June 18, 1935. P. HUNGERBÜHLER 2,005,085

TIME CONTROLLED SWITCH

Filed Dec. 5, 1930

Fig 1

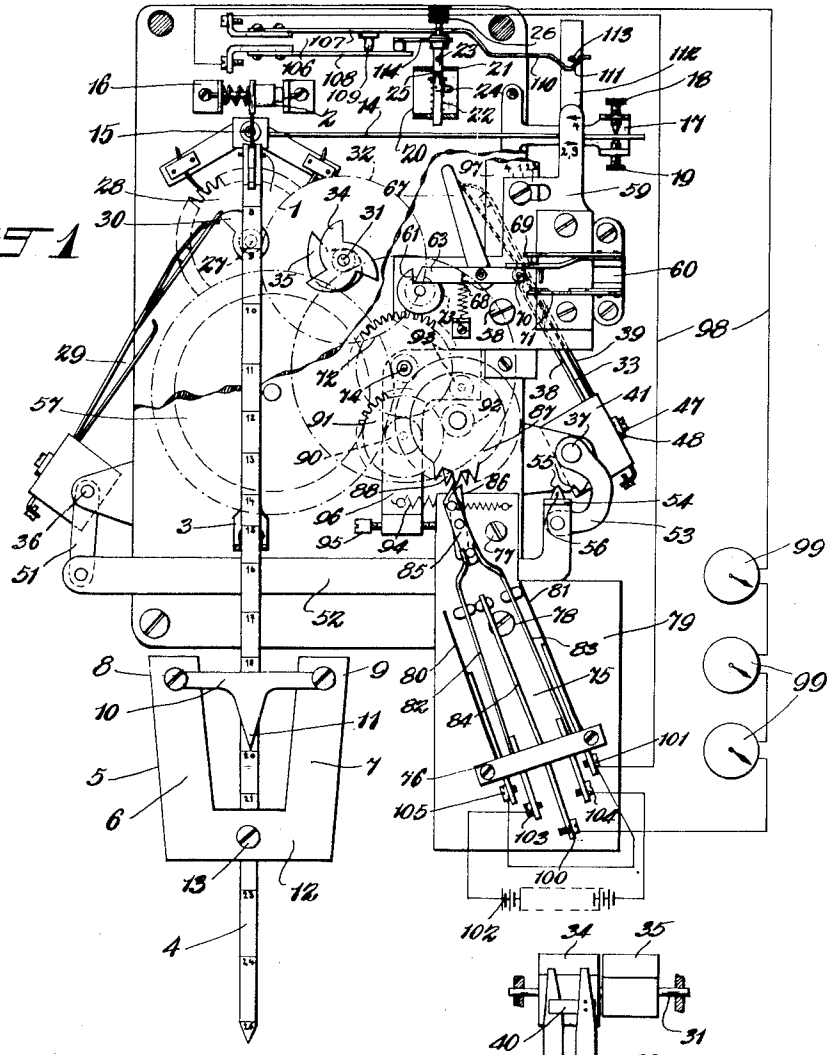


Fig 3

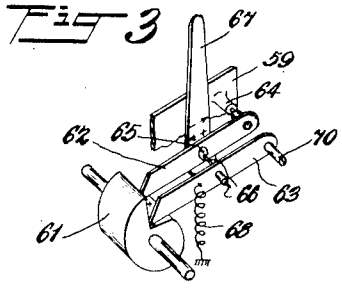
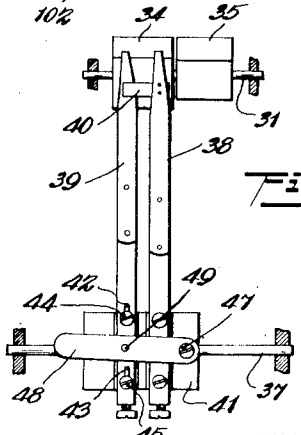


Fig 2



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TIME CONTROLLED SWITCH

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9 Claims. (Cl. 200—30)

The invention relates to time-controlled devices for governing electrical circuits, and more especially to such mechanisms having unusually wide time period variation and control.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the instrumentalities and combinations pointed out in the appended claims.

The invention consists in the novel parts, construction, arrangements, combinations and improvements herein shown and described.

The accompanying drawing, referred to herein and constituting a part hereof, illustrates one embodiment of the invention, and together with the description, serves to explain the principles of the invention.

Of the drawing:—

Fig. 1 is a front elevation of one form of mechanism embodying the invention, with certain parts broken away and others shown in section;

Fig. 2 is an enlarged side elevation of a circuit-controlling mechanism operated from an extension of shaft 31; and

Fig. 3 is a perspective detail of certain controlling mechanisms shown in the upper right-hand part of Fig. 1.

The invention comprises as one of its main features a plurality of switches or other electrical circuit-controlling devices, and a governing clock movement having means for widely varying the relative time-speed of the clock movement, and means for actuating or controlling the various switches or like devices from different parts of the clock mechanism moving at different speeds but in a definite time ratio with respect to each other. The invention provides further means for widely-varying the time-speed ratio of the clock mechanism, and through such variable control and the before-described relation of the respective circuit-controlling devices, an exceedingly wide and accurate variation is effected in the time periods or operation periods of the mechanism as applied to one or more circuits.

The invention provides furthermore, a time-ratio speed control for the clock mechanism calibrated in time-intervals having a definite relation to the relative speed of the respective circuit-control operating devices, whereby a setting of the time-regulating means may be directly made to effect time-interval operation or control of the circuits within fractions of a second and over a very wide range of time.

In connection with one or more of the features of the invention already described, two or more switches or other circuit-controlling devices may be arranged in parallel and be controlled respectively by different parts of the clock mechanism moving in a predetermined speed ratio, thereby securing a very wide extension in the time range of control of a particular circuit.

Referring now in detail to the present preferred embodiment of the invention as illustrated by the accompanying drawing, the pendulum of the clock movement comprises a pendulum rod 4 which is suspended in a conventional manner on the pin 1 of a suspension member 2 and is guided by means of a pendulum fork 3. Rod 4 is provided with a scale calibrated in seconds graduations from 8 to 25 seconds, although any desired range may be provided. The pendulum bob 5 is preferably U-shape, and is mounted so as to be movable along the pendulum rod 4 and bears a resilient pointer 10 fixed to the sides 6, 7 of the pendulum bob 5 by means of screws 8, 9. The end 11 of the pointer 10 indicates the centre of gravity of the pendulum bob and lies over the graduations of the scale on the pendulum rod 4. For securing the bob in the desired position a set screw 13 is arranged on the transverse member 12 and engages the rod, clamping the bob 5 to the rod. By reason of the indication of the centre of gavity by the end 11 of the pointer 10 the pendulum bob 5 may be employed both in the position shown in the drawing and also in the reversed position, which is necessary when the lower graduations 24, 25 are used. The U-shape of the pendulum bob 5 also permits movement of the pendulum bob 5 to the upper graduations, 8, 9 of the scale at the upper end of the pendulum fork 3. In this manner the whole length of the pendulum rod 4 is rendered useful for the variation of the frequency of the switching operation.

In order to produce a very rapid oscillation of the pendulum, such as is required for the comparatively low signalling times, the pendulum co-acts with an auxiliary spring 14, fixed at one end to a block 16 mounted on a pendulum arbor, e. g., the pallet arbor 15, and extends laterally therefrom, and at the other end is mounted so as to slide between two set-screws 18, 19 which are variably positionable in a carrier member or double bracket 17, while the auxiliary spring 14 makes its oscillatory movements between such set screws.

Means are also provided for stopping the pendulum and, as embodied, this stopping device 20 comprises a stopping pin 23 movable in a frame

21 and acted upon by a spring 22. This stopping pin 23 has a locking pin 25 guided in a bayonet slot 24 in the frame 21 and an operating knob 26 extending through an opening in the cover of the apparatus and capable of being easily raised or lowered.

For periodically actuating the switching members, later to be described, there is provided a cam 30 on the arbor 27 of the escapement wheel 28 and this contacts with a contact device 29, while on the arbor 31 of the five-minutes wheel 32 there are fixed two cams 34, 35 coacting with a switch 33.

The switches 29, 33 are arranged at the sides of the clock frame, and are generally similar in construction to one another except in the arrangement of their mountings 36, 37. For moving switch 33 alternatively into operative relation to cam 34 or cam 35 it is variably positionable longitudinally of the arbor 37, on which it is mounted, which is not the case with the switch 29, since this cooperates with only one cam 30.

The switch 33, which is shown in plan in Figure 2, comprises two contact springs 38, 39, and contact spring 38 is provided with a contact plate 40 for making the contact. Spring 38 is fixed while the other contact spring 39 is arranged so as to be movable on an insulating block 41, and for this purpose contact spring 39 is provided with slots 42, 43, through which extend screws 44, 45 threaded into the insulating block 41. For moving contact spring 39 an insulating lever 48 is pivotally mounted on screw 47 and is also connected to the longitudinally movable contact spring 39 by means of a pin 49. As lever 48 is moved in either the one or the other direction contact spring 39 is moved accordingly. Dependent on the position of the contact spring 39, the latter will rest either a longer or shorter time on its actuating cam 35, and in this way the duration of the contact between the two members 38, 39 can be easily and accurately varied. The axial movement of the insulating block 41 on the arbor 37 enables the pair of contact springs 38, 39 to be brought alternatively into engagement with either of the cams 34 or 35.

For selectively moving the switches 29 and 33 into and out of operative relation to the actuating cams a shifting means is provided comprising the levers 51, 52 and 53, and the free end 54 of the link 52 is preferably resilient and is provided with a projection 56 engaging in a notch 55. By means of the notch 55, the lever system 51, 52 and 53 may be secured in any one of three positions, viz. in one position where only switch 29 is in operative position, in a second position where the switch 33 is in operative position, and in a third position where both switches 29, 33 are out of engagement with their actuating cams 30, 34 or 35.

Additional switching means are provided to be operated at different periods and as embodied are supported on a lever plate 59, mounted on one of the front plates 57 of the clock and pivotally mounted on a screw 58. This switch 60 is made in the form of a so-called scissors-lever switch and is shown in detail in Figure 3. For actuating the switch a cam 61 is provided coacting with two scissors-levers 62, 63, one of which is pivotally mounted by bearing 64 on the lever plate 59 and the other is medianly pivoted by a pin 66 mounted on an eccentric 65 which is rotatably mounted on the scissors lever 62. The eccentric 65 is connected to a lever 67, provided with adjustment marks, and moving this lever 67, the scissors lever 63, which is resiliently held against cam 61 by a spring 68 and is provided at its free end with an insulating pin 70 coacting with a contact spring 69, is moved longitudinally relatively to the scissors lever 62. In this manner the duration of the contact between the two contact members 69, 71 can be varied. Cam 61 is driven by gears 72, 73, gear 72 being mounted on the hour wheel arbor 74.

Additional switching means are also provided on the front plate 57 of the movement, and an insulating strip 76 is mounted on plate 79 which is fixed to the front plate 57 by screws 77, 78. Contact springs 80, 81, 82, 83 and 84 are secured to plate 79 and the two contact springs 82, 83 are actuated by two scissors-levers 85, 86.

The switching actuating member of the contact device 75 comprises two gears 87, 88 which are displaced relatively to one another and are driven through two different sets of gearing, i. e. either through gears 90, 91 and 92 or through gears 93, 92 from the gear 72 mounted on the hour wheel arbor 74. In this arrangement, the two pinions 90, 93, are arranged on a bell-crank 96 which is pivotally mounted on the hour wheel arbor 74 and is provided with an adjusting screw 95 acting against a spring 94. The bell crank 96 rests against the lever plate 59 carrying switch 60, so that when turning the latter about the screw 58 the bell crank 96 turns about the arbor 74 and gear wheel 72 is thereby either coupled through one train of gearing 90, 91, or through the toothed pinion 93 with the scissors-lever-actuating gears 87, 88, or is brought out of engagement therewith.

To enable the individual operative positions of the gearing to be determined exactly, the plate 59 is provided with a mark and a plate 97 fixed to the front plate 57 is also provided with marks indicating three positions. In the position of the plate 59 shown in the drawing, the gear 72 is out of engagement with the pinion 73, and is geared to gears 87, 88 through the gearing 90, 91. The mark on the plate 59 then lies opposite the mark 2, 3 on the plate 97. On the further turning of the plate 59 up to the mark 1 the bell crank 96 will be turned about the hour-wheel arbor 74, in such a manner that the gear 91 comes out of engagement with the pinion 92. In this position the pinions 73, 92 are thus uncoupled from the driving gear 72. In the left-hand extreme position marked 4 of the plate 59 the gear 72 is in engagement with the pinion 73 of the cam 61 and through pinion 93 is geared with the pinion 92 of the gears 87, 88, placing both switches 60, 75 in operative position. The switch-actuating members 61, 87, 88 are then moved at the same angular velocity.

The switches controlled by the switch-actuating members 30, 34, 35, 61 can either be connected in parallel to a common signal circuit or they can be connected to separate signal circuits, as desired. The current reversing device 75 on the other hand is preferably connected to a separate signalling circuit 98, which may include the polarized signalling devices 99. The signalling devices 99 may serve for various purposes, such for example, as in factories for controlling the duration of definite industrial operations. As shown in the drawing, the signalling circuit 98 is connected to terminals 100, 101, the battery 102 to terminals 103, 104 and the two terminals 101, 105 are connected directly together.

In signalling circuit 98 there is also preferably provided an auxiliary switch 106, which has two

contact springs 107, 108. The upper contact spring 107 bearing a contact pin 109 is provided with an extension 110, and is bent at 111 to receive an insulating pin 113 on an extension 112 of plate 59. By this means, when the plate 59 is moved into the position mark 1, i. e. the position in which both the cam 61 of the contact device 60 and also the switching members 87, 88 of the reversing device 75 take up their inoperative positions, the auxiliary switch 106 is opened by the resilience of the spring 107 and by this means any wasting of current in the signal circuit 98 is prevented. In the two extreme positions of plate 59 the insulating pin 113 on the lever arm 112 is pressed against the sides of the bent portion 111 to hold the auxiliary switch 106 in its closed position.

The auxiliary switch 106 is also controlled by the stopping device 20. For this purpose the actuating member 23 is connected to a spring 114 resting on the lower contact spring 108 of the auxiliary switch 106. By downward movement of the pin 23 the contact spring 108 is moved away from the opposite contact pin 109 and therefore also any unnecessary consumption of current in the signalling circuit 98 is avoided when the clock is at rest.

The graduation of the pendulum rod 4 is carried out in accordance with the signals to be produced by the cam 30 of the switch 29. In the present embodiment, the frequency of the signals varies from 8 to 25 seconds, and can be read off directly from the pendulum rod 4 for the switch 29. The twenty-six second signal can also be set by approximation. The indicating end 11 of the pendulum bob 5 then lies approximately a centimetre beyond the pendulum rod 4. In the position of the pendulum bob 5 on the pendulum rod 4 shown in the drawing, the switch 29 will make a momentary closure of the signal circuit every 20 seconds. In order that the current impulses produced by the contact device 29 and transmitted into the signal line, when following one another rapidly shall not be too short or when following one another slowly shall not last too long, the contact spring 39 must be moved accordingly by actuating lever 48 (Figure 2). In Figure 1, the switch 29 is in the operative position and contact 38 has just fallen from the cam 30 and come into contact with the contact spring 39. In the next two seconds, for instance, the contact spring 39 will slip off the cam 30 and by this means the contact between the two contact springs 38, 39 is again interrupted.

The two cams 34, 35 coacting with switch 33, since they are mounted on the five-minutes wheel arbor 31, are moved ten times slower than the cam 30 on the escapement wheel arbor 27.

To determine the position of the pendulum bob 5 on the scale of the pendulum rod 4 for a definite signal frequency to be produced by the cam 34, the given signalling frequency must be divided by 3⅓, since the cam 34 being made in three parts produces three switching operations during one revolution. Thus for this series of signals, signals having a frequency of 27 to 86 seconds can be produced. If for example, an interval of 52 seconds between signals is desired, the switch 33 is first moved along its arbor 37 until it lies opposite cam 34 (Figure 2). Then by actuating the resilient end 54 of the link 52 the contact device 29 is brought out of its operative position and the contact device 33 into its operative position. In addition the number, for which the pendulum bob 5 must be adjusted on the pendulum rod 4, must be determined, and for this purpose, 52 should be divided by 3⅓, which gives 15.6. The set screw 13 of the pendulum bob 5 is released and the end 11 of the pointer set between 15 and 16, after which the pendulum can be set in operation.

With the switch 33 controlled by the cam 35, such device is only actuated once during one revolution of the cam 35 instead of thrice. This cam 35 is moved at one tenth the speed of cam 30, and signal frequencies between 80 seconds and 260 seconds can be produced in this series of signals. For the adjustment of the pendulum bob 5 on the pendulum rod 4, a ten times smaller amount is thus always taken.

The method of operation of the switch 33 is the same as that of the switch 29, except that the switch 33 must be moved either to the left or to the right (Figure 2) in order to enable it to be brought into operative position with the required cam 34 or 35.

The fourth cam 61 arranged on plate 59 and driven through the gearing 72, 73 by the hour wheel arbor 74 runs at such a speed that the signal times are 33⅓ times greater than those indicated on the pendulum rod 4. Thus in this series signal frequencies up to 15 minutes can be set. For example, should it be desired to close switch 60 every 800 seconds, the position for the pendulum bob is obtained by multiplying 800 by 3 and dividing this product by 100, which gives 24. The pointer 10 of the pendulum bob 5 is thus to be adjusted to the mark 24. In this case also, the duration of contact of the switch 60 can be adapted to the set time of signal by turning the lever 67. On the dropping of the scissors lever 62 from the cam 61 the insulating pin 70 of the scissors lever 63 is moved downwards and consequently the two contact springs 69, 70 contact with one another. Shortly afterwards the scissors lever 63 will also fall from the cam 61 and the contact between the two contact springs 69, 71 will again be interrupted by the tension of the spring 68.

The switch actuating members 87, 88 of the current reversing device 75, when the gearing 90, 91 is connected, runs at a speed which is similar to that of the five minutes wheel 32 and, when the gear 93 is connected, at a speed which is similar to that of the switch-actuating member 61 of the contact device 60. The switch-actuating members 87, 88 can thus be actuated in two series of time signals, one comprising frequencies from 80 to 260 seconds and the other frequencies from 260 to 900 seconds.

The two scissors-levers 85, 86 are controlled by the teeth of their corresponding gear wheels 87, 88 in such a manner that the two contact springs 82, 83 on the movement of the scissors lever 85 off the tooth of the wheel 87 are moved to the left, and on the movement of the scissors lever 86 off the tooth of the wheel 88 are moved to the right. In the first case, the contact spring 82 comes into contact with contact spring 80, and contact spring 83 with contact spring 84. In the second case the contact spring 82 comes into contact with contact spring 84, and contact spring 83 with contact spring 81. Positive and negative impulses are then sent into the circuit 98 and the polarized signalling device 99 is correspondingly actuated.

The invention in its broader aspects is not limited to the specific mechanisms shown and described but departures may be made therefrom

within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What I claim is:—

1. A switching mechanism including in combination a pair of levers, one of said levers being provided with a fixed pivot, the second lever being medianly pivoted on the first with their ends in substantial alinement, an actuating cam, means for normally pressing one end of the levers against the cam, and a switch operated by the free end of the second lever.

2. A switching mechanism including in combination a pair of levers, one of said levers being provided with a fixed pivot, the second lever being medianly pivoted on the first, an eccentric mounting for the second pivot, an actuating cam, said levers being so positioned that they engage the cam in approximate alinement, and a switch operated by the free end of the second lever.

3. A switching mechanism including in combination a pair of levers, one of said levers being provided with a fixed pivot, the second lever being medianly pivoted on the first, an actuating cam, one end of each lever contacting with the cam along approximately the same line, and a switch operated by the free end of the second lever.

4. A switching mechanism including in combination a pair of levers, one of said levers being provided with a fixed pivot, the second lever being medianly pivoted on the first by an eccentrically mounted pivot, means for rotating the eccentric to move the levers relatively to each other to place the ends of levers out of exact alinement with each other, a cam with which the ends of the levers coact and a switch actuated by the free end of the second lever.

5. A switching mechanism including in combination a pair of substantially parallel contact-supporting members, means for advancing or retracting the end of one member relative to each other and a cam for raising and lowering the members.

6. A switching mechanism including in combination a pair of substantially parallel contact-supporting members, a cam with which the end of the members contacts for moving said members relative to each other and means for advancing or retracting the end of one member to vary the period during which the contacts are closed.

7. A switching mechanism including in combination a pair of substantially parallel members, an actuating cam with which one end of the members contact for moving said members relative to each other, a contact carried by one member and contacting with the other means for varying the period during which the contacts are closed and means for varying the period between successive closings of said contacts.

8. In a time switch, the combination of a pendulum, a resilient member extending to one side of the pendulum and connected therewith, a switch controlled by the pendulum, a second switch in series with said first switch, means for opening said second switch and for simultaneously therewith contacting with the resilient member to hold the pendulum against movement.

9. In a time switch, the combination of a clock movement, a plurality of switches adapted to be connected in parallel, switch controlling means associated with different parts of the clock and running at different rates in a predetermined speed ratio whereby a very wide range of variation in the frequency of the switching operations may be effected by one speed of the clock movement, regulating means for widely varying the speed of the clock movement, and means for alternatively bringing the several switches into operative relation to the time control.

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