July 8, 1969 C. E. MILLER 3,454,730

TIMING MECHANISM

Filed Nov. 13, 1967

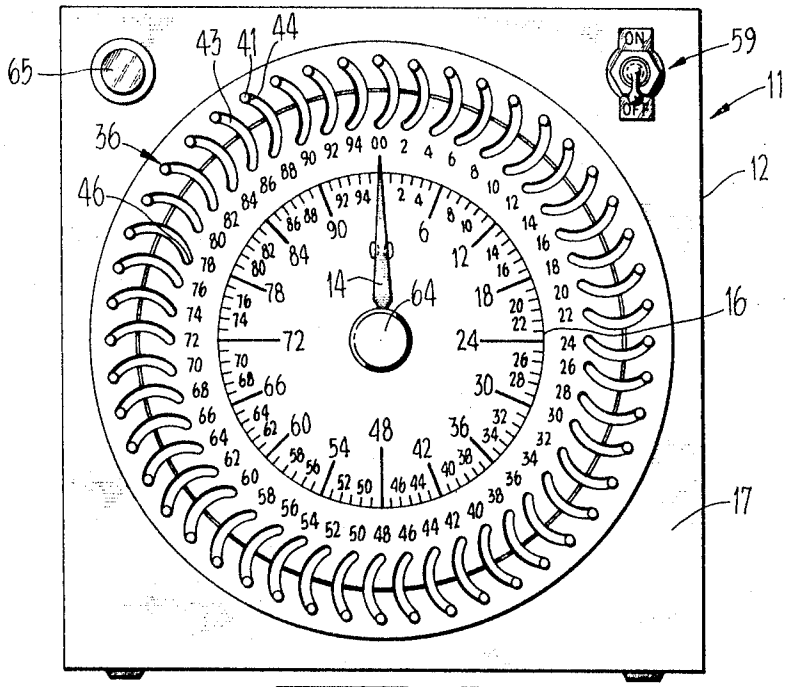

Fig. 1

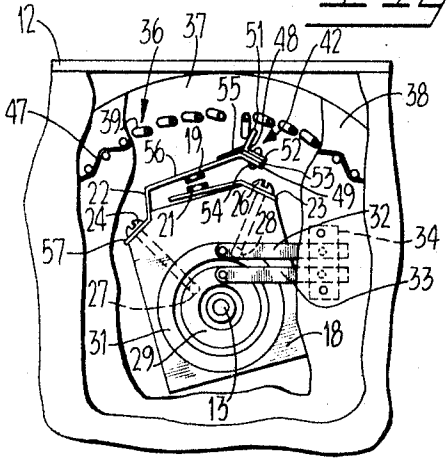

Fig. 2

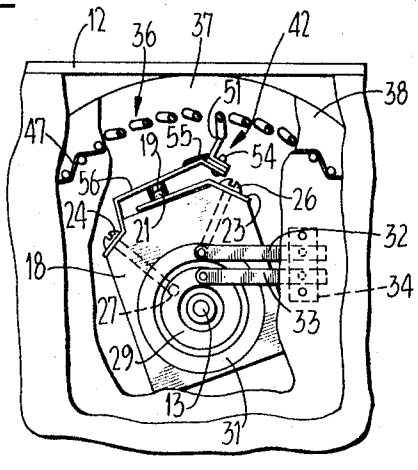

Fig. 3

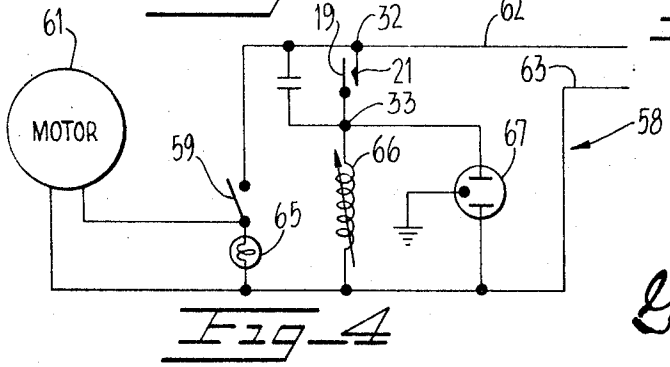

Fig. 4

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TIMING MECHANISM

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ABSTRACT OF THE DISCLOSURE

A number of timing actuators are arrayed about a dial to operate switch contacts. An L-shaped ribbon structure is mounted to rotate with an arbor carrying a time indicating hand and engage the timing actuators to cause closing of the switch contacts. A switch is connected in series with the motor drive and a source of power to inactivate the motor drive. The switch contacts are connected in series with an alarm which in turn are connected together in parallel with the serially connected switch and motor drive. A manually operable knob is joined to the arbor for rotating the time indicating hand when the motor drive is inactivated for zero setting the time indicating hand.

Background of the invention

Timing mechanisms, such as timing clocks, which include a number of timing actuators for controlling switches to, for example, initiate the sounding of an alarm at selected times are well known. Timing clocks of these types are disclosed in U.S. Patents 2,098,965 and 2,806,910 entitled, "Clock," and issued respectively Nov. 16, 1937, and Sept. 17, 1957, to Henry C. James, Jr., and U.S. Patent 3,348,008 issued Oct. 17, 1967, to Clifford E. Miller, the instant applicant. These timing clocks include a number of actuators arrayed about a clock dial which are selectively moveable into the path of a switch contact closing cam. The cam is carried by a carrier which extend from the hour hand arbor of the timing clocks and is rotatable therewith. The actuators are in the form of cranks having handles extending through arcuate slots in the face of the clock circumferentially spaced about the clock dial. When the handles are positioned at the outer ends of the slots, the cranks are pivoted out of the path of the cams. Movement of the handles toward the inner ends of the slots pivots the associated cranks into the path of the cams for engagement therewith at times determined by the extent to which the cranks are inwardly pivoted. When the cams engage a crank, the contacts are closed to engage an alarm or the like. The contacts are maintained closed until the carrier moves the cams beyond the engaging crank unless the crank is pivoted out of engagement with the cams by movement of the associated handle to the outer end of the slot. Consequently, if the crank is not pivoted out of engagement with the cams, additional switch contact closures cannot be accomplished until the carrier moves the cams beyond the engaging crank.

In conducting scientific experiments, an accurate timing mechanism of the type described would be useful for indicating when steps of the experiment are to be performed. Unfortunately, the construction of the cams and the inexactness characteristics of setting the cranks to engage the cams at selected times have prevented such prior art mechanisms from being satisfactory for use where precise timing is required, particularly, where it is desired to carry-out a sequence of switch contact closures closely spaced in time. For example, the construction of the cams of the prior art timing mechanisms has limited the minimum time interval between successive switch closures to about five minutes. Furthermore, the

accuracy with which the cranks can be set to cause a switch contact closures at a selected time is on the order of many minutes.

Therefore, considerable advantage is to be gained by providing a timing mechanism which can be set to operate switch contacts precisely at selected times, which selected times may be at precise intervals of fractions of a minute.

Summary of the invention

The present invention relates to timing mechanisms of the type having a number of timing actuators arrayed about a dial which may be preset to operate switch contacts at selected times when engaged by a cam rotating with a time indicating hand of the mechanism. More specifically, the timing mechanism of the present invention includes a particularly constructed cam for engaging the timing actuators and means for setting the timing actuators which enables the timing mechanism to be precisely set to operate the switch contacts at selected times, with successive operations able to be effected at intervals of as little as fractions of a minute. The cam is an L-shaped ribbon structure joined to one end of a conductive member which is fastened to a carrier which rotates with a time indicating hand of the mechanism. The conductive member also carries a switch contact which, depending upon the location of the fulcrum about which the conductive member turns, will contact or disengage another switch contact when the L-shaped ribbon cam engages a timing actuator. The L-shaped ribbon cam includes a first extremity which extends from the conductive member towards the actuators arrayed about the dial of the timing mechanism. The other extremity of the L-shaped ribbon cam serves to secure the ribbon cam to the conductive member. The ribbon construction of the cam minimizes the contact time between the timing actuators and the cams.

Although this enables the timing mechanism to operate the switch contacts at intervals spaced only fractions of a minute apart, precise timing is realized only if the actuators can be set precisely so that they are engaged by the cams at the exact time desired. Towards realizing this precision, an exact zero-set means is provided which together with the accurately located timing actuators provide the ability to operate the switch contacts at the exact instant in time desired. More particularly, means are provided to inactivate the power drive operating the time indicating hand of the mechanism, hence, the rotating cam which engages the timing actuators to operate the switch contacts. Indicating means are in circuit connection with the switch contacts and a source of power which activates the indicating means upon operation of the switch contacts. A manually operable mechanism is coupled to rotate the time indicating hand and cam carrier rotating therewith. To zero-set the timing mechanism, the timing actuator which is engaged by the cam when the time indicating hand is at zero on the dial is positioned in its associated slot through which its handle extends for engagement by the rotating cam when the time indicating hand is at the zero position of the dial. The power drive is inactivated by the provided means, and the time indicating hand is rotated about the dial by operating the manually operable mechanism. The time indicating hand is rotated until the cam rotating therewith engages the preset timing actuator to activate the indicating means. At the instant the indicating means is activated manual rotation of the time indicating hand is terminated. The timing mechanism is thusly precisely set at zero and readied for use. Since the timing actuators of timing mechanisms of the aforedescribed type are accurately located about the dial, the precisely zero-set timing mechanism is able to provide precise timing at intervals as small as fractions of a minute.

Accordingly, it is the object of the present invention to provide a timing mechanism which can be set to operate switch contacts precisely at selected times.

More particularly, it is an object of the present invention to provide an accurate timing mechanism which can be set to operate switch contacts at precise intervals of fractions of a minute.

Another object of the present invention is to provide a precise timing mechanism particularly suited to activate indicating means to signal the precise time for executing steps of scientific experiments or other multiple stepped event.

A further object of the present invention is to provide a timing mechanism which can be accurately zero-set whereby precise timing is obtained during operation.

Still another object of the invention is to provide such a timing mechanism which while the power drive is causing movement can be set to indicate a time interval by adding the interval to the time indicated and setting the appropriate crank.

Brief description of the drawings

With reference to the accompanying sheet of drawings:

FIGURE 1 is a front elevation view of a electrically powered timing mechanism with the improved cam engaging means and the zero-set means in accordance with the present invention.

FIGURE 2 is a fragmentary rear elevation view of the timing mechanism with the rear plate broken away to show the cam carrier and cam in the position just as the cam engages a timing actuator.

FIGURE 3 shows the cam carrier and cam of FIGURE 2 after the cam carrier has advanced to the position where the cams engage the timing actuator to effect operation of the switch contacts carried by the cam carrier.

FIGURE 4 is a schematic illustration of the electrical circuit for zero-setting of the timing mechanism.

Detailed description of the preferred embodiment

Referring to the drawings, particularly FIGURES 1–3, the timing mechanism **11** of the present invention includes a housing **12** which houses a synchronous drive motor coupled by a gear train to drive the arbor **13** carrying the time indicating hand **14** in the manner described and shown in aforementioned patents and patent application. In the particular embodiment illustrated, only a single time indicating hand is shown. However, as will become apparent from the following detailed description, additional timing hands advanced at different speeds could be provided.

The time indicating hand **14** is positioned adjacent a time indicating dial **16** on the front face **17** of the housing **12**. In the illustrated embodiment, the dial **16** is calibrated in terms of minutes of a ninety-six minute period, and the synchronous drive motor and a gear train are arranged to effect one revolution of the arbor **13**, hence, the time indicating hand **14** every ninety-six minutes.

In order that electric circuits may be closed or opened at predetermined time intervals of the ninety-six minute period, a carrier **18** is secured to and is rotated with the arbor **13**. A pair of opposed switch contacts **19** and **21** born by conductive members **22** and **23** are secured to the periphery of carrier **18** by screws **24** and **26**. Each of the screws **24** and **26** are of conductive material and extend into the carrier **18** to contact respective conductive extensions **27** and **28** connected to coaxial conductive slip rings **29** and **31** respectively mounted in carrier **18**. Stationary brushes **32** and **33** are mounted to a terminal board **34** within the housing **12** and respectively ride on one of slip rings **29** and **31** to provide means of connecting the opposed switch contacts **19** and **21** to operate mechanisms.

Pursuant to present invention, operation of the switch contacts **19** and **21** at selected times is accomplished by means of a plurality of timing actuators in the form of crank pins **36** accurately located at regular intervals, for example, corresponding to two minutes in the illustrated embodiment, circumferentially about the time indicating dial **16**. The crank pins **36** are journalled between spaced frame plates **37** and **38** located within the housing **12**. Each pin **36** has a journal section **39** and a handle portion **41** extending through the front face **17** of the housing **12** for rotating the crank pin **36** into position for engagement with a cam **42** rotated with the carrier **18** to operate the switch contacts **19** and **21**. The particular construction of the cam **42** of the present invention will be described in greater detail hereinbelow. The detail of the construction of the crank pins **36** is described in the aforementioned patents and patent applications. The crank handles **41** respectively extend through a plurality of arcuate slots **43** defined in the front face **17** at circumferentially spaced locations about the dial **16**. The arcuate slots **43** are located exactly at two mintue intervals about the dial **16**, with each slot **43** allowing the crank pin **36** extending therethrough to be positioned for engagement with the rotating cam **42** at fractions of the two minute interval. The handle portions **41** of the crank pins **36** extend sufficiently through the arcuate slots **43** to permit them to be grasped to position the crank pins **36** at the desired location within the respective arcuate slots **43**.

The crank pins **36** normally are positioned with their respective handle portions **41** at the outer ends **44** of their respective slots **41**. In this position, the crank pins **36** are out of engagement with the cam **42** rotated with the carrier **18**. Positioning of the handle portions **41** toward the inner ends **46** of the slots **41** swings the crank pins **36** into the path of the cam **42**. As the carrier **18** rotates with the time indicating hand, the cam **42** will engage the crank pins **36** of associated with the inwardly positioned handle portions **41** to be actuated to operate the switch contacts **19** and **21**. The extent to which the handle portion **41** is positioned inward towards the inner end **46** of the slot **41** determines the particular fraction of the two minute interval, hence, second of the ninety-six minute period, at which the cam **42** will operate the switch contacts **19** and **21**. A flat-leaf spring **47** wound about the inner ends of the crank pins **36** as shown in FIGURES 2 and 3 provide sufficient friction force to prevent the crank pins from rotating, i.e., changing their position, when engaged by the cam **42**.

The particular construction of the cam **42** of the present invention enables operation of the switch contacts **19** and **21** at precise intervals of fractions of a minute. More particularly, an L-shaped ribbon structure **48** is fastened to one end **49** of the conductive member or flexible arm **22**. The L-shaped ribbon structure **48** has a first extremity **51** which extends from the flexible arm **22** towards the crank pins **36**. The second extremity **52** forming the L-shaped ribbon structure **48** joins to the flexible arm **22**. In cases where the L-shaped ribbon structure **48** is constructed from conductive material, a piece of insulating material **53** is sandwiched between the conductive flexible arm **22** and second extremity **52**. A nylon rivet **54** is employed to fasten the L-shaped ribbon structure **48** and insulating material **53** to the flexible arm **22**. Such a construction electrically isolates the L-shaped structure **48**, hence, crank pins **36** from the conductive member or flexible arm **22**.

The end portion **49** of the flexible arm **22** carrying the L-shaped ribbon structure **48** is canted from the main body **56** of the flexible arm **22** so that the crank pin engaging extremity **51** of the L-shaped ribbon structure **48** extends in the direction generally radially from the arbor **13** carrying the carrier **18**. With the extremity **51** arranged in this fashion, the contact time between the extremity **51** and the crank pins **36** is minimized whereby successively circumferentially located crank pins **36** can be positioned to operate the switch contacts **19** and **21** at times separated by as little as thirty seconds. Insulating varnish **55**

is provided at the end of the flexible arm **22** proximate the cam **42** to prevent accidental electrical connection between the conductive flexible arm **22** and the crank pins **36**.

As explained hereinbefore, depending upon the location of the fulcrum about which the flexible arm **22** bends relative to the switch contacts **19** and **21**, the cam **42** will either effect a switch closure or opening. In the illustrated embodiment, the fulcrum is located to effect a switch closure. The fulcrum is formed by anchoring the end **51** of the flexible arm **22** distal the cam **42** to the carrier **18** by the screw **24**. The opposing switch contacts **19** and **21** are joined to the conductive members **22** and **23** to be located inbetween the screw **24** and cam **42** locations on the flexible arm defining the conductive member **22**. The flexible arm **22** is mounted about the conductive member **23** to carry the switch contact **19** out of engagement with the opposite switch contact **21** unless the cam **42** engages a crank pin **36**. One arrangement for effecting a switch opening would be to locate the fulcrum medially of the conductive member **22** with normally engaging switch contacts at the end **57** of the member **22** distal the cam **42**. Instead of a flexible arm type conductive member **22**, a rigid arm pivoted at the middle could be employed to effect a switch opening.

The ribbon construction of the crank pin engaging cam **42** enables the switch contacts **19** and **21** to be operated at intervals spaced only fractions of a minute apart. However, to realize precise timing, the crank pins **36** must be set so that they are engaged by the cams **42** precisely at the exact time desired. With particular reference to FIGURE 4, the precise timing is accomplished by providing means **58** for exactly setting the time indicating hand **14** at zero relative to the crank pin **36** which is engaged by the cam **42** when the time indicating hand is at zero on dial **16**. Referring to FIGURE 1, the numbers associated with the arcuate slots **43** indicate the upper time limit of the two minute intervals during which the crank pins **36** can be set to engage the cam **42**. Hence, the crank pin **36** associated with the arcuate slot **43** identified by the "00" marking can be set to engage the cam **42** during the last two minute interval, i.e., from ninety-four to ninety-six minutes, of the ninety-six period, with the ninety-six minute point in the period corresponding also to the zero point in the period.

To exactly set the time indicating hand **14** to zero, the means **58** includes a switch **59** connected in series with the primary source of power, for example, the conventional AC line voltage, and the synchronous drive motor **61**. The synchronous drive motor **61** is connected across the lines **62** and **63** delivering power from the AC line voltage source to cause the motor **61** to drive the arbor **13**, hence, the time indicating hand **14** and carrier **18**, and the desired rate. In setting the time indicating hand **14** to zero, the switch **59** is opened (as shown in FIGURE 4) to disconnect the drive motor **61** from the AC line voltage power source. A lamp **65** is provided to indicate when the drive motor **61** is inactivated. The time indicating hand **14** carried by the arbor **13** to which the carrier **18** is secured is turned manually about the dial **16** by, for example, a knob **64** (see FIGURE 1) fixed to the end of the arbor **13**. The switch contacts **19** and **21** are electrically connected in series with a current responsive indicating means or alarm **66** which together are electrically connected between the lines **62** and **63** in parallel with the serially connected switch **59** and motor **61**. In this particular embodiment illustrated, the stationary brush **32** on the terminal board **34** is connected to the line **62** thereby connecting the switch contact **21** thereto. The stationary brush **33** connected to the switch contact **19** carried by the flexible arm **22** is connected to one side of the alarm coil **66**, with the other side of the alarm coil **66** connected to the line **63**. In this manner, the bell can be activated by closing the switch contacts **19** and **21** even though the drive motor **61** is inactivated by opening the switch **59**.

As the time indicating hand **14** is turned manually towards the zero point on the dial **16**, the cam **42** is rotated with the carrier **18**. The crank pin **36** located in the arcuate slot **43** identified by the "00" marking is positioned in the most inward point of the slot **43**. Hence, when the time indicating hand **14** reaches the point on dial **16** corresponding to zero relative to the location of the crank pins **36** about the dial **16**, the cam **42** will engage the inwardly positioned crank pin **36** thereby closing the switch contacts **19** and **21** to cause the alarm **66** to be sounded. At this instant the manual rotation of the time indicating hand **14** is terminated and the crank pin **36** engaging the cam **42** returned to the outer location of the slot **43**. The time indicating hand **14** is exactly at the zero point of the ninety-six minute period and the timing mechanism thusly ready to provide switch contact operations to operate, for example, external mechanisms connected to the convenience outlet **67** connect in series with the switch contacts **19** and **21** at precise times and at intervals spaced as close as fractions of a minute. Accurately zero-setting of the time indicating hand **14** provides the precise timing capability because each of the arcuate slots **43** are spaced exactly at regular intervals corresponding, in the illustrated example, exactly to two minutes.

While the present invention has been described with respect to a single illustrated embodiment, numerous modifications and variations are possible within the scope of the present invention.

What is claimed is:

1. In a timing mechanism of the type including crank pins circumferentially located at regular intervals about a dial and mounted for selective movement into and out of position for engagement with a cam for operating switch contacts which cam is positioned to be surrounded by the circumferentially located crank pins and is rotatably mounted to an arbor carrying a time indicating hand driven by a power drive, the improvement comprising, a carrier member mounted to said arbor to rotate therewith, first and second conductive members mounted insulatingly apart on said carrier member, one of said conductive members mounted for movement toward the other, each of said conductive members carrying one switch contact located opposite the switch contact carried by the other conductive member, said cam including a ribbon structure mounted to said conductive member mounted for movement toward the other conductive member, said ribbon structure extending from the conductive member towards the circumferentially located crank pins to be normally out of engagement with the crank pins and to contact crank pins when moved into position for engagement with said cam, said ribbon structure effecting relative movement between said conductive members to operate the switch contacts upon engaging the crank pins, means to inactivate the power drive operating the time indicating hand, indicating means, a source of power in circuit connection with said indicating means to operate the indicating means, means to electrically connect the switch contacts in series with the indicating means and the source of power so that the indicating means is activated by the source of power when the ribbon structure engages a crank pin, and manually operable means for turning the arbor joined to the carrier member.

2. The timing mechanism according to claim **1** wherein said power drive is an electrical drive motor, said inactivating means is a switch, said electrical drive motor and switch is electrically connected in series with said source of power, said serially connected switch contacts and indicating means electrically connected in parallel with the serially connected electrical drive motor and switch.

3. The timing mechanism according to claim **1** wherein said conductive member mounted for relative movement

towards the other conductive member is a flexible arm mounted above the conductive arm to maintain said switch contacts normally separated, and said ribbon structure mounted on said flexible arm to close said switch contacts when engaging crank pins.

4. The timing mechanism according to claim **3** wherein said flexible arm is secured to said carrier at one end thereof, said ribbon structure is mounted at the end of said flexible arm opposite the end secured to the carrier, and the switch contact is mounted between the ends of the flexible arm.

5. The timing mechanism according to claim **4** wherein said ribbon structure is an L-shaped member having first and second extremities, said second extremity is mounted to the flexible arm, and said second extremity extends towards the crank pins.

6. The timing mechanism according to claim **5** further including an insulating member interposed between the second extremity and the flexible arm to electrically isolate the flexible arm from the L-shaped ribbon structure.

7. The timing mechanism according to claim **6** further including an insulating coating on the side of the flexible arm facing the crank pins over a portion of the end of the flexible arm proximate the L-shaped ribbon structure.

8. The timing mechanism according to claim **1** wherein said crank pins are positioned at locations about the dial corresponding to two minute intervals of the time interval corresponding to a single revolution about the dial of the time indicating hand carried by the arbor.

9. The timing mechanism according to claim **8** wherein said dial is graduated in minutes.

10. In a timing mechanism of the type including crank pins circumferentially located at regular intervals about a dial and mounted for selective movement into and out of position for engagement with a cam for operating switch contacts which cam is positioned to be surrounded

by the circumferentially located crank pins and is rotatably mounted to an arbor carrying a time indicating hand driven by a power drive, the improvement comprising, a carrier member mounted to said arbor to rotate therewith, a stationary conductive member mounted on said carrier, a flexible conductive arm mounted on said carrier insulated and spaced above said stationary conductive member, one switch contact located medially on said flexible arm, the other switch contact mounted on the stationary conductive member opposite the switch contact on the flexible arm to be normally separated therefrom, an L-shaped ribbon structure having first and second extremities, said second extremity secured to said flexible arm at the end thereof opposite that which is secured to the carrier, said first extremity extending towards the circumferentially located crank pins to be normally out of engagement with the crank pins and to contact crank pins when moved into position for engagement with said cam, said L-shaped ribbon structure bending said flexible arm toward said stationary conductive member to close said switch contacts upon engaging the crank pins, and means to electrically connect the switch contacts to an electrical circuit.

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