulating material for holding the flexible, and thus movable, contact member 58 and the rigid contact member 57, respectively. The face plate 4 is also provided with a stud shaft 15 upon which is mounted, for free rotation, the gear sector 16. The gear teeth 17 of this sector 16 meshes with the pinion 6.

The sector 16 is provided with a switch actuating stud 18, which stud, made of suitable insulation, operates to close the circuit at contact members 57 and 58 when the sector is rotated to its extreme counterclockwise position. A spring 20 of suitable characteristics and under any adjusted tension is disposed between the adjusting means 14. This adjusting means comprises the bracket 49, stud bolt 48, and nut 47. The plate 9 is also provided with a plurality of holes 45 so that rough adjustments of the tension of spring 20 may be made by shifting the upper attachment of the spring and for a finer adjustment the nut 47 may be operated to different positions on the bolt 48.

The spring 20 normally actuates the sector 16 to its extreme counterclockwise position so that the sector 16 normally rests against the right-hand side of stop 21. When in this position to engage stop 21, the contact members 57 and 58, acted upon by stud 18, are closed.

From the foregoing description of the face plate 4 and the description of the elements secured to it, it is apparent that the entire face plate assembly may be removed as a unit by merely removing the screws 22 and 23.

The shaft 7, shown more clearly in the cut away portion of Fig. 2, is provided with a disc 24 of aluminum, copper, silver, or some other conducting metal. This disc 24 is loosely mounted on the shaft and is held in operative relation to the pinion 6, and thus the shaft 7, by the friction clutch disc 25. This friction disc 25 is biased against the disc 24 and thus the pinion 6 by the suitably loaded compression spring 26 disposed between

the friction member 25 and washer 27 loosely mounted on shaft 7 and held in axial position on shaft 7 by the pin 28. It will be noted that the shaft and all the parts on it may be removed as a unit, after removal of the face plate 4, without affecting the position of the other elements of the relay.

By means of suitable studs on the base 1, I mount four coils, 66, 68, 69 and 70 having their axes normal to the disc 24. These coils are connected in series to a suitable source of direct current, as shown in Fig. 3 and as represented by the rectifier 77 in Fig. 4. To vary the flux density of the flux disposed transverse the disc 24 the adjustable resistor or rheostat 67 is provided.

Disposed on the lower right-hand position of the base 1 is a voltage responsive solenoid 29. This solenoid has a rectangular C-shaped construction with the coil 53 of the solenoid disposed within the C. An armature 30 is disposed within the coil and is axially moved toward the right with a rapid movement when the coil is energized. The armature is guided within the coil by suitable facing U-shaped non-magnetic guides 31 and 32. This provides for free movement of the armature.

The left-hand end of the armature is provided with a rod 33 guided for horizontal movement by the lugs 34 and 35. This rod is provided with a projecting bent arm 36 disposed to engage pin 37 on the lower arm 38 of the sector 16. A spring 39 of considerable strength and under tension is hooked to the rod at 40 and to a stud 41 on the base 1. When the solenoid coil is deenergized the armature moves to the left under the action of spring 39. This spring 39 is selected sufficiently strong to overcome spring 20 so that when the solenoid coil is deenergized arm 36 acting on pin 37 rotates sector 16 rapidly clockwise without rotating disc 24 through pinion 6. The friction disc 25 permits this kind of operation.

When the solenoid coil 53 is energized arm 36 is moved to the right without affecting or operating on pin 37 to alter the position of pin 37 on the lower projection 38. The sector 16 is thus freed to be actuated counterclockwise by the spring 20. The speed of operation of the section 16 in the counterclockwise direction is delayed by the eddy currents in disc 24 caused by the density of the flux disposed transverse of the disc 24.

Since the distance of the disc 24 from the adjacent ends of the coils 66, 68, 69 and 70 may be varied by the axial movement of the pinion 6 by the nuts 9', since the position of stop 18 on the sector 16 may be changed angularly, and since the current strength of the coils 66, 68, 69 and 70 may be varied by rheostat 67, and further since the tension of spring 20 is adjustable, and also since the gear ratio between the disc 24 and sector 16 can be changed, it is apparent that the time of movement of sector 16 in the counterclockwise direction may be varied over a very wide range.

In many applications and particularly on board ship many automatically restarting motors are connected to the same source of supply. In the event of a voltage failure it is imperative, when voltage returns to the supply system, that the motors or other loads be not connected to the supply at the same time. The preferred operation is the reconnection of the various loads to the supply in a definite sequence. By using one of my relays for each of the loads and adjusting my timing relays for the respective loads for different time constants, the required sequence may be obtained.

Assuming that motor M, Fig. 3, is in one load unit as above mentioned. For normal operation of load unit M, switch 51 is closed whereupon a circuit is established from bus 50 through switch 51, conductor 52, solenoid coil 53 and conductor 54 to bus 55.

The armature 30 is thus rapidly moved to the right releasing the sector 16 to the control of spring 20 and the action of coils 66, 68, 69 and 70, which are also energized by the closure of switch 51. After a definite time, depending on the adjustments of nuts 9', nut 47, and rheostat 67, contact members 57 and 58 are closed.

Closure of contact members 57 and 58 establishes a circuit from energized conductor 52 through coil 56 of relay 56', contact members 57 and 58, strip 59 and conductor 60 to bus 55. Operation of relay 56' closes contact members 61 and 62. The relay is held in by contact members 61 and the coil 63 of the line switch is energized and the motor M is thus connected to the buses 50 and 55 by contact members 64 and 65.

In the event of a voltage failure, all the parts move to the position shown in Fig. 3 except that switch 51 is closed. When voltage returns on the buses 50 and 55, the sequence above described is reenacted.

In the showing in Fig. 4, when switch 71 is closed a circuit is established from bus 70' through switch 71, conductor 72, contact members 73, coil 53, and conductor 74 to bus 75. Another circuit is established from conductor 72 through contact members 76, rectifier 77 to energized conductor 74. From the direct current terminals of the rectifier the coils 66, 68, 69 and 70 are thus energized.

After a predetermined time, contact members 57 and 58 close whereupon a circuit is established from energized conductor 72 through coil 78 of the line contactor 79, strip 59 and conductor 80 to lens 75.

Operation of line contactor 79 causes the closure of contact members 81, 82, 83 and 84. The motor is thus energized and the line contactor is held in by the circuit through contact members 84. Opening of contact members 73 and 76 removes the energization from the time limit relay.

Upon voltage failure, the condition of the circuits is again as shown in Fig. 4 except switch 71 is closed. When the voltage comes back on the buses the cycle above recited is repeated.

From the foregoing, it will be apparent that I have provided a simple and efficient time limit device which, when properly designed, can produce any selected time constant from one second to twenty-five seconds, or more, particularly if the gear ratio between disc and sector is increased.

Since both coil 53 and the magnets 66, 68, 69 and 70 are deenergized simultaneously, the relay will reset very fast. The disc is then turned rapidly in clockwise direction by spring 39, without being retarded. Whether or not the clutch 25 slips is not very important for this operation. However, the clutch 25 is of particular value if, instead of the coils, permanent magnets are used for damping. In this case, spring 20 should be too weak to overcome clutch friction and spring 39 should be strong enough to exceed clutch friction.

My invention is not limited to the use of electromagnets but the reference characters 66, 68, 69 and 70 may as well designate permanent magnets.

My invention is not limited to the specific

showing made but is only limited by the scope of the claims hereto appended.

I claim as my invention:

1. A time limit device of the direct current type comprising in combination, a source of direct current, a plurality of coils connected to said source of direct current, a base for the coils, said coils being mounted on the base with their axes in parallel relation and so that the ends of the coils fall in substantially the same plane, a rotatably mounted disc disposed a given distance from the ends of said coils and rotatable in a plane parallel to the plane defined by the ends of said coils, disc operating means including biasing means for normally biasing said disc to a given angular position, electromagnetic means having a spring-biased element for operating said disc when said electromagnetic means is deenergized to another angular position through said disc operating means, means operable by said electromagnetic means, when said electromagnetic means is energized, to release said disc operating means to thus release said disc for rotation to its first given angular position, said disc, being in the magnetic field of said coils, is thus retarded in its rotation to a selected speed for a selected period of time, and switching means operable by said disc at the end of its rotation to its first angular position.

2. A time limit device of the direct current type comprising in combination, a source of direct current, a plurality of coils connected to said source of direct current, a base for the coils, said coils being mounted on the base with their axes in parallel relation and so that the ends of the coils fall in substantially the same plane, a rotatably mounted disc disposed a given distance from the ends of said coils and rotatable in a plane parallel to the plane defined by the ends of said coils, means for adjusting the distance of the disc from the ends of the coils, disc operating means including biasing means for normally biasing said disc to a given angular position, electromagnetic means having a spring-biased element for operating said disc through said disc operating means to another angular position when said electromagnetic means is deenergized, means operable by said electromagnetic means, when said electromagnetic means is energized, to release said disc operating means to thus release said disc for rotation to its first given angular position, said disc, being in the magnetic field of said coils, is thus retarded in its rotation to a selected speed for a selected period of time, and switching means operable by said disc at the end of its rotation to its first angular position.

3. A time limit device of the direct current type comprising in combination, a source of direct current, a plurality of coils connected to said source of direct current, a base for said coils, means for adjusting the current traversing said coils to thus alter the flux density at the ends of said coils, said coils being mounted on the base with their axes in parallel relation and so that the ends of the coils fall in substantially the same plane, a rotatably mounted disc disposed a given distance from the ends of said coils and rotatable in a plane parallel to the plane defined by the ends of said coils, disc operating means including biasing means for normally biasing said disc to a given angular position, electromagnetic means having a spring-biased element for operating said disc through said disc operating means to another angular position when said electromagnetic means is deenergized, means operable by said electromagnetic means, when said electromagnetic means is energized, to release said disc operating means to thus release said disc for rotation to its first given angular position, said disc, being disposed in the magnetic field of said coils, is thus retarded in its rotation to a selected speed for a selected period of time, and switching means operable by said disc at the end of its rotation to its first angular position.

4. A time limit device of the direct current type comprising in combination, a source of direct current, a plurality of coils connected to said source of direct current, a base for said coils, means for adjusting the current traversing said coils to thus alter the flux density at the ends of said coils, said coils being mounted on the base with their axes in parallel relation and so that the ends of the coils fall in substantially the same plane, a rotatably mounted disc disposed a given distance from the ends of said coils and rotatable in a plane parallel to the plane defined by the ends of said coils, disc operating means including biasing means for normally biasing said disc to a given angular position, means for adjusting the biasing force of said disc biasing means, electromagnetic means having a spring-biased element for operating said disc through said disc operating means to another angular position when said electromagnetic means is deenergized, means operable by said electromagnetic means, when said electromagnetic means is energized, to release said disc operating means to thus release said disc for rotation to its first given angular position, said disc, being disposed in the magnetic field of said coils, is thus retarded in its rotation to a selected speed for a selected period of time, and switching means operable by said disc at the end of its rotation to its first angular position.

5. A time limit device of the direct current type comprising in combination, a source of direct current, a plurality of coils connected to said source of direct current, a base for said coils, means for adjusting the current traversing said coils to thus alter the flux density at the ends of said coils, said coils being mounted on the base with their axes in parallel relation and so that the ends of the coils fall in substantially the same plane, a rotatably mounted disc disposed a given distance from the ends of said coils and rotatable in a plane parallel to the plane defined by the ends of said coils, means for adjusting the distance of the disc from the ends of the coils, disc operating means including biasing means for normally biasing said disc to a given angular position, electromagnetic means having a spring biased element for operating said disc through said disc operating means to another angular position when said electromagnetic means is deenergized, means operable by said electromagnetic means to release said disc operating means to thus release said disc for rotation to its first given angular position, said disc, being disposed in the magnetic field of said coils, is thus retarded in its rotation to a selected speed for a selected period of time, and switching means operable by said disc at the end of its rotation to its first angular position.

6. A time limit device of the direct current type comprising in combination, a source of direct current, a plurality of coils connected to said source of direct current, a base for said coils, means for adjusting the current traversing said coils to thus alter the flux density at the ends of said coils, said coils being mounted on

the base with their axes in parallel relation and so that the ends of the coils fall in substantially the same plane, a rotatably mounted disc disposed a given distance from the ends of said coils and rotatable in a plane parallel to the plane defined by the ends of said coils, disc operating means including biasing means for normally biasing said disc to a given angular position, means for adjusting the biasing force of said disc biasing means, electromagnetic means having a spring-biased element for operating said disc through said disc operating means to another angular position when said electromagnetic means is deenergized, means operable by said electromagnetic means to release said disc operating means to thus release said disc for rotation to its first given angular position, said disc, being disposed in the magnetic field of said coils, is thus retarded in its rotation to a selected speed for a selected period of time, and switching means operable by said disc at the end of its rotation to its first angular position.

7. A time limit device of the direct current type comprising in combination, a source of direct current, a plurality of coils connected to said source of direct current, a base for said coils, means for adjusting the current traversing said coils to thus alter the flux density at the ends of said coils, said coils being mounted on the base with their axes in parallel relation and so that the ends of the coils fall in substantially the same plane, a rotatably mounted disc disposed a given distance from the ends of said coils and rotatable in a plane parallel to the plane defined by the ends of said coils, means for adjusting the distance of the disc from the ends of the coils, disc operating means including biasing means for normally biasing said disc to a given angular position, means for adjusting the biasing force of said disc biasing means, electromagnetic means having a spring-biased element for operating said disc through said disc operating means to another angular position when said electromagnetic means is deenergized, means operable by said electromagnetic means to release said disc operating means to thus release said disc for rotation to its first given angular position, said disc, being disposed in the magnetic field of said coils, is thus retarded in its rotation to a selected speed for a selected period of time, and switching means operable by said disc at the end of its rotation to its first angular position.

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