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TIMING APPARATUS

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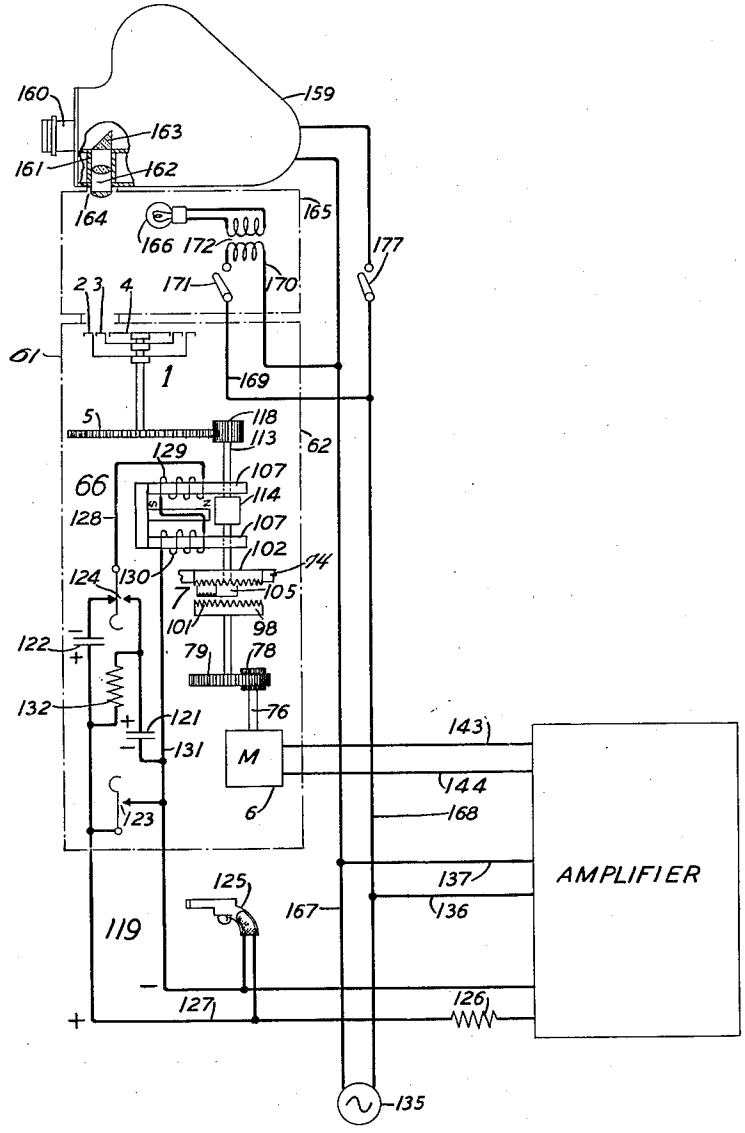

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TIMING APPARATUS

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3 Claims. (Cl. 175—335)

This invention relates to timing devices and more particularly to a timing device for indicating elapsed time for an event, or the time taken by a moving object in traveling from one predetermined point to another. The invention while not necessarily limited to such use is particularly adapted for timing races or other sports events. Certain features which are subsequently described and which constitute this invention are improvements over the timing device disclosed in G. T. Kirby application Serial No. 620,437.

The object of this invention, therefore, is to provide improved means for accurately determining the time taken for a race or other event.

The improvement constituting this invention resides in means for operating a clutch which serves to couple a synchronous motor to a chronometer.

A feature of this invention resides in a condenser discharge system for operating a polarized clutch operating magnet which operates the clutch.

Another feature resides in a ballast resistance arrangement in the condenser discharge system to prevent undue rapid charging of the condenser and unbalancing of an amplifier system by the condenser discharges.

This invention may be used in conjunction with a motion picture camera when it is desired to have pictures of an event and a record of the elapsed time appear on the same motion picture film, or it may be used without the camera when only time records are required.

The drawing shows a schematic of the timing apparatus.

In timing races and other events with this apparatus the synchronous motor is started some time before the beginning of the event. A starting signal is then given to start the event. When the starting signal is given the clutch is operated to connect the synchronous motor to the chronometer. The chronometer is continued in operation from the beginning of the event until a contestant or a predetermined number of contestants have crossed a certain line. Some time before this predetermined line is crossed by a contestant or contestants, lamps to illuminate the dials of the chronometer are lighted and the motion picture camera is brought into operation. Pictures are then taken of the event and the chronometer dials. In each frame of the motion picture film, therefore, there appears an image of the contestant or contestants as the line is approached or crossed and a picture of the chronometer dials showing them in their relative positions with respect to some predetermined point at the time the picture was taken.

To more clearly point out the improvements in which this invention resides reference will now be had to the drawing.

To provide quick acting and positively operating means for operating the clutch upon a momentary closure of a pair of contacts the polarized clutch operating magnet **66** is employed. The polarized clutch operating magnet **66** as shown in the drawing is included in a start signal control circuit **119**. The start signal control circuit **119** is connected to a portion of an amplifier **120** and contains a pair of condensers **121** and **122**, the start key **123** and the stop key **124**. The portion of the amplifier **120** to which the start signal control circuit **119** is connected supplies direct current potential to charge the condensers **121** and **122**. The polarized clutch operating magnet **66** is operated by discharge current from the condenser **121** or **122** when one of the keys **123** or **124** is operated or when contacts are closed in a starting pistol **125**.

The condensers **121** and **122** are normally maintained in a charged condition but are limited to a comparatively slow rate of charging by means of the resistance **126**. The resistance **126** also prevents the amplifier **120** from being affected by discharge current from the condensers **121** and **122**. The start signal control circuit **119** is normally as follows. From the amplifier **120**, comparatively high value resistance **126**, conductor **127**, condenser **122**, left hand contacts of stop key **124**, conductor **128**, upper winding **129** of polarized clutch operating magnet **66**, lower winding **130** of polarized clutch operating magnet **66**, conductor **131** to the amplifier **120**. In shunt across the conductors **127** and **131** and in parallel with the start key **123** and the stop key **124** is a resistance **132** and the condenser **121**. In this circuit positive potential is normally applied to the windings of the polarized clutch operating magnet **66** by way of the comparatively high value resistance **126**, conductor **127**, condenser **122**, left-hand contacts of stop key **124** and conductor **128**. Positive potential is also supplied to the condenser **121** by way of the resistance **132**. Since the condensers **122** and **121** are only brought to a charged condition in a comparatively slow manner by reason of the comparatively high value resistance **126** and since no sudden increase or sudden change in potential is applied to the windings of the polarized clutch operating magnet **66**, the armature

114 of the polarized clutch operating magnet 66 remains in its last operated position which, merely for the purpose of illustration, will be assumed to be toward the upper pole-piece 107. Under this condition, the flyer arm 105 of the clutch 7 is held against the stop clutch member 102 which, as shown in the drawing, is attached to the frame 74. When the start key 123 is manually operated the contacts in the key are momentarily closed. The condenser 122 then discharges current by way of the conductor 127 and the closed contacts of the start key 123 and applies a sudden positive potential to the windings of the polarized clutch operating magnet. This causes a magneto motive force in the pole-pieces 107 of the clutch operating magnet 66, the magneto motive force applied aiding the magneto motive force, due to the permanent polarizing magnet, in one pole and opposing the magneto motive force, due to the permanent polarizing magnet, in the other pole. This increases the flux in the larger air gap and reduces the flux in the smaller air gap or may even produce magnetic polarities across the smaller air gap to produce a repelling force between these adjacent pole-faces. The armature 114 of the polarized clutch operating magnet 66 is therefore moved over toward the lower pole-piece of the polarized clutch operating magnet 66 and the clutch flyer arm 105 is moved into engagement with the annular rotating clutch member 98 which is driven by the motor 6. In this movement of the armature 114 of the polarized clutch operating magnet 66, the shaft 113 moves the comparatively wide pinion 118 across the rim of the master gear 5. This pinion 118, however, is of sufficient width to remain in engagement with the master gear 5 of the chronometer 1. When the clutch flyer arm 105 is brought into engagement with the annular rotating clutch member 98 the shaft 113 is rotated and the chronometer 1 is set in operation. Upon release of the start key 123 the contacts of the key immediately open and the discharge circuit for the condenser 122 is broken. The condenser 122 then begins to charge up again but is limited to a comparatively slow charging process by reason of the comparatively high value resistance 126. The comparatively high value resistance 126 in addition to limiting the condenser 122 to a slow charging process also prevents either the charging or discharging of the condenser 122 from affecting the amplifier 120. Since the amplifier 120 is also utilized in supplying energy to a tuning fork, not shown, which is employed in connection with the supply of current to the synchronous motor 6 which drives the chronometer 1, it is important that the amplifier be protected from any effects which might cause its unbalance.

Instead of operating the start key 123 as above described to cause operation of the polarized clutch operating magnet 66 and the connecting of the synchronous motor 6 by way of the clutch 7 to the chronometer 1 it may be desirable to control the starting of the chronometer 1 by means of a starting signal which will give an audible signal for the starting of an event. The starting signal for a race or other sports event is often given by the firing of a pistol. A starting pistol 125 therefore is shown as being connected across the conductors 127 and 131. Contacts in the starting pistol 125 are preferably momentarily closed and opened simultaneously with the firing of the pistol. For instance, contacts in the pistol 125 may be closed when the cartridge is struck by the hammer of the pistol and opened again on the slight rebound of the hammer. It is common practice in small firearm constructions to have the hammer strike the cartridge on a slight overthrow movement and then move back to normal fired position. The contacts of the pistol therefore may close when the hammer is in the overthrow position and open again when it moves back to the normal position immediately after striking the cartridge. The condenser 122 would then discharge on the instant the cartridge was struck by the hammer and the impulse from the condenser would proceed by way of the conductor 127, thence through the closed contacts of the pistol 125 and through the conductor 131 to the windings of the polarized clutch operating magnet 66.

To stop the chronometer 1 the stop key 124 is manually operated to close its contacts. This, like the operation of the start key 123 or the firing of the pistol 125 is a momentary closure of the contacts and provides for a condenser discharge to operate the polarized clutch operating magnet 66. When the stop key 124 is manually operated to close its right hand contacts the condenser 121 discharges by way of the right hand contacts in the stop key 124, conductor 128, and windings 129 and 130 of the polarized clutch operating magnet 66. This increases the flux in the upper pole-piece 107 and decreases the flux in the lower pole-piece 107 of the polarized clutch operating magnet 66 sufficient to attract the armature 114 toward the upper pole-piece 107 of the polarized clutch operating magnet 66. The clutch flyer arm 105 would then be moved out of engagement with the annular rotating clutch member 98 and into engagement with the stop clutch member 102. Since the polarized clutch operating magnet 66 is operated on comparatively high potential condenser discharge current and these surges of current are of extremely short duration, there is no pronounced heating of the windings of the polarized clutch operating magnet 66, such, for instance, as would occur if the start signal control circuit had been closed for a comparatively long period to cause operation of the clutch operating magnet.

Since the amplifier employed in connection with this invention may be of standard and well known design, details of the amplifier are not shown in the schematic. The amplifier 120, however, is supplied with operating current from an alternating current generator 135 over the conductors 167, 168, 136 and 137. From an output connection of the amplifier 120 amplified current of controlled frequency is supplied over the conductors 143 and 144 to the synchronous motor 6.

When the timing apparatus above described is to be used in conjunction with a motion picture camera, a motion picture camera equipped with two lenses and of the type described in the above identified G. T. Kirby application is provided. The motion picture camera may be of standard construction and modified by having a lens system added to it for viewing the dials of the chronometer 1 or the lens system for viewing the dials of the chronometer 1 may be permanently built into the camera construction. In the drawing a motion picture camera 159 has been included. The motion picture camera 159 is provided with the usual lens system 160 for projecting images onto a motion picture film within the camera. Extending from the lens

system 160 of the motion picture camera 159 is a lens system 161 for viewing the dials 2, 3 and 4 of the chronometer 1. The lens system 161 comprises a light passage 162 which is in communication with the lens system 160 and the dials of the chronometer 1. Included in the lens system 161 and located within the lens system 160 of the camera is a prism 163 which will project an image of the dials into the view line of the camera 159 within the lens system 160. In alignment with the lens system 161 is an aperture 164 in the casing 165. The casing 165 has one open side and as shown in the drawing, rests with the open side down on the cover 61 of the casing 62 of the chronometer 1. Supported within the casing 165 and not in alignment with the aperture 164 is a lamp 166 which serves to throw light on the dials 2, 3 and 4 of the chronometer 1. The lamp 166 is supplied with current from the source of alternating current 135 by way of the conductors 167, 168, 169, 170, switch 171, and transformer 172.

The motion picture camera 159 may be driven by a spring motor such as is common in motion picture camera constructions, or it may be driven by an electric motor. In the preferred embodiment, as shown in the drawing, the camera 159 is electrically driven, the motor for the camera being supplied with current from the source of alternating current 135 over the conductors 167 and 168 and switch 177.

Assuming that the apparatus above described is to be used in timing a sporting event such, for instance, as a race and that the amplifier 120 is connected to the source of alternating current 135 the operation is as follows: A starting signal for the event is given. Simultaneously with the giving of the starting signal contacts are closed and then immediately opened in either the pistol 125 or in the start key 123. With the closing of the contacts at either of these points, condenser 122 discharges and increases the flux in the lower pole-piece 107 and decreases the flux in the upper pole-piece 107 of the polarized clutch operating magnet 66. The armature 114 is then moved downward toward the lower pole-piece 107 of the polarized clutch operating magnet 66. The shaft 113 is moved longitudinally and the clutch flyer arm 105 is moved out of engagement with the stop clutch member 102 and into engagement with the annular clutch member 98. The annular clutch member 98 is driven by the synchronous motor 6 by means of a gear 79 engaged by a pinion 78 on the shaft 76 of the motor. Since the annular clutch member 98 is being driven by the synchronous motor 6 and since the shaft 113 is connected by means of the pinion 118 to the master gear 5 of the chronometer 1; the dials 2, 3 and 4 of the chronometer 1 are set in rotation. The armature 114 of the polarized clutch operating magnet 66 will be maintained in the last operated position by the magnetism in the lower pole-piece 107 until the polarized clutch operating magnet 66 is operated again. The clutch flyer arm 105 also will be held in engagement with the annular clutch member 98 by reason of the magnetic pull in the lower pole-piece 107 of the polarized clutch operating magnet 66. The chronometer 1 will continue to operate until the stop key 124 is manually operated to close the right-hand contacts of the key. When a contestant crosses the finish line the stop key 124 is operated to close its right-hand contacts. The condenser 121 will then discharge and cause increase of flux in the upper pole-piece 107 and decrease of flux in the lower pole-piece 107 of the polarized clutch operating magnet 66. The armature 114 will then be moved toward the upper pole-piece 107. The shaft 113 will be moved upward longitudinally and will carry the clutch flyer arm 105 out of engagement with the annular clutch member 98 and into engagement with the stop clutch member 102. Since the stop clutch member 102 is secured to the frame 74 the chronometer 1 will be immediately stopped. The elapsed time for the event can then be read from the dials 2, 3 and 4 as they stand relative to a fixed point.

If the motion picture camera 159 is being used in conjunction with the chronometer 1 to time the event, the stop key 124 would not be manually operated until the event was all finished or until a predetermined number of contestants had crossed the finish line. When the camera 159 is to be used, camera 159 is set in operation by closing the switch 177 as the contestants approach the finish line. Prior to the closing of the switch 177 the switch 171 is operated to close the circuit to the lamp 166. The switch 171 should be closed prior to the bringing into operation of the camera 159 to permit the lamp 166 to reach its full intensity of illumination before pictures are taken of the dials 2, 3 and 4. With the lamp 166 lighted and the camera 159 in operation pictures of the finish of the event are taken together with pictures of the rotating dials 2, 3 and 4 of the chronometer 1. Since each frame of the film of the motion picture camera contains a picture of the event and the dials 2, 3 and 4 of the chronometer 1, the positions of contestants relative to a finish line and the time in which they reach such points can be readily determined.

What is claimed is:

1. In an apparatus of the class described, including a polarized magnet, a control circuit for said polarized magnet, a source of current supply in said control circuit, a pair of conductors extending from said source of current supply to windings of said polarized magnet, a condenser in series with the windings of said polarized magnet, a condenser in parallel with the windings of said polarized magnet, a contact making device connected across the conductors of said circuit to provide a discharge path for current from said first-mentioned condenser through said polarized magnet in a direction opposite to that normally maintained through the windings of said polarized magnet, and a circuit breaking and making device to disconnect said first-mentioned condenser from said polarized magnet and to make a discharge path for said second-mentioned condenser through said polarized magnet, said circuit making and breaking device having break contacts in series with said first-mentioned condenser and said polarized magnet, and a make contact in series with said second-mentioned condenser.

2. In an apparatus of the class described, including a polarized magnet, a control circuit for said polarized magnet, a pair of conductors in said control circuit, a source of current supply for said control circuit, a start key connected across said pair of conductors, a stop key, normally closed contacts in said stop key connected in series with said polarized magnet, a condenser in series with said polarized magnet and the normally closed contacts in said stop key, a resistance device in series with said source of current sup-

ply and said condenser, a condenser and a resistance connected in series across said pair of conductors and in parallel with the windings of said polarized magnet, and a make contact in said stop key between said second-mentioned condenser and the resistance associated therewith, said stop key operating to disconnect said first-mentioned condenser from said polarized magnet and to connect said second-mentioned condenser directly in parallel with the windings of said polarized magnet, each of said condensers being so arranged in the control circuit that it will separately discharge through the windings of said polarized magnet in a direction opposite to the direction of discharge of the other condenser.

3. In an apparatus of the class described, including a polarized magnet, a control circuit for said polarized magnet, a source of current supply for said control circuit, a pair of conductors connected to said source of current supply and to said polarized magnet, a condenser normally in series with the windings of said polarized magnet, a condenser in parallel with the windings of said polarized magnet, a contact making device connected across said pair of conductors and a contact breaking and making device having break contacts in series with the first-mentioned condenser and said polarized magnet, and a make contact to bring the said second-mentioned condenser in connection with said polarized magnet in place of said first-mentioned condenser.

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