Oct. 27, 1936. W. MUIR ET AL 2,058,712

STOP CLOCK

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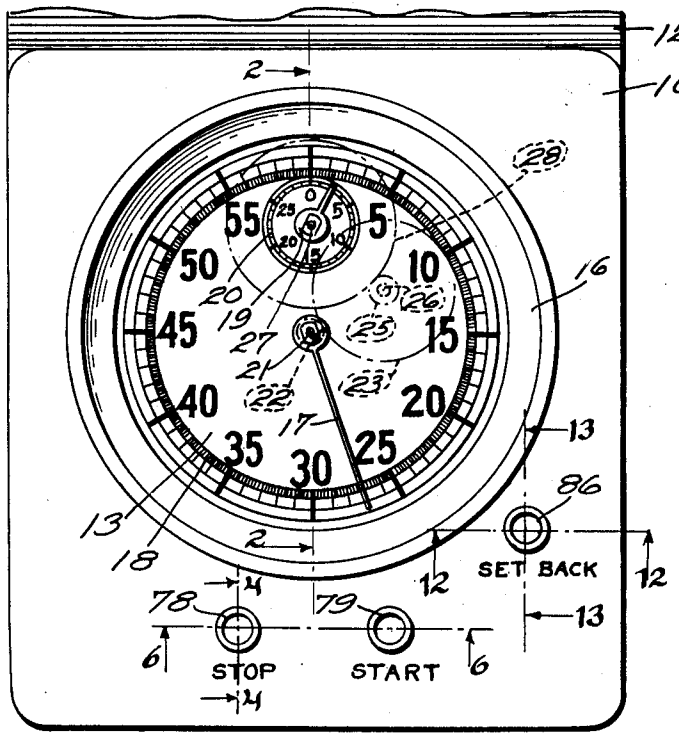
Fig. 1



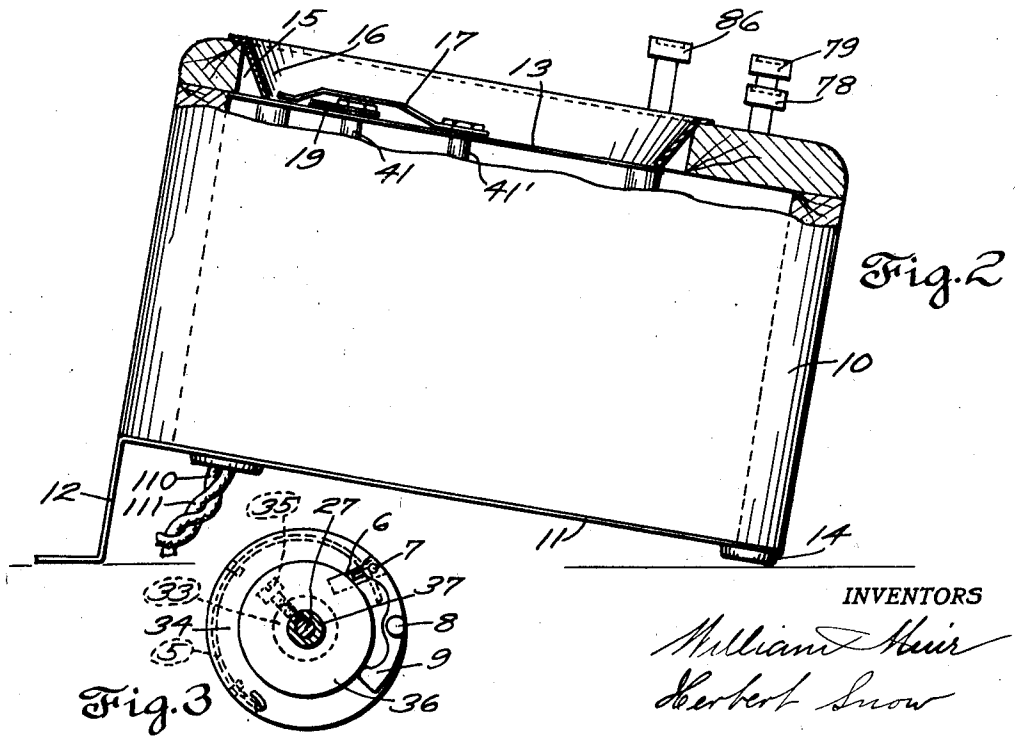


Fig. 2

Fig. 3

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Fig. 4

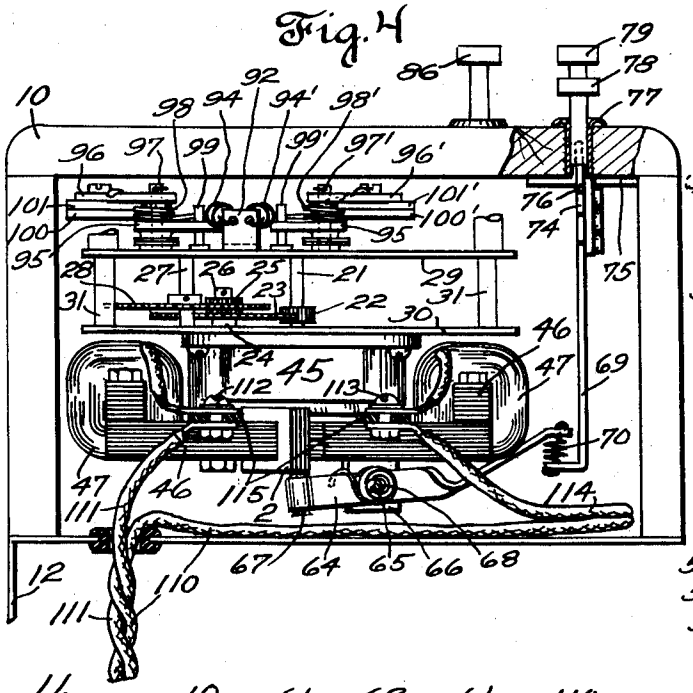


Fig. 7

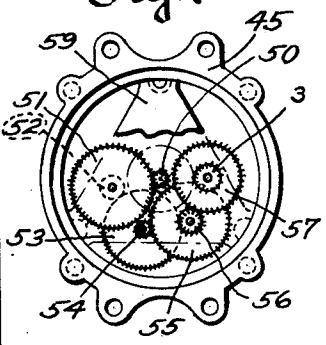
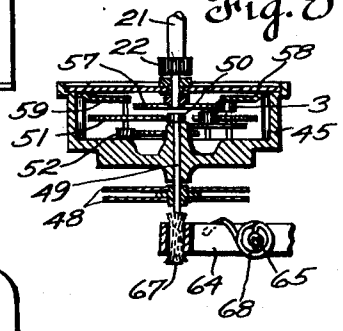


Fig. 8



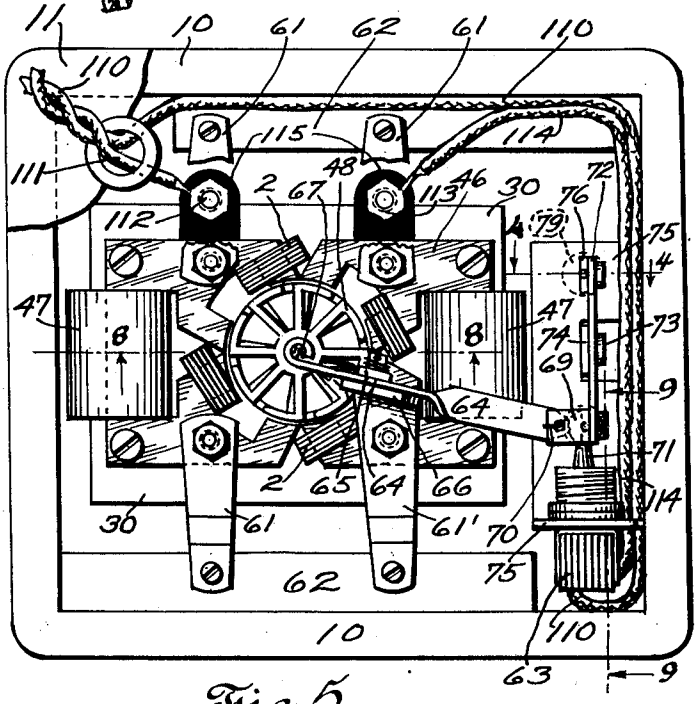


Fig. 5

Fig. 6

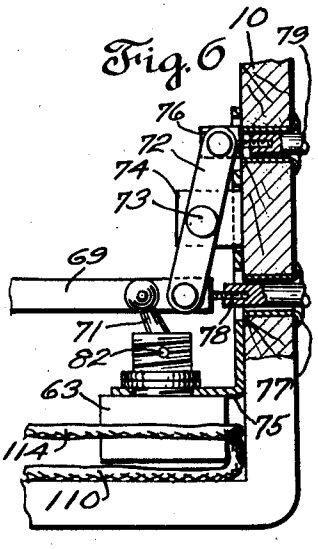


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Fig. 15

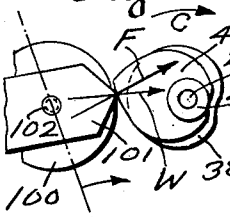


Fig. 16

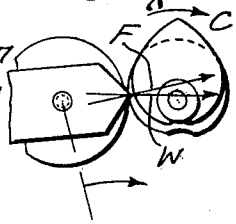


Fig. 17

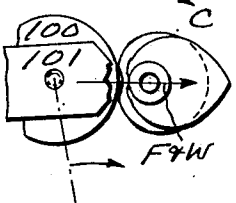
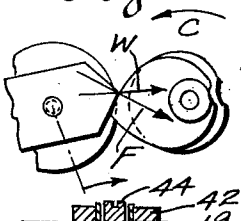


Fig. 18



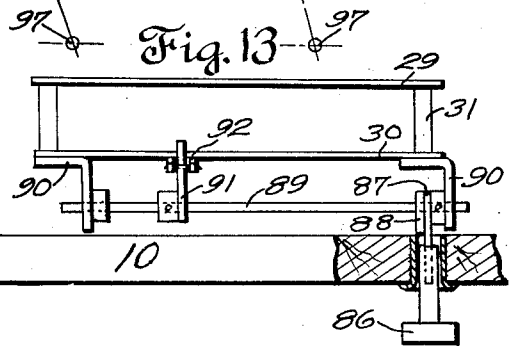


Fig. 13

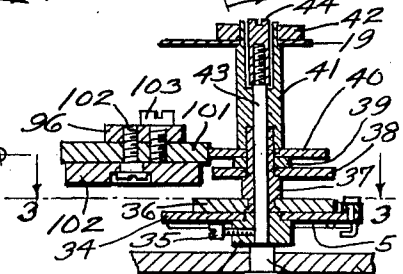
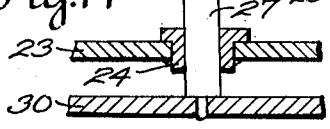


Fig. 14



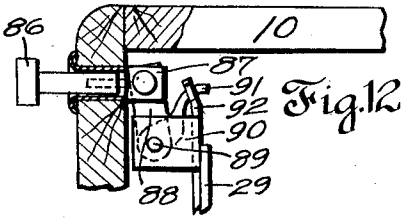
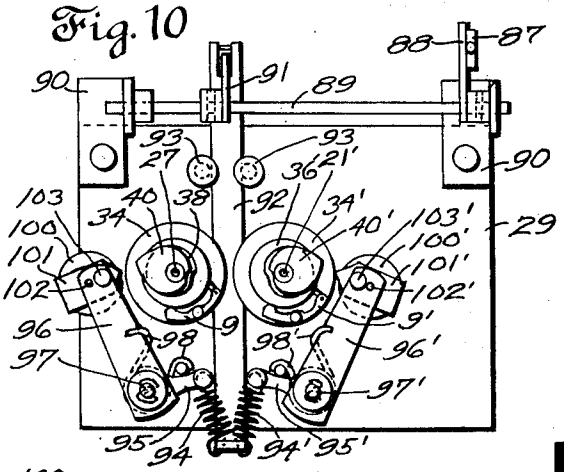


Fig. 12

Fig. 10



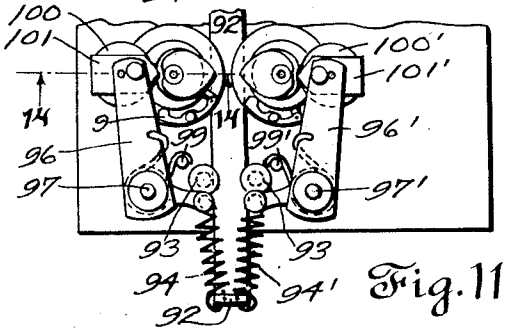


Fig. 11

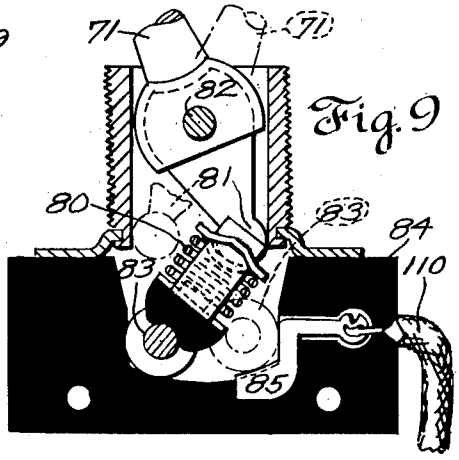


Fig. 9

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Patented Oct. 27, 1936

2,058,712

UNITED STATES PATENT OFFICE

2,058,712

STOP CLOCK

William Muir, Bristol, and Herbert Snow, Burlington, Conn., assignors to The H. C. Thompson Clock Co., Bristol, Conn., a corporation of Connecticut

Application August 21, 1933, Serial No. 686,124

13 Claims. (Cl. 58—78)

This invention relates to stop-clocks or instruments for temporarily indicating varying intervals of elapsed time, characterized by accuracy in the starting and stopping of one or more time indicators in their travel away from a normal or zero starting position responsive to the actuation of manual controllers designed to start and stop this travel and characterized by the ability to instantly set back to their starting or zero position the one or more time indicators employed from whatever position around the complete scale of graduations such indicator may have attained at the time of its stopping, and to restore such indicator or indicators accurately to their zero positions.

An object of this invention is to provide an instrument for the above purpose which may be started, stopped and set back by the manipulation of controls so disposed and so functioning that the user has to look at the instrument only at the time of and for the purpose of reading the recorded period of elapsed time prior to setting back the time indicators and can therefore concentrate attention upon the process, test, race, or other procedure which is being timed.

Another object is to make use in an instrument for this purpose, of an electric motor, and preferably a synchronous motor of the self-starting type, as the time keeping prime mover which impels the time indicators.

A further object is to provide a means to prevent over-running of such motor from the effect of the momentum of its driven parts, and preferably mechanical means involving a brake which in one form of the invention may act in conjunction with the working of an electric switch that supplies and cuts off the electric current which runs the motor.

A further object is to arrange an electric motor for the above use so that its rotating armature, or the shaft thereof, may be accessible for the application of a mechanical brake thereto, even though the portion of said shaft which is provided with a pinion for driving a reduction train of gears may, together with said gears, be inaccessibly enclosed within a housing designed to contain a bath of lubricant for the moving parts.

A further object is to provide a type of set-back mechanism for the time indicator which may simultaneously act upon one time indicator together with any desired number of additional and inter-geared indicators whereby each and all of such indicators may, at one stroke of a single manual controller, be accurately re-positioned at their starting or zero point on one or more scales of graduations after they have completed a time run, or at any time during such run.

A further object is to provide a set-back mechanism for a rotating time indicator which is capable of returning the indicator to its zero position in one direction if the indicator has been stopped between its zero position and a point 180 degrees displaced therefrom in the direction of the automatic travel of the indicator, and may be returned to its zero position in the opposite direction, or in a continuation of the direction in which the indicator was automatically traveling, if the indicator is to be returned from a point displaced from its zero position between 180 and 360 degrees in the direction of automatic travel.

A further object of the invention is to connect the several manual controllers employed so that they may complete their designed actuation of the mechanical parts with a small amount of movement susceptible of being imparted by the fingers of a single hand of the operator and preferably through resilient interior connections relieving all the delicate parts from strain regardless of how the manuals may be wrongfully operated by an uninformed user.

The above and other aims of the invention, will be better understood from the following detailed description in which reference is made to the appended drawings, wherein:

Fig. 1 is an outside view looking generally downward upon the instrument.

Fig. 2 is a view looking at the left side of Fig. 1 with part of the side wall of the case broken away on plane 2—2 in Fig. 1 better to show the mounting of the dial and indicator pointers and the bezel surrounding same.

Fig. 3 is a detail view of the friction clutch which imparts rotation to each of the time indicators while permitting it to be freely back-settable at will, the parts being shown double their preferred size as they would appear looking down from the plane 3—3 in Fig. 14.

Fig. 4 is a view similar to Fig. 2 with the lower side wall of the case removed to expose the interior mechanism, certain details being shown in section on plane 4—4 in Figs. 1 and 5 better to illustrate their construction.

Fig. 5 is a bottom plan view looking upwardly at Fig. 4 with the base plate of the instrument removed.

Fig. 6 is a fragmentary view looking from the right at Fig. 5 showing the motor control switch and the push button operated rocking beam

which actuates the same, the casing wall being shown in section on plane 6—6 in Fig. 1.

Fig. 7 is a bottom plan view of the reducing train within its lubricating housing for the motor, as it would appear if the necessary parts were removed in Fig. 5.

Fig. 8 is a central cross section of the parts shown in Figs. 5 and 7 as they would appear if taken in section on the plane 8—8 in Fig. 5.

Fig. 9 is a greatly enlarged sectional view through the motor control switch as the parts would appear if viewed from the plane 9—9 in Fig. 5 looking in the direction of the arrows.

Fig. 10 is a view of the back-setting mechanism as it would appear looking down upon the same in Fig. 4.

Fig. 11 shows some of the same parts as Fig. 10 in the position to which they move for returning the time indicators to zero position.

Fig. 12 is a fragmentary view of the manual actuating parts looking from the right at Fig. 10, the casing wall appearing partly in section on plane 12—12 in Fig. 1.

Fig. 13 is a view of these same parts as they would appear looking from above at Fig. 10, the casing wall appearing partly in section, on plane 13—13 in Fig. 1.

Fig. 14 is a vertical central sectional view taken on the plane 14—14 in Fig. 11 showing the parts for driving and back-setting the time indicators on a scale twice as large as they appear in Fig. 11.

Figs. 15 to 18 inclusive are diagrams showing different relative positions of the compound back-setting cams for the time indicators and of the wedge-wheel device that acts upon said cams in explanation of the directions of movement and of the acting forces which in different situations accomplish the backsetting, the size of the parts corresponding to Fig. 14 or being twice their actual preferred size.

Since in the preferred construction, the casing of the stop clock is not depended upon for any insulative quality this casing 10 may be cast or stamped from metal, but the same is herein shown built of wooden sides and with a wooden top as commonly employed in instrument construction, and the bottom is adapted to be closed by a removable base plate 11 provided with a flange portion 12 to cause the instrument as a whole to rest on a table in a slightly inclined position as shown in Fig. 2 so that the graduated time dial 13 may be more easily viewed by the operator. Rubber buttons such as 14 may take the weight of the front portion of the instrument and serve to keep it from sliding on the surface upon which it rests.

The case is provided with a circular opening 15 through its top wall in which fits the bezel 16 extending downward to the time dial 13 and exposing the fast pointer 17 centrally pivoted to sweep over the large scale of graduations 18 as well as the slow pointer 19 eccentrically pivoted to sweep over the smaller scale of graduations 20. The central spindle 21 carrying the fast pointer 17 has fixed thereto the pinion 22 which meshes with a reduction gear 23 fixed to hub 24 as is also the reduction pinion 25, all rotating on a fixed stud 26 (see Figs. 1 and 4) and the slow pointer 19 is carried on the spindle 27 to which is fixed the gear 28 which is in mesh with the reduction pinion 25, whereby the pointers 17 and 19 simultaneously travel at different rates of speed and are respectively speeded in the embodiment herein illustrated so that the fast pointer 17 will make thirty complete revolutions for each revolution of the slow pointer 19, but this is an arbitrary relationship which may be varied to suit the purposes for which the stop clock is to be used. The numerals on the large scale of graduations 18 may represent seconds in which case the fast pointer 17 is speeded to complete one revolution in one minute and the ordinals on the small scale of graduations 20 may designate the number of complete revolutions which have been performed by the fast pointer 17. As shown in Fig. 1, the large scale of graduations 18 is subdivided so that the smallest units thereof represent fifths of a second.

While the pointer 17 is carried by the spindle 21 and the pointer 19 by the spindle 27, these pointers are not positively impelled by their respective spindles but rotate therewith only because of a light frictional drive mechanism whose purpose may be served by the construction shown in Fig. 3 and Fig. 14 which will be taken as illustrative of suitable means by which both pointers 17 and 19 may be impelled or any additional pointers which might be employed. In Fig. 14, spindle 27 is shown to have bearings in a top frame plate 29 and a bottom frame plate 30 secured in spaced relation by the posts 31. Resting on the bearing shoulder 32 of spindle 27 is the hub 33 of the friction drive disc 34 and the hub 33 is secured rotatively to spindle 21 by the set screw 35. Above and resting on the drive disc 34 is the friction driven disc 36 whose hub 37 carries fixedly thereon the following superimposed parts,—the stationing cam 38, the spacer washer 39, the dislodging cam 40, the pointer hub 41, the pointer 19, and its retaining nut 42,—all of which comprise when assembled, a solid integral structure freely rotatable upon the reduced spindle portion 43 and retained thereon by the terminal hollow screw 44, the function of the stationing and dislodging cams referred to is later to be described in connection with the back-setting mechanism. As shown in Fig. 3, the friction shoe 9 is pivoted at 8 on the top surface of drive disc 34 and bears lightly on the smooth periphery of driven disc 36 at one end and carries at the other end the downwardly bent, hooked wire-guard 7 having clearance in the cut-out 6 in disc 34, and engaged by the wire-spring 5 which is anchored to the bottom surface of disc 34 for urging shoe 9 lightly against the edge of disc 36.

Coming now to the motor by which spindle 21 is driven, and in turn drives the spindle 27, it will be seen in Figs. 4, 5, 7 and 8 that this motor comprises the following parts,—a cylindrical housing 45 for a reduction train, this housing being screwed to the bottom frame plate 30, an electro-magnetic stator indicated as a unit by the ordinal 46 and comprising laminations of suitable magnetic properties and surrounding a portion of which are the two coils of field winding 47, and the armature 48 fixed to its spindle 49 which latter has a long bearing in a portion of the motor housing 45.

It will be seen from Fig. 8 that whereas the central pointer spindle 21 and the motor armature spindle 49 are concentric, the latter drives the former only through a train of speed reducing gears confined within the housing 45 and enmeshed in the following order. Pinion 50 fast to the inner end of spindle 49 drives gear 51 whose pinion 52 drives gear 53 whose pinion 54 drives gear 55 whose pinion 56 drives gear 57 whose pinion 3 is brought into mesh with the pointer spindle gear 57 fast to spindle 21 as is the pinion 22 heretofore mentioned, the latter

being on the outside and the former on the inside of the diaphragm plate 58 which seals the rear of the motor housing 45 so that it may contain a bath of lubricant for the reducing train. A triangular shaped bearing plate 59, indicated fragmentarily in Fig. 7, may be employed to assist in providing bearings for the spindles of the reducing train which are shown, but not numbered, in Figs. 7 and 8. In Figs. 4 and 5 the shape of the pole pieces of the motor stator is clearly indicated, certain of these pole pieces carrying the so called shading coils 2 which assist in the self-starting properties of the motor, and the armature 48 is shown in Figs. 5 and 8 to have a construction and configuration which assists in the attainment of strong starting torque and assurance of running in synchronism with the oscillations of an alternating current as well understood in that art.

The electric motor as a whole, and thereby the frame plates 29 and 30 are mounted in the case 10 by means of four legs 61, two of which are shown broken away in Fig. 5 to expose the electrical connections, and these legs 61 may be screwed to shelf formations 62 on the interior of the side wall of the case.

The control instrumentalities for the motor will next be described and they include a stopping and starting switch 63 (most clearly shown in Fig. 9) and a mechanical brake 64 (most clearly shown in Figs. 4, 5 and 8). The brake 64 consists of a lever pivoted at 65 on a downwardly turned extension 66 on one of the motor mounting legs 61', one end of this lever being curled for grasping a brake pad 67 preferably of felt or soft fibrous material and adapted to be pressed against the outer end of the armature spindle 49, a light spring 68 carried on the pivot stud 65 tending to release the brake and hold the brake pad 67 clear of the armature spindle 49 to allow free running of the motor except when the brake is purposely applied. The opposite end of the brake lever 64 is given a quarter twist and is disposed just above the bent lower terminal of a vertical slide bar 69 and connected thereto by an extension spring 70 so that when bar 69 is depressed in Fig. 4 it will pull down upon spring 70 which will cause spring 70 to swing the brake 64 clockwise overcoming the power of the release spring 68 and thus applying the brake pad 67 against the armature spindle 49 yieldingly but with enough force to instantly stop the rotation of all parts.

Hinged to slide bar 69 is the operating extension 71 of the toggle switch 63 and also hinged to bar 69 is one end of a rocking beam 72 pivoted at 73 to an ear 74 of the bracket 75 which also supports the body of the switch 63, itself being secured against the inner surface of the wall of the case. At the opposite end of the rocking beam 72 is swiveled a hinge plate 76 which, as is the upper terminal of slide bar 69, is provided with a threaded stem in alignment with push button openings through the casing wall in which eyelets 77 are mounted to give bearing for the stop button 78 and for the start button 79, the former engaging the threaded extension on slide bar 69 and the latter engaging the threaded extension on hinge plate 76 whereby the alternate pushing down of buttons 78 and 79 will rock the beam 72 and reciprocate the slide bar 69 between the position of parts shown in Figs. 6, 8 and 9 where the switch 63 is open and the brake 67 applied, and the position of parts shown in Fig. 4 and by broken lines in Fig. 9 where the switch is closed and the brake released. The slide bar 69 may be normally biased to each of its said positions by the characteristic of the snap-action causing spring within the switch 63 as plainly shown in Fig. 9 where this spring designated as part 80 is under compression between the inner end 81 of the switch operating extension 71 pivoted to the hollow cylindrical body or neck portion of the switch at 82 and between the contact roller 83 of the switch being insulated therefrom. As this type of snap switch is well known in the art, it will suffice to mention that the parts named move with a snap action between their full line position and their broken line position in Fig. 9 when the operating extension of the switch is sufficiently swung and always maintain one or the other of these positions, there being imbedded in the insulating body 84 of the switch any suitable pair of circuit terminals one of which is shown at 85 to be bridged by the contact roller 83 when in its broken line position for completing the circuit through the switch.

Fuller details of the construction of a snap switch operating as above described and suitable for use herein are described in United States Patent No. 1,744,629 granted January 21, 1930 to Monroe Guett. The movable parts of the switch may be constructed as shown in the U. S. Patent to Guett No. 1,680,101 granted August 7, 1928, and in the U. S. Patent to Nero No. 1,919,119 granted July 18, 1933.

Coming now to the means by which one and both of the time indicating pointers 17 and 19 may be instantly restored to its starting or zero position whether or not the motor heretofore described is running, we return to the stationing and dislodging cams 38 and 40 respectively which as shown most clearly in Fig. 14 are fixedly carried on the same rigid assembly of parts as is the time indicating pointer 17 or 19 and the friction driven discs 36 and 36'. There being two exactly similar sets of back-setting parts, one for the pointer 17 and the other for the pointer 19, it will suffice to describe one of these sets of parts and this will be done with respect to the parts carried upon the spindle 27, the corresponding parts on spindle 21 being correspondingly designated by similar reference characters primed. It has been described that the friction driven disc 36 is impelled by the very light friction applied thereto by the parts shown in Fig. 3 so the rotating structure of which cams 38 and 40 are a part does not require the application of much force to cause its turning independently of the spindle 27. This turning is required to take place almost instantaneously for convenience in use when resetting the pointers to zero and is accomplished by mechanism which derives its actuation from depressing the set-back button 86 adapted to slide in a bushed hole in the casing wall as do buttons 78 and 79. The set-back button 86 engages the threaded extension of a hinge plate 87 pivoted to an arm 88 which is pinned to the long shaft 89 having a bearing at either end in brackets 90 secured to the top frame plate 29. At another point shaft 89 carries the hook shaped actuator 91 pinned thereto by means of its hub. The actuator 91 plays in a forked terminal of the set-back bar 92 constrained to slide lengthwise against the top surface of the top frame plate 29 by the overhanging heads of four shoulder studs 93. At its opposite end, the bar 92 is upturned to afford anchorage for two similar back-setting springs 94 and 94' each of which

pulls upon the short ends 95 and 95' respectively of a bell crank structure including the set-back arms 96 and 96' pivotally mounted on the frame posts 97 and 97' and normally positioned as shown in Fig. 10 by the release springs 98 and 98' one of whose ends bears upon the frame studs 99 and 99' which also act to limit the swing of arms 96 and 96' away from each other to the position as shown. At the end of the back-setting arms 96 and 96' are carried the freely rotatable wheels 100 and 100' and the rigidly positioned wedges 101 and 101' each of whose method of mounting will be clear from Fig. 14 where the shoulder screw 102 is seen to fixedly clamp the wedge 101 against the arm 96 while providing a free pivot for the wheel 100 and there is further shown the screw 103 entering the wedge 101 and the arm 96 to prevent relative rotation between these two parts while in no way interfering with the freedom of the wheel 100 to turn. The coaction between the wedge 101 and the dislodging cam 40, with which it only engages, and the coaction between the wheel 100 and the stationing cam 38 with which it only engages are demonstrated diagrammatically in Figs. 15 to 18 inclusive explanative of how the simultaneous inward throw of the arms 96 and 96' can cause the wedge and wheel carried by each arm to so act upon its respective dislodging or stationing cam that these cams will be forced from whatever position they may be found occupying instantaneously into the positions they are shown to occupy in Fig. 11, corresponding to which both pointers 17 and 19 are established in their zero positions.

Referring now more particularly to Figs. 15 to 18, the relation of parts in Fig. 15 assumes that the back-setting arm 96 is actuated at a time when the pointer is displaced slightly more than 180 degrees from its starting point. The nose of the wedge 101 which protrudes very slightly beyond the periphery of the wheel 100 contacts with the heart shaped dislodging cam at a point slightly below its apex. Under these circumstances the movement of the point of contact so far as the wedge is concerned is indicated by arrow W. The direction of the resulting force applied to cam 40 is normal to the surfaces of contact or in the direction of arrow F and the resultant movement of the cam about its pivot will be clockwise or in the direction of arrow C. The turning of the cams clockwise under continued pressure to the right by the wedge and wheel has in Fig. 16 transferred the original contact between the wedge and the heart-shaped or dislodging cam to a contact between the wheel 100 and the other or stationing cam 38. Here the movement of the point of contact of the wheel 100 about the pivot 97 is indicated by arrow W, the resultant direction of force normal to the surfaces in contact is indicated by the arrow F and the resultant rotation of the cams about their pivot 27 will be clockwise or as indicated by arrow C. In Fig. 17 the resetting action has been completed and the wheel 100 is shown seated against the curved notch in the stationing cam 38 the direction of all forces acting being as per arrow F which is a state of equilbrium opposing any further turning of the cams in either direction and thus definitely and accurately positioning the pointer at zero. Fig. 18 shows the beginning of the resetting movement in a case where the pointer had completed less than a half turn of travel away from its zero position with the result that the wedge 101 engages the dislodging cam 40 at a point above instead of below its apex. The direction of movement of the wedge point is as per arrow W as it was in Fig. 15 but the resulting force acting normal to the surfaces at their point of contact becomes in the direction of arrow F which will result in a resetting of the cams and of the time pointer back to zero position in a contra-clockwise direction as indicated by arrow C.

The electrical connections comprise a lead-in wire, 110 coming from the supply line (not shown) and going directly to one of the stationary contacts 85 of the switch, and the other lead-in wire 111 coming from the opposite side of the supply line (not shown) and connected to one binding post 112 of the electric motor. The other binding post 113 of the motor is connected by buss wire 114 to the other stationary contact (not shown) in the switch 63 whereby the conductive bridging of these two stationary switch contacts by the snap-action roller contact 83 of the switch completes the circuit from one side of the supply line through the switch and through the motor to the other side of the supply line. The switch binding posts 112 and 113 are carried by insulating brackets 115 secured to the motor stator 46.

In practical operation, it is first seen to by the user that each of the pointers are stationed at their starting or "zero" positions. If this is not the case, set-back button 86 is depressed, which by the thrust of hinge plate 87 swings arm 88 and hence shaft 89 clockwise in Fig. 12. Hook 91 thereby forces the set-back bar 92 downward (as viewed in Figs. 10, 11, and 12) and by the simultaneous and equalizing pull of springs 94 and 94' moves the set-back arms 96 and 96' toward each other from their spread positions in Fig. 10 to their closest position in Fig. 11. This causes the wedge 101 and wheel 100 to act respectively on cams 40 and 38 and at the same time causes the wedge 101' and wheel 100' to act respectively on cams 40' and 38' in the manner heretofore explained with reference to Figs. 15 to 18, inclusive, so that the pointers are both instantly established at zero position as permitted by the friction slippage between shoe 9 and disc 36. The set-back arm 96 and button 86 will be restored to their positions shown in Figs. 10 and 12 by the springs 98 and 98' as soon as finger pressure is released on the set-back button 86, this leaving cams 38 and 38' and cams 40 and 40' free from interference by any of the set-back parts.

At the moment some process or event begins, which is to be timed by our improved stop-clock, start button 79 is depressed. This swings the rocking beam 72 contra clockwise in Fig. 6 which thrusts the slide bar 69 and the stop button 78 to the right as viewed in Fig. 6, or upwardly in Fig. 4, letting up on spring 70 so that the brake release spring 68 tilts brake lever 64 slightly contra-clockwise in Figs. 4 and 8 thus removing the soft brake pad 67 from contact with the end of armature spindle 49 (see Fig. 8). At approximately the same time, this same action of slide bar 69 has flipped the switch extension 71 from full line position to its broken line position in Fig. 9, causing switch spring 80 to be compressed over its dead center relation to the contact roller 83 whereupon, this roller snaps to its broken line position in Fig. 9, bridging stationary contact 85 and a similar stationary contact (not shown) to furnish current to the electric motor through wire 110, contact 85, roller 83, other contact like 85 (not shown), buss wire 114, and from the motor back to the line through wire 111. The motor instantly starts to

run and through the gears in housing **45** (see Figs. 7 and 8) impels the central, or fast pointer, spindle **21** and also the slow pointer spindle **27** through the additional gear train **22**, **23**, **25**, and **28**. Free of interference by the back setting parts, all parts which are integral with the pointers **17** and **19** on hubs **37'** and **37**, respectively, will be impelled in unison with the spindles **21** and **27** respectively because of the friction between shoes **9** and **9'** and the discs **36** and **36'**, respectively. Thus the pointers will start their travel away from "zero" position and continue so to travel at their relatively different rates of speed until the stop button **78** is depressed at the expiration of the process or event that is being timed.

Depressing stop button **78** reverses the movement of parts operated by the rocking beam **72** and restores all parts to their full line positions in Figs. 4, 6 and 8, whereupon the travel of the motor and of the pointers is instantly stopped by the shutting off of current and the simultaneous application of brake pad **67** against the armature shaft **49**.

It will be observed that the toggle action of the switch spring **80** is made use of to bias the stop and start parts into each of their two possible positions above described. Means outside the switch could of course be substituted for this purpose, but in the construction as shown, the power of spring **80** as well as the strength of spring **70** must be great enough to overcome the power of brake releasing spring **68** in order to maintain the parts in their "stopped" or full line positions in Figs. 4, 6 and 10.

Among the modifications that will suggest themselves from the preferred embodiments of the invention herein disclosed is the mounting of both the fast and slow pointers **17** and **19**, with or without additional pointers, to be concentrically rotatable on a common spindle together with their back setting cams and clutch parts practically unchanged from the form herein shown. Other forms of manual controllers may be substituted for the push buttons **78**, **79** or **86**. Springs may be added or eliminated from the connections between the parts as herein shown. The motor employed if electric need not for all purposes be a synchronous motor but may be a direct current or mere induction motor, which if not self starting can be set in motion by commonly employed agitators to set the armature spinning by manual actuation, which in case of a synchronous motor will subsequently fall into step with the oscillations of the electric current if alternating. Such agitators might be set in action by the stroke of button **79** or its equivalent which switches current to the motor. Nor are the teachings of this disclosure limited in their useful application to electric motors, as spring motors with or without chronometer escapements to give accuracy in time, might be employed in their stead. All of the back-setting parts here shown and described would be useable without modification in a spring-motor driven stop clock, and if such motor required agitating to insure its starting, the suggestion for agitating starters above made would equally apply. Button **78** or **79** may be eliminated and the remaining one of these two buttons pushed and pulled to operate the stop clock.

The following claims therefore, intend to define not only the precise mechanisms herein shown, but all fair equivalents which would fall within their terminology, and will be understood as directed to the broadest aspect of the principles of construction and function which they recite. We claim as our invention:

1. In a stop-clock, in combination, an electric timing motor having an armature including a shaft, one end of which shaft is accessible from the outside of said motor, time indicating means connected to derive motion from said shaft, and a mechanical stop brake mounted to be manually pressed against the end of said shaft in a direction according to the axis of said shaft whereby the thrust friction of said shaft aids in quick stoppage thereof.

2. In a stop-clock, in combination, an electric timing motor having a rotor including a shaft, a speed reducing train driven by said shaft and disposed to leave one end of said shaft accessible from the outside of said motor, time indicating means connected to derive motion from the slow end of said reducing train, and a mechanical stop brake including a wad of relatively soft material mounted to be swung into braking engagement with the end of said shaft.

3. In a stop-clock a universal set-back mechanism for simultaneously returning two separate time indicators to their normal or zero positions, including in combination, one time indicator mounted to travel at a speed corresponding with a series of time unit graduations, another time indicator separately mounted to travel at a different speed corresponding with a different series of time unit graduations, two separately movable back-setters arranged to act simultaneously and respectively on said two indicators in a manner to restore them to their respective zero positions on their scales of graduations, and a single manual controller spring-connected to both of said back-setters for transmitting thereto an equalized actuating force, together with means acting automatically to restore said manual controller to its original position when released by the hand of the operator.

4. In combination with an electric motor, a current control switch, a lever movable between current-on and current-off positions for operating said switch, a biasing spring arranged to act on said lever to prevent the stationing of said lever at all points intermediate its said positions, a mechanical brake mounted to be applied to a moving part of said motor to arrest the same, and connections between said lever and brake whereby the bias of said spring on said switch lever maintains said brake either fully applied or fully released with respect to the said movable part of the motor.

5. In combination with an electric motor, a current control switch, a switch operating lever, a circuit-controlling contact in said switch, a toggle action spring acting between said lever and contact to bias both said lever and contact into either circuit-making or circuit-breaking positions, a mechanical brake mounted to be applied to a movable part of said motor to arrest movement of same, and connections between said lever and brake whereby the biasing action of said toggle spring upon said lever maintains said brake applied to said motor in the circuit-breaking position of said switch contact and permits said brake to be released from said motor in the circuit making position of said switch contact.

6. Mechanism for instantly stopping the rotation of a motor armature and reducing train operated thereby, including in combination, with a lubricating housing for said train, a shaft for said armature, a bearing for said shaft in the wall of said housing, a movable controller mounted

exterior of said housing, and a brake pad carried by said controller to be applied axially against the end of said shaft exterior of said housing and to be retracted from said shaft by respectively different movements of said controller.

7. An instrument for registering elapsed time comprising in combination, a box-like casing including a base portion and a cover wall supported thereby fully in view of the operator, a time graduated dial occupying a portion of the area defined by said cover wall, an indicating pointer pivoted to sweep over said dial, a motor contained in said casing and connected to rotate said pointer, a set-back mechanism contained in said casing and connected to rotate said pointer, and three manually depressible push buttons mounted to project from said cover wall in proximity to said dial and to one another, one of said buttons being connected to operate the set-back mechanism and the other two buttons being operative, respectively, to start and to stop said motor.

8. An instrument for registering elapsed time as described in claim 7, in which the three manually depressible push buttons are positioned sufficiently close to one another to be operated in rapid succession by different fingers of the operator's hand without change of position of the hand or observation to determine the location of the push button intended to be operated.

9. An instrument for registering elapsed time as described in claim 7, in which the three manually depressible push buttons are disposed to move in a direction encompassed by the base portion of the casing whereby the casing need not bodily be held to prevent its movement when manually operating said push buttons.

10. An instrument for registering elapsed time as described in claim 7, in which the three manually depressible push buttons are closely positioned to one another to be operated in rapid succession by respectively different fingers of the operator's hand and are mounted to move in lines directed toward the base portion of the casing whereby the casing need not be held to prevent its bodily movement when said push buttons are manually operated.

11. A stop-clock movement comprising in combination, a movement frame including rigidly spaced bearing plates, rotative elements of a reduction train operating between said plates, an electric motor unit including a spindle carrying one of said elements and projecting through both of said plates, said motor unit being carried on the exterior surface of one of said plates, a spindle carrying another of said elements and projecting outside the opposite plate, two time indicators carried respectively by said spindles in slippable relation thereto and outside the said opposite plate, and back-setting mechanism carried on the exterior surface of the said opposite plate intermediate the same and said indicators and operatively connected to rotate both said indicators simultaneously in relation to their respective spindles.

12. In a stop-clock, mechanism for simultaneously backsetting to zero positions a plurality of time indicators including in combination, with said indicators, two separately movable backsetters adapted to act simultaneously and respectively on said indicators to move the latter toward their respective zero positions, and a single manual controller having differential connections to each of said back-setters thereby to transmit the movement of said controller to each of the backsetters in variable degree to accord with the difference in resistance offered by each of the time indicators to its respective back-setter.

13. In mechanism for simultaneously backsetting to zero positions a plurality of time indicators, in combination with said indicators, two separately movable backsetters adapted to act simultaneously and respectively on said indicators to move the latter toward their respective zero positions, a single manual controller for motivating said back-setters, and yielding connections between each of said back-setters and said manual controller whereby resistance offered to the action of said backsetters by either indicator is inoperative to prevent further movement of the manual controller to operate the backsetter to which the other indicator is responsive.

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