Jan. 14, 1930. H. N. PACKARD 1,743,231

DEVICE FOR TIMING AND CONTROLLING IMPULSES

Filed May 29, 1920

Fig. 1.

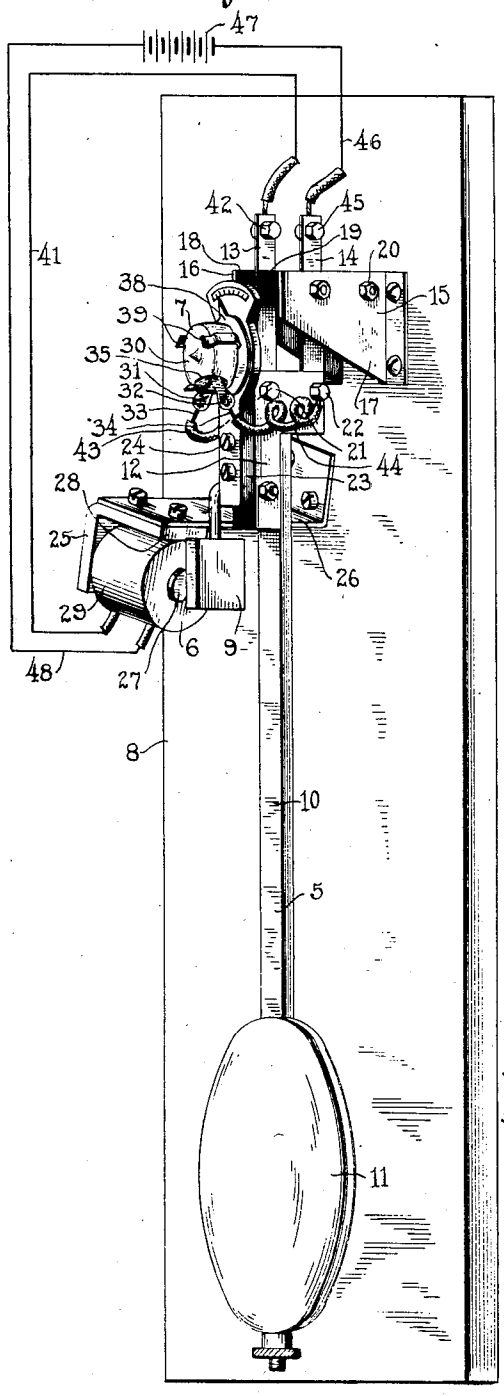


Fig. 2.

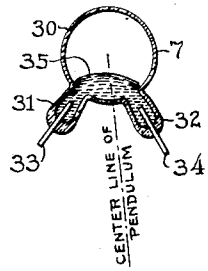


Fig. 3.

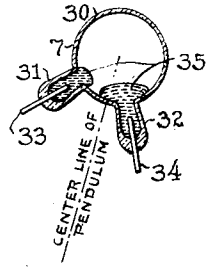
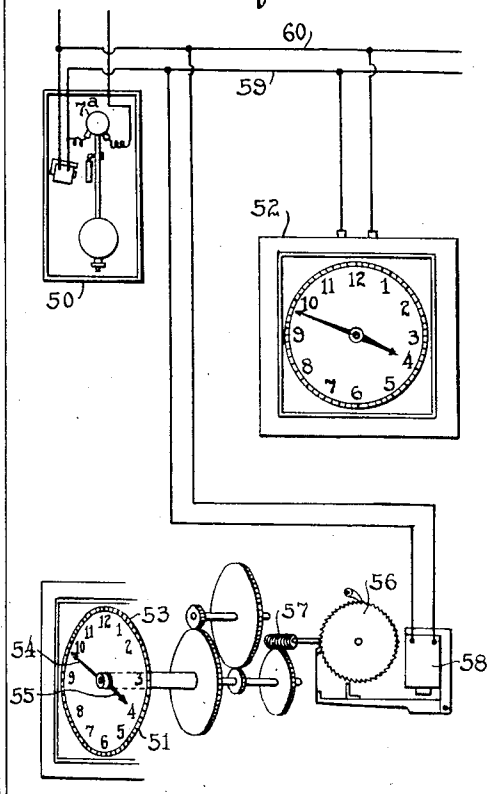


Fig. 4.



Inventor
Horace N. Packard
By Fowler & Hubbard
Attorney

Patented Jan. 14, 1930

1,743,231

UNITED STATES PATENT OFFICE

HORACE N. PACKARD, OF MILWAUKEE, WISCONSIN, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CUTLER-HAMMER, INC., A CORPORATION OF DELAWARE

DEVICE FOR TIMING AND CONTROLLING IMPULSES

Application field May 29, 1920. Serial No. 385,125.

This invention relates to devices for timing and controlling impulses, and while not limited thereto, is particularly applicable to electrically operated clocks of the oscillatory pendulum type.

One object of the invention is that of providing an exceedingly simple and compact yet accurate, durable and reliable device of the character stated.

Another object is that of providing a device of the character stated which is particularly adapted to serve as a master for effecting time control of associated instrumentalities.

Another object is that of providing an electrically operated time controlled device including apparatus adapted to effect direct control of electric circuit connections traversed by relatively heavy currents for chronometric control of associated electrically operated devices without necessitating interposition of relays.

Another object is that of providing an electrically operated clock involving timing means and circuit control means adapted to co-operate with maximum efficiency and wherein mutual functional interference is minimized.

Other objects and advantages will hereinafter appear.

In the accompanying drawing wherein is illustrated an embodiment of the invention,

Figure 1 is a perspective view thereof;

Figs. 2 and 3 are sectional detail views illustrating like portions of the structure shown in Fig. 1, but in different operative positions; while,

Fig. 4 is a diagrammatic view illustrating certain of the possible applications of the device.

Referring to Figure 1 of the drawing, the same illustrates an electric clock comprising an oscillatory pendulum 5, an actuating electro-magnet 6 therefor and a switch 7 to be operated by the pendulum for controlling the energizing circuit of said electro-magnet. The pendulum 5 is resiliently supported upon a fixed vertical panel 8, the electro-magnet 6 being secured to said panel and adapted to co-operate magnetically with an armature member 9 carried by the pendulum. The switch, which is of a construction adapting the same to make and break circuit respectively upon partial rotation thereof in opposite directions, is mounted directly upon the pendulum for oscillation therewith to thereby control and time the operation of the electro-magnet for causing the latter to impart an impulse to the pendulum at a predetermined stage in each successive oscillation thereof.

More particularly the pendulum 5 comprises a rod 10 having at its lower end a radially adjustable bob 11 and having its upper end rigidly secured to an oscillable insulating base 12 which also serves to support the switch 7 and the armature 9, while a pair of spaced conductive springs 13 and 14 serve to connect said base 12 with a fixed insulating bracket 15 which projects forwardly from the panel 8. Said springs provide jointly for resilient support of the aforementioned oscillable parts, and also provide the necessary flexible electrical connections between the switch and the fixed support parts.

The bracket 15 comprises a pair of similar flanged side members 16 and 17, preferably comprising sheet metal stampings, arranged in spaced and registering relation with one another with their respective flanges secured directly to the panel 8 and their main portions extending in parallel relation horizontally forwardly therefrom. A pair of rectangular insulating blocks 18 and 19 are arranged in parallel relation with their lower surfaces horizontal and flush with one another between said side members, 16 and 17, said insulating blocks being adapted to receive the springs 13 and 14 therebetween. A plurality of bolts 20 extend through said side members and said insulating blocks (in staggered relation to the springs 13 and 14, as shown) for drawing said blocks together to securely clamp said springs therebetween for direct support of said springs and of the oscillatory parts carried thereby, said springs being, moreover, fully insulated from one another by the arrangement just described.

The oscillable base 12 preferably comprises

a pair of similar and registering inverted L-shaped insulating blocks having their upper surfaces horizontal and arranged flush with one another, said blocks being clamped together about the lower extremities of the springs 13 and 14 by means of screw bolts including bolts 21 and 22 which are arranged in permanent electrical contact with the respective springs to provide terminals therefor. The aforedescribed construction of said base and the bracket 15 thus provides a two-point resilient suspension for the pendulum.

An elongated board 23, preferably of insulating material, is secured at its lower portion of the front face of the oscillable base 12 by means of bolts 24, the latter also serving to secure the pendulum rod 10 to said base, said board providing at its upper end a support for the switch 7 whereas the armature member 9 is adjustably secured between said board and said oscillable base.

The electro-magnet 6 preferably comprises a U-shaped magnetic frame 25 mounted upon the panel 8 by means of an interposed bracket 26, said frame having its parallel legs arranged substantially in the plane of oscillation of the armature 9 and provided with polar faces 27 and 28 arranged adjacent said armature but located beyond the range of normal oscillation thereof. An energizing coil 29 is mounted upon one of said parallel legs, the other of said legs being secured directly to the bracket 26.

The switch 7 is preferably of the type disclosed and claimed in a patent of Erwin R. Stoekle No. 1,492,584, dated May 6, 1924, and comprises a substantially circular sealed bulb or container 30 of glass or other suitable insulating material adapted to oscillate in a vertical plane about its own major axis. Said container is provided with downwardly extending hollow radial portions 31 and 32, forming internal wells or pockets arranged to include therebetween a radial angle preferably less than 90 degrees, the openings connecting said wells with the interior of the container proper being relatively restricted. Conductors 33 and 34 are sealed within the lower terminal portions of said projections respectively, said conductors being located in the main exteriorly of the container and having their upper portions positioned within the respective wells and terminating preferably substantially flush with the inner arc surface of the container proper.

The lower portion of said container including said wells is filled with a dense conductive fluid medium 35 such as mercury, the quantity thereof being sufficient to extend continuously between said wells for providing electrical connection of the conductors 33 and 34 so long as the container occupies an angular position wherein said wells are substantially symmetrically arranged with reference to the vertical.

Upon rotation of said container through a predetermined angle, which in practice need not exceed 20 degrees, the mercury contained within one well is elevated above the level of the main body of mercury within the container for effecting sudden interruption of such electrical connection, between mercury surfaces exclusively, whereas obviously upon restoration of the container to such symmetrical relation, said circuit connection is similarly re-established. Such interruption of circuit is ordinarily effected without appreciable arcing. However, under certain conditions and particularly in breaking a relatively heavy current, a material arc of brief duration may be drawn.

In practice the space within the container not occupied by the aforementioned conductors, including the fluid conductor 35, is preferably evacuated, prior to sealing of the container, for removal of any gaseous matter which might react unfavorably upon the exposed conductive parts. This feature, however, is not absolutely essential and on the other hand such space might be filled with an electrically inert and nonoxidizing gas to minimize the effects of possible arcing between the mercury surfaces undergoing separation, whereas under certain conditions such space might even be left open to atmosphere.

Obviously throughout the aforedescribed circuit controlling action of the switch, the container and the main body of the mercury therein are not displaced bodily to any appreciable extent. Moreover the slight elevation of one of the radial extensions and the small portion of mercury contained therein, together with its associated solid conductors, is practically completely compensated by corresponding lowering of the other radial extension and its similarly associated parts. Thus the mechanical power required to effect such operation is minimized and the device rendered sensitive to influences of exceedingly small magnitude, whereas such actuation involves practically no sudden release of stored energy, whereby said element is particularly adapted to mounting directly upon a pendulum in the manner described for performing its intended circuit controlling functions without to any appreciable degree interfering with the normal functions of the pendulum itself. Also, by the foregoing construction and arrangement of parts, whereby movement of the container is limited to rotation substantially within its own contour, the operative space requirements of the device are minimized.

In practice the aforedescribed switch is directly mounted upon an adjustable clamping device 38, the latter having forwardly projecting clips 39 to engage and secure the container 30 thereto. Said clamping device is itself mounted at the upper end of the in-

sulating board 23 in such relation as to effect positioning of said container with its major axis coincident with the axis of oscillation of the pendulum, whereby during operation, said switch is subjected to substantially pure oscillation unaccompanied by translatory movement whereas, as is apparent the mercury of the switch exerts practically no momentum effect upon the pendulum. In practice the clamping device is preferably made angularly adjustable in a vertical plane with reference to the support 23, the latter being preferably provided with an indicating segment and said clamping device having a pointer for facilitating exact adjustment of the position of the switch with reference to the pendulum.

In practice one side of the coil 29 may be connected by a conductor 41 to a terminal 42 carried at the upper end of the spring support 13. A conductor 43 serves to connect the lower terminal 21 of said spring support with the conductor 33 of the switch 7 while a similar conductor 44 serves to connect the conductor 34 of said switch with the lower terminal 22 of the spring support 14. The upper terminal 45 of said latter mentioned spring support is connected by conductor 46 with a suitable source of electrical energy such as a battery 47, or optionally a source of alternating current, the opposite side of such source being in turn connected to the opposite side of coil 29 by means of conductor 48, it being, however, understood that other instrumentalities may be included in such circuit. The conductors 43 and 44 are preferably flexible in character and of sufficient length to permit adjustment of the switch relative to its support although during normal operation of the device no movement between said switch and the pendulum takes place.

The foregoing parts being in the relative positions illustrated, the switch 7 being in a relation to maintain conductivity between its terminals the energizing circuit of electromagnet 6 is completed. Said electromagnet thus attracts its armature 9 and draws the same together with the pendulum to the left. However, at a predetermined stage in such movement, and before said armature has been permitted to seal with the adjacent polar face of said electro-magnet, the switch 7 acts in the manner aforedescribed to interrupt said energizing circuit, whereupon attraction between said electro-magnet and said armature ceases and the pendulum is free to swing in the opposite direction. Owing to the high surface tension of the mercury within the container 30, circuit is not re-established therethrough until the pendulum has swung back a material distance past the point at which said circuit was previously broken, this feature being illustrated particularly in Figs. 2 and 3. Thus at the instant when said circuit is re-established, the armature 9 is substantially outside the range of attraction of the electro-magnet 6 whereby the latter does not to any appreciable extent retard movement of the pendulum to the right. However, as said pendulum again starts its movement to the left, the attraction exerted by the electro-magnet increases up to the point at which the circuit is again automatically broken in the manner described.

The aforedescribed time lag incident to re-establishment of the energizing circuit thus insures that the attraction of the armature 9 by the electro-magnet preponderates during the time wherein the pendulum is moving toward the left, whereby under the control conditions stated said magnet serves to impart regular impulses to said pendulum in such direction for building up and continuing its oscillation.

By suitable adjustment of the switch 7 with reference to its support, the former may be caused to effect interruption of the energizing circuit of the magnet uniformly at the proper stage of oscillation of the pendulum and by means of the foregoing adjustment together with adjustment of the pendulum bob, the device may be calibrated with great accuracy.

Certain of the earlier described features of the switch including that of interrupting circuit between mercury surfaces in the presence of an electrically inert reducing agent serve to render said switch capable of controlling currents of magnitudes many times greater than that required to effect operation of the aforedescribed pendulum, whereby the device is adapted to act as a master for effecting time control of associated devices which in practice may comprise subsidiary clocks or other mechanism wherein such character of control is necessary or desirable.

Figure 4 illustrates such an arrangement wherein a master clock of the character hereinbefore described is adapted to effect operation of other clocks in synchronism therewith.

In said figure, 50 represents a master clock having subsidiary clocks 51 and 52 arranged to be controlled thereby. The clock 51 which is illustrated in detail comprises a fixed dial 53 having hands 54 and 55 to be operated at the proper speed ratio by means of a solenoid ratcheting device 56 acting through suitable gearing including a worm drive 57, the operating solenoid 58 being arranged in parallel with the operating electro-magnet of the master clock, it being, however, understood that said solenoids might be arranged in series if desired. Circuit wires 59 and 60 controllable by the switch 7^a of the master clock serve to connect the clock 52 in circuit, said clock being understood to be similar to the clock 51 aforedescribed. It is furthermore obvious that other devices which are capable of operation by a ratcheting solenoid or similar mechanism and wherein the power re-

quirements are not excessive may also be operated in a similar manner from said master clock.

What I claim as new and desire to secure by Letters Patent is:

1. In an electric clock, the combination with an oscillatory pendulum, of flexible suspension means therefor comprising a plurality of spaced and insulated resilient conductive elements arranged to connect said pendulum with a fixed support and constituting the only physical connection therebetween, and an electric switch carried bodily by said pendulum and having terminal contacts movable therewith, said conductive elements forming exterior circuit connections for said contacts.

2. In an electric clock, the combination with an oscillatory pendulum, of flexible suspension means therefor comprising a plurality of spaced and insulated resilient conductive elements arranged to connect said pendulum with a fixed support and constituting the only physical connection therebetween, an electric switch carried bodily by said pendulum and having terminal contacts movable therewith, said conductive elements forming exterior circuit connections for said contacts, and an actuating electromagnet for said pendulum, the energizing circuit of said electromagnet being controllable by said switch.

In witness whereof, I have hereunto subscribed my name.

HORACE N. PACKARD.