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K. V. KEELEY

2,256,117

TIMING DEVICE

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Fig. 1

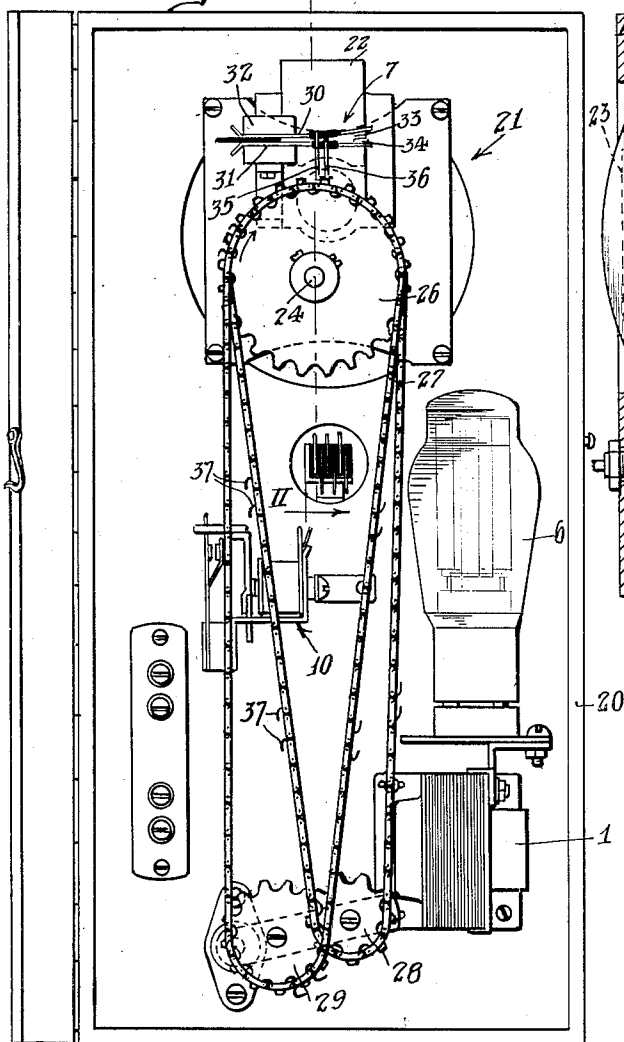


Fig. 2

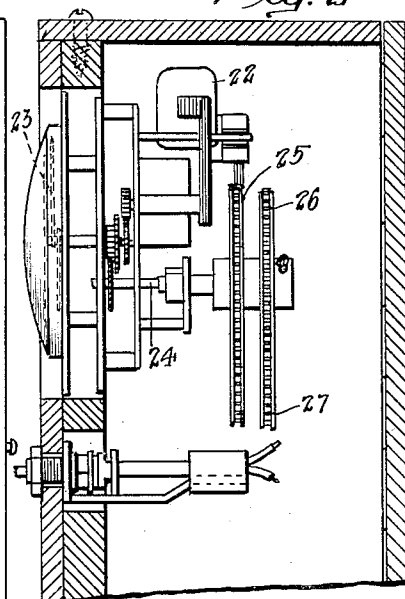


Fig. 3

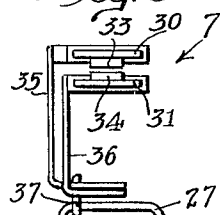


Fig. 5

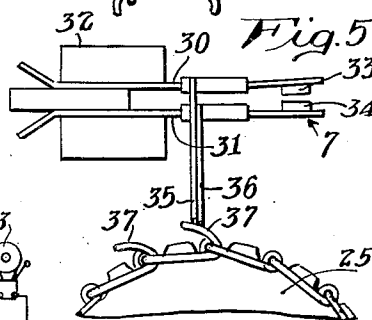
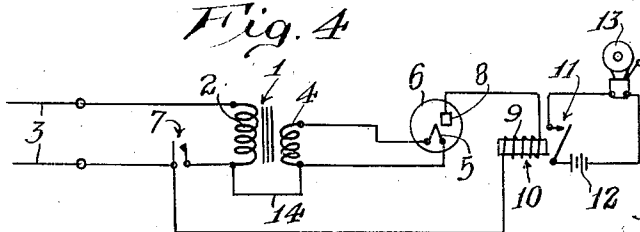


Fig. 4



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TIMING DEVICE

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5 Claims. (Cl. 161—1)

This invention relates broadly to timing devices, and particularly to non-mechanical timing devices distinct from clock movements, and the like. More specifically, the invention relates to a timing device which depends upon the thermal inertia of a vacuum tube element.

An object of the invention is to provide a timing device capable of controlling an electric circuit for a predetermined relatively short period with fair accuracy and without the use of mechanical moving mechanisms, such as clock works.

Another object is to provide a timing device which may be employed in connection with any closure switch in an electrical circuit for closing or opening a second circuit for a fixed period of time following actuation of the first mentioned switch independent of the period of closure of the switch.

Another object is to provide a timing switch adapted to close or open a work circuit for short fixed intervals at predetermined different hours of the day with a relatively simple and inexpensive equipment.

The invention will be explained by describing in detail a system and apparatus incorporating the invention, specifically adapted for ringing bells in schools, and the like, at the periods of commencement of different classes. It will be understood, however, that the invention is adaptable to other specific systems and is not to be limited to the specific system shown and described.

In the drawing:

Fig. 1 is an elevation view of a clock switch incorporating my invention, adapted to recurrently close a bell circuit, or the like, for short intervals of time;

Fig. 2 is a sectional view, taken in the plane II—II of Fig. 1;

Fig. 3 is a greatly enlarged detail view of the contact mechanism of the clock shown in Fig. 1;

Fig. 4 is a schematic diagram showing the electrical circuit employed; and

Fig. 5 is an enlarged detail view of the switch mechanism, the view being taken at right angles to the view of Fig. 3.

Referring first to Fig. 4, there is shown a step-down transformer 1 having a primary winding 2 adapted to be energized from a suitable source of alternating current, such as a commercial power line 3, and having a secondary winding 4 of a suitable number of turns in proportion to the number of turns in winding 2 to supply a proper voltage for energizing the cathode 5 of

a vacuum tube 6. The circuit between the power line 3 and the primary winding 2 of the transformer is normally interrupted by switch contacts 7 so that the cathode 5 of the vacuum tube is normally de-energized and cold. The vacuum tube 6 also has an anode 8 which is connected through the winding 9 of a relay 10 to the power side of the switch 7. As shown in Fig. 4, the relay 10 is provided with contacts 11 which are normally open when the relay 10 is not energized, but closed in response to energization of the relay. Thus the contacts 11 are shown connected in series with a battery 12 and an electric bell 13. Obviously, any other source of electric power may be employed instead of the battery 12.

Under normal conditions of operation, when the switch 7 is open, the relay 10 is de-energized because it can receive current only through the vacuum tube 6 and when the cathode 5 of the tube is cold no current can flow through the tube. As previously indicated, the cathode 5 is cold when the switch 7 is open because no current is flowing in the primary winding 2 of the transformer.

Now assume that the switch 7 is closed, thereby completing a circuit from the power line 3 to the primary winding 2 of the transformer. This causes current to flow in the primary winding 2, inducing current in the secondary winding 4, which heats the cathode 5 of the vacuum tube 6, thereby rendering the tube conductive. However, no current flows from the cathode to the anode of the tube 8 at this time because the winding 9 is connected directly in series between the anode 8 and the cathode 5 through the contacts of the switch 7, a conductor 14 interconnecting the switch end of the primary winding 2 to the cathode 5. Therefore the relay 10 remains de-energized following the closure of switch contacts 7, although the cathode 5 of the tube 6 remains heated. However, when the switch contacts 7 are opened, a circuit from the power line 3 to the winding 9 of relay 10 is completed and maintained for a brief period of time, due to the thermal inertia of the cathode 5. Thus a circuit path can be traced from the upper side of power line 3 through the primary winding 2 of the transformer 1 through conductor 14, the cathode 5 and anode 8 of tube 6 and winding 9 back to the lower side of the power line 3. Of course the primary winding 2 of transformer 1 offers some impedance to the flow of current through this circuit, but the impedance of winding 2 can readily be made low enough, as

compared to the impedance offered by the tube 6 and the relay winding 9 so that sufficient current will flow while the cathode 5 is heated to energize relay 10. Energization of relay 10, of course, closes contact 11 and rings the bell 13, the latter continuing to ring until the relay 10 is again de-energized. Relay 10 will be de-energized as soon as the cathode 5 cools off to a point where its electron emission is insufficient to supply enough current to hold the relay 10.

Recapitulating, each time the switch contacts 7 are closed and then opened current flows through the winding of relay 10 for a definite period of time, depending upon the thermal inertia of the cathode 5 of tube 6. This time will be substantially independent of the period of closure of the contacts 7, provided they close long enough to permit the cathode 5 to attain full operating temperature.

In the simple circuit described, a 2-electrode vacuum tube is disclosed having only a cathode and an anode. It is possible, however, that for specific applications it may be desirable to employ a tube having other electrodes in addition to the cathode and anode.

The circuit described with reference to Fig. 4 lends itself admirably to use in a bell-ringing system for schools, factories, and the like, in which the switch contacts 7 are closed and opened at predetermined hours of the day by a clock mechanism. The system is particularly adapted for such use because the time of closure of the bell circuit is quite independent of the period of closure of the contacts 7, and it is quite easy to construct a clock switch that will open a pair of contacts at fairly accurate time intervals whereas it is more difficult and expensive to construct clock-actuated switches which not only close at predetermined hours of the day, but also remain closed for an accurately measured short interval of time.

Referring now to Fig. 1, there is depicted a complete apparatus for closing a circuit, such as a bell circuit, for fixed intervals of time at predetermined hours of the day. As shown in Fig. 1, the apparatus comprises a cabinet 20 in which are mounted the transformer 1, the vacuum tube 6, the relay 10 and a clock mechanism 21 incorporating the switch contacts 7.

The clock mechanism proper may be of any well-known type, and need not be described in detail. As shown to best advantage in Fig. 2, the particular mechanism shown is of the electrical type employing a motor 22 actuating a train of gears which rotate the hands 23. The shaft 24 of one of the gears is extended rearwardly and mounts a pair of sprockets 25 and 26 which support and drive an endless chain 27. Thus the chain, after passing over the sprocket 26, passes down under an idler sprocket 28, thence up over the sprocket 25, thence down under a second idler sprocket 29 and then back over sprocket 26 again. By employing the two sprockets 25 and 26 and the idler sprockets 28 and 29 spaced a substantial distance therefrom, a relatively long chain may be employed, which requires a correspondingly long time to pass through a complete cycle, although its linear speed may be relatively great. It is desirable to have a high linear speed on the chain because it carries elements for actuating the switch mechanism and if the chain moves rapidly, it is possible to obtain greater accuracy in the timing of the contact closure. Obviously, if necessary or desirable, a larger number of sprockets may be employed. Thus three

drive sprockets and three idler sprockets, or four drive sprockets and four idler sprockets might be employed.

The switch contacts 7 are positioned above the sprockets 25 and comprise, as shown in Figs. 3 and 5, a pair of resilient strip members 30 and 31, respectively, supported at one end between insulating blocks 32 and carrying juxtaposed contacting points 33 and 34. Each of the strips also has insulatingly attached thereto a cam follower. Thus the upper strip 30 has a follower 35 insulatingly secured thereto and the contact strip 31 has a follower 36 secured thereto. These followers 36 terminate at their lower ends in transverse surfaces positioned closely adjacent to each other immediately above the path of the chain 27 on the sprocket 25. The sprocket 25 is provided at spaced intervals therealong with outwardly projecting rearwardly extending cam wires 37, these cams being so spaced along the chain as to contact the cam followers 35 and 36 at predetermined desired intervals. As shown, the cams 37 are so spaced as to pass under the cam followers at each hour at definite intervals, such as 5 or 10 minutes, after the hour.

As each of the cams 37 passes under the cam followers 35 and 36 it first lifts both cam followers by substantially equal amounts to carry the contact strips 30 and 31 both upwardly while maintaining them in spaced apart relation. However, as the cam 37 continues its motion it releases the cam follower 35 a few seconds before it releases the cam follower 36, thereby permitting the contact strip 30 to drop while the contact strip 31 is still held in uppermost position, causing closure of the contact points 33 and 34. As the chain continues its motion, the cam 37 passes away from the cam follower 36, permitting it to release and again open the contact points 33 and 34.

With the chain mechanism of the type described, it is easy to close the contacts 7 at desired periods during the day and maintain them closed for an appreciable interval of time sufficient to heat the cathode 5 of the tube 6 and thereby energize the relay 10 for an accurately measured period of time, as previously described in connection with Fig. 4. On the other hand, it is relatively difficult and expensive to devise a cam and cam follower mechanism that would close the contacts 7 for a short period of time measured as accurately as that measured with the vacuum tube in the manner described.

As previously indicated, the invention has numerous applications other than the specific system described, and the invention is therefore to be limited only as set forth in the appended claims.

I claim:

1. A timing system comprising a vacuum tube having a thermionic cathode and an anode, the cathode being adapted to be electrically heated, a current source, a device adapted to be energized from said source, an energizing circuit for said cathode to heat the same, and means for substantially simultaneously interrupting flow of heating current to said cathode and completing an electrical circuit including said source, said tube and said device in series, whereby current flows in said series circuit to energize said device only while said cathode remains heated following interruption of heating current thereto.

2. In combination, a vacuum tube having a thermionic cathode and an anode, the cathode being adapted to be electrically heated, a cur-

rent source, a device adapted to be energized from said source, and means for successively applying current from said source to said cathode to heat it above an electron-emitting temperature and then through said tube to said device whereby current flows in said device to energize it only while said cathode remains heated following interruption of heating current thereto.

3. In combination, a vacuum tube having a thermionic cathode and an anode, a current source, a device adapted to be energized from said source and circuit means including a switch for completing a circuit from said source to said cathode to heat the cathode when said switch is closed and for completing a circuit for connecting said source to said tube and device in series when said switch is open, whereby current flows in said series circuit to energize said device only while said cathode remains heated following completion of said series circuit.

4. An electrical system comprising a switch, a current source, a current-actuated device and means responsive to closing and opening of said switch for supplying current from said source to said device for a fixed length of time only immediately following the opening of said switch, said fixed length of time being determined by said means and being substantially independent of the electrical characteristics of said device.

5. A signalling system comprising a switch and means for periodically recurrently closing it for a period of time and then opening it for a period of time exceeding a predetermined minimum, a current source, a current-actuated device, and means responsive to said closing and said opening of said switch for supplying current from said source to said device following said opening of said switch, for a predetermined time less than said predetermined minimum.

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