March 6, 1934. E. A. SPEAKMAN 1,950,273

TIMING SYSTEM

Filed Jan. 8, 1931 2 Sheets-Sheet 1

Fig. 1.

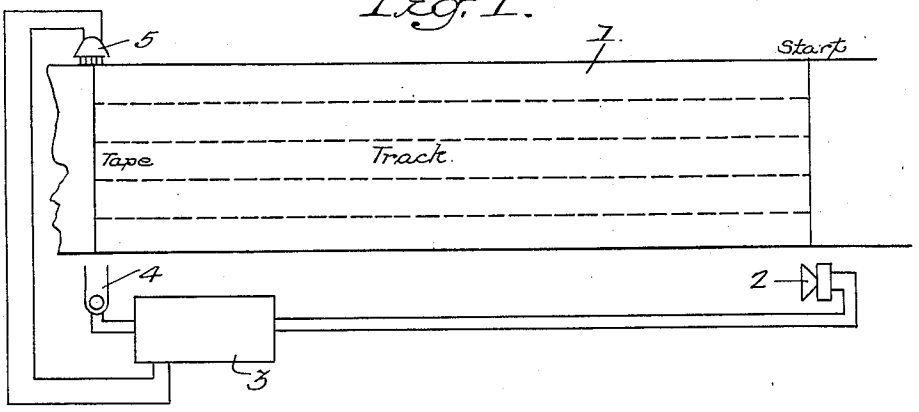


Fig. 2.

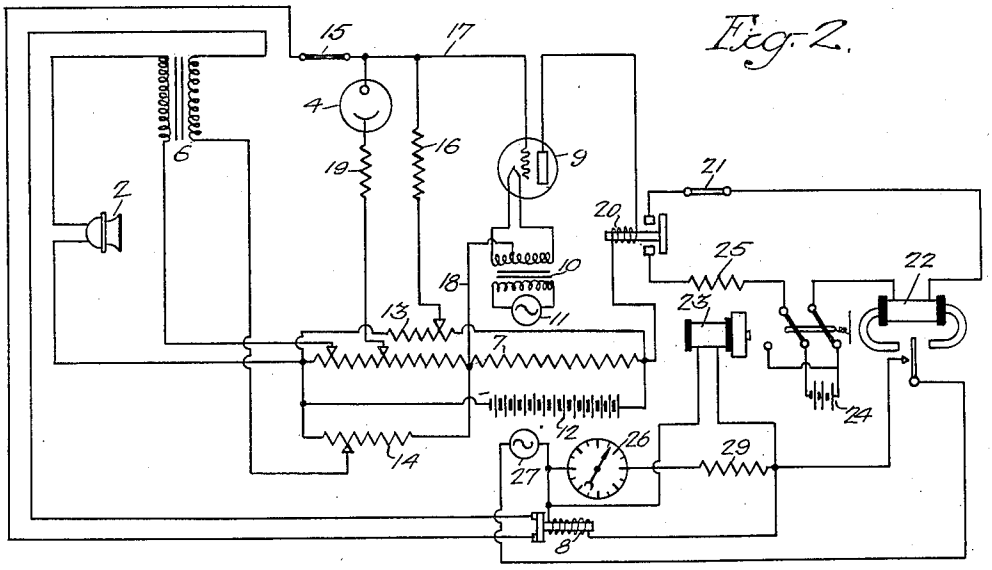
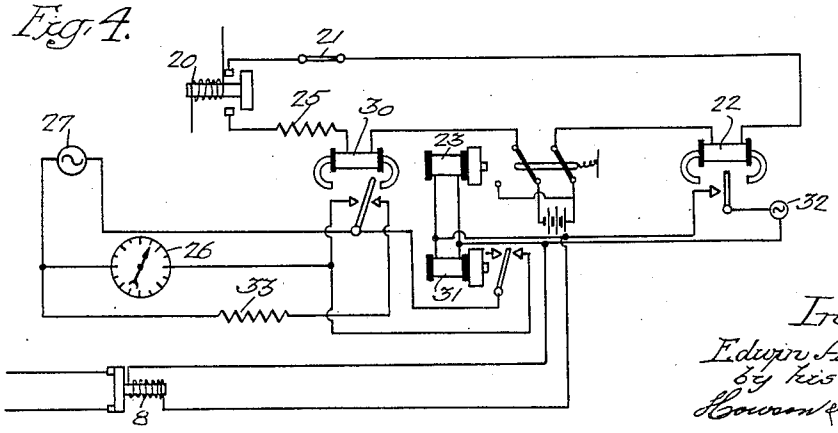


Fig. 4.



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Fig. 3.

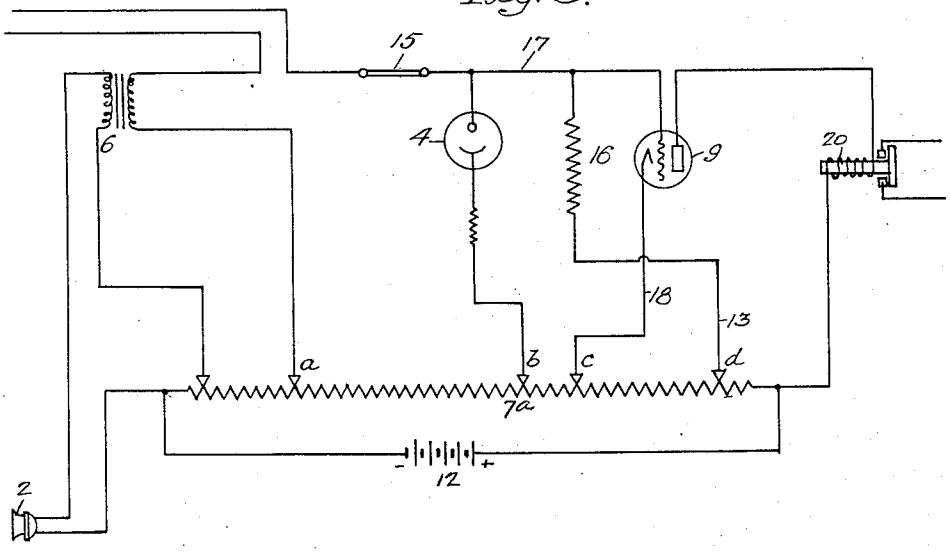
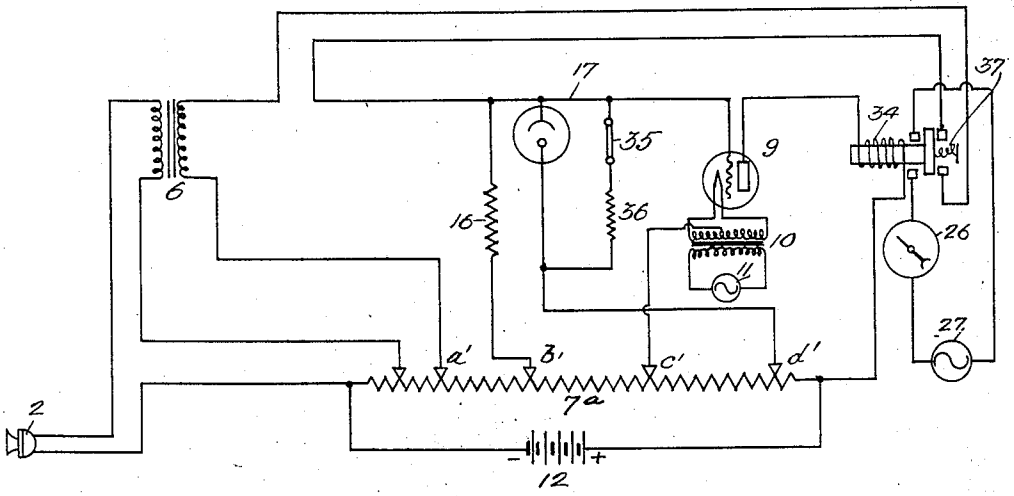


Fig. 5.



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UNITED STATES PATENT OFFICE

1,950,273

TIMING SYSTEM

Edwin A. Speakman, Narberth, Pa.

Application January 8, 1931, Serial No. 507,507

11 Claims. (Cl. 161—18)

This invention relates to timing apparatus by which the time of travel of a body or object over a certain path may be measured or recorded. The general object of the invention is to provide a system for this purpose giving a higher degree of accuracy than has heretofore been obtainable in such systems. The invention is particularly applicable to timing foot races, horse races, automobile races, or other races.

The invention consists primarily of the provision of means responsive to the sound of a starting gun or other audible signal to start a timing device, and means responsive to light to stop the timing device which a beam of light is intercepted by the first object crossing the finish line. Alternately, on oval tracks, the means responsive to light may be used to both start and stop the timing device in response to the interception of a light beam at the beginning and end of a race.

In order to record accurately the time of any race, it is necessary to eliminate the human element. This is apparent from a study of the human reaction time which is concerned with the speed of nerve impulses and the physical response which they produce. Track races are ordinarily timed with a stop watch operated by a human timer. The watch is started and stopped by the pressure of a spring release. However, there are always time intervals between the times when the race actually starts and stops and the times that the timer pressed the spring release. Observation has shown that these time intervals are each at least 0.16 seconds in duration, and that they do not compensate each other because the finish of the race is not recorded in the same way as the start thereof. At the start of the race the stop watch is started subsequent to the firing of the starting gun, while at the finish the crossing of the finish line is anticipated by the timer. All racing times, as at present recorded are, therefore, subject to the human element which may make them from 0.1 to 0.2 seconds inaccurate. The ideal timer should record the beginning as well as the end of a race as nearly as possible instantaneously, or at least with equal and compensating time lags.

A more specific object of the invention is, therefore, to provide a timing system which will approach as closely to the ideal or perfect system as is possible. The timing system is controlled entirely by the starting and finishing signals themselves, thereby eliminating the human element which is ordinarily involved. By means of the system the over-all operation of the various elements is accurate to within .01 seconds.

The above and other objects of the invention will be more clearly apparent hereinafter. Reference may be had to the following detailed description and the accompanying drawings for a clearer understanding of a specific embodiment of the invention.

In the drawings:

Fig. 1 is a plan view of a race track showing schematically the system of the invention associated therewith;

Fig. 2 is a schematic wiring diagram of a preferred embodiment of the system of the invention;

Fig. 3 is a wiring diagram of a simplified modification of a portion of the system;

Fig. 4 is a wiring diagram of a modification of a portion of the system of Fig. 2; and

Fig. 5 is a wiring diagram of modified system.

Referring to the drawings, there is indicated in Fig. 1 a race track 1 which may be adapted for any particular type of race, as previously indicated. A microphone 2 is placed adjacent the starting line and is connected to timing apparatus 3. A photo-electric cell 4, or other suitable light sensitive device, forms a part of the system and is also connected to the timing apparatus. This device is placed adjacent the finish line of the track, and is adapted to receive a beam of light from a spot-light 5 also placed adjacent the finish line on the opposite side of the track. The spot-light may be connected to the timing apparatus so as to receive its current from a suitable source forming a part of the apparatus, as clearly indicated. Any other suitable light source may be used in place of the spot-light. The starter stands about ten yards in front of the microphone, and the sound from the starting gun reaches the microphone and the runner's ears practically simultaneously. Actuation of the microphone sets into operation the timing apparatus, which continues to operate until the beam of light at the finish line is interrupted by the passing of the first runner or object to finish.

In Fig. 2 there is disclosed in detail a system designed and constructed in accordance with the invention. As indicated in this figure, microphone 2 is connected in series with the primary winding of transformer 6 and an adjustable portion of a potentiometer resistance 7. The secondary winding of transformer 6 is in circuit with the contacts of a relay 8, whose purpose will be more apparent hereinafter. The system includes a vacuum tube amplifier 9 which may comprise the

usual three-electrode amplifying tube of conventional form. The cathode of the tube may be supplied with energizing current through a suitable transformer 10 from a source of alternating current 11. The anode or plate supply voltage for the tube is derived from a source of unidirectional voltage 12, which is also adapted to supply various other operating potentials for the system, as will be clearly apparent as the description proceeds.

Source 12 may have a pair of potentiometer resistances 7 and 13 shunted across its terminals and a third potentiometer resistance 14 may be connected across a portion of potentiometer 7. The lower terminal of the secondary winding of transformer 6 is connected by means of a variable contact to potentiometer 14, while the upper terminal of the winding is connected through the contacts of relay 8, as previously indicated, and through switch 15 to the control electrode or grid of tube 9. The purpose of switch 15 will be explained later. A resistor 16 has one terminal connected to grid conductor 17, while its other terminal is connected by means of a variable contact to potentiometer 13. The photo-electric cell 4, or other suitable light sensitive device, has its anode also connected to conductor 17, while its cathode is connected through a current-limiting resistance 19 to potentiometer 7 by means of a variable contact. The grid cathode circuit of tube 9 is completed by means of conductor 18, connected between the midpoint of secondary winding of transformer 10 and an intermediate point of potentiometer resistance 7.

The plate circuit of the amplifying tube includes the winding of a relay 20, which is adapted to be energized by a suitable increase in the plate current of the tube to operate the timing device circuit. This relay functions to control a circuit which includes in series switch 21, the winding of a polarized relay 22, the contacts of a slow-acting double-pole relay 23, source of polarizing potential 24 and a current-limiting resistor 25. The contacts of polarized relay 22 control the circuit of the indicating device 26, which may take the form of any suitable electric clock adapted to start and stop instantaneously upon the closure or opening of the circuit. A suitable source of alternating current 27 supplies the necessary operating energy to the clock. If a low voltage timing device is used, a suitable step-down transformer may be used. This source also supplies energizing current for relays 8 and 23. The circuit through timing device 26 includes a resistor 29.

The amplifying circuit is so designed that the timing device can only be started by the proper sound entering the microphone, and stopped by the interception of the light beam on the photo-cell. The same vacuum tube is used to amplify the impulse, first from the microphone and then from the photo-electric cell. While various individual power sources for the various elements of the system have been shown for clarity of illustration, it will be apparent that a single commercial A. C. source may be used and the necessary D. C. potentials obtained by siutable rectifying devices.

It will be noted that a constant current from source 12 will normally flow through resistor 16, causing a voltage drop thereacross. This drop may be controlled differentially by means of potentiometers 13 and 14. The normal grid bias for the tube is at the same time controlled by means of these potentiometers. It will be apparent that these potentiometers are included in parallel paths from the cathode to the grid of the tube when relay 8 is closed, and that by virtue of the current flowing in these paths opposing potentials are set up between the grid and cathode of the tube. These potentials are preferably adjusted by means of the potentiometers to provide sufficient negative bias on the grid to give practically zero plate current. Adjustment of potentiometers 13 and 14 enables the placing of a suitable negative bias on the anode of the photo-cell with respect to its cathode, thereby rendering the cell inoperative. Since potentiometers 13 and 14 are also included in parallel paths between the cell electrodes, their adjustment will effect the biasing of the cell also. The normal current flow through the microphone may be controlled by means of its adjustable contact along potentiometer 7. It will be noted that by means of a plurality of suitable potentiometers, as shown, a flexible system of control for the various elements of the system is obtained. It will be obvious, however, that a single potentiometer could be used to obtain the various potentials but would give less flexibility and less fine adjustment. Such a modification will be described later.

Considering now the operation of the system, the circuit of the secondary winding of a transformer 6 is normally closed through the contacts of relay 8 which is deenergized. A negative biasing potential is, therefore, applied to the grid of the amplifying tube, as described above. A negative biasing potential is also applied to the photo-cell anode, as explained above, thus causing the cell to be inoperative while the microphone circuit is closed. The adjusted grid bias of the tube makes is sensitive to the gun sound only and not to extraneous noises which might enter the microphone.

Since the sound wave from the gun consists of a compression followed by a rarefaction, the current through the microphone and transformer 6 first increases and then decreases. A complete cycle of potential variation thus results across the secondary of transformer 6. The connections are so arranged that the grid side of the secondary receives the positive charge first and then the negative. The grid is, therefore, first effected positively. The positive potential overcomes the negative grid bias and causes appreciable plate current flow. The increase in plate current causes sufficient energization of relay 20 to operate the same, thereby completing the circuit through the winding of polarized relay 22. The contacts of relay 23 are normally biased by means of a suitable spring, or the like, to the right. Current of a suitable polarity, therefore, flows to the polarized relay which closes its contacts to complete the circuit through device 26 and resistor 29. The timing device, therefore, starts and continues to operate until its circuit is subsequently opened, as will appear later.

It will be noted that the polarized relay also closes a circuit for relay 8, thereby energizing the same and opening the circuit of the secondary winding of transformer 6. This renders the microphone inoperative and opens one of the parallel biasing paths for the tube and cell. As a result, the negative potential previously established on the anode of the photo-cell is removed and a positive potential is placed thereon by potentiometer 13. The voltage drop across resistor 16 due to the electron flow in the cell then causes a negative potential to be applied to the

grid of the amplifying tube and causes a drop in the plate current. Therefore, relay 20 is deenergized and opens the circuit of polarized relay 22. However, the contacts of this relay remain closed, because its armature is unbiased. In the meantime, relay 23 has also been energized by the closure of the contacts of relay 22, as will be clearly obvious. Relay 23, therefore, functions to reverse the polarity of the current to be subsequently applied to polarized relay 22. Relay 23 is slow acting so that it will act after relay 20 has closed and opened its contacts. The action of relay 20 is speeded up by making relay 8 fast acting, since it is the operation of relay 8 that causes relay 20 to operate in each case. If relay 23 were to reverse the polarity of the polarized relay before relay 20 could open its contacts, the polarized relay would immediately open its contacts prematurely, thereby stopping the timing device. In fact, a thorough study will make it evident that with the contacts of relay 20 always closed, both relays 23 and 22 will operate back and forth continuously.

When the light received by the photo-cell is intercepted, as by a runner crossing the finish line, the electron emission from the cathode of the photo-cell is less and the voltage drop across resistor 16 is, therefore, decreased. This causes a less negative or more positive potential to be applied to the grid of the amplifying tube.

The plate current, therefore, increases, causing energization of relay 20 which again closes the circuit of the polarized relay, causing it to open the timing device. Since relay 8 is now deenergized, its contacts immediately close, thereby rendering the microphone operative and again placing the original negative bias on the grid of the amplifying tube. A decrease in the plate current of the tube, therefore, results and relay 20 is deenergized. Since relay 23 is also deenergized, its contacts are drawn to the right by the biasing spring and the polarity applied to the polarized relay is proper for the repeating of the operation of the system. Thus the system resets itself. It should be noted also that completion of the circuit through secondary winding of transformer 6 causes the application of the original negative potential to the anode of the photo-cell, thereby again rendering it inoperative. The photo-cell is, therefore, immediately rendered inoperative by the first inpulse which it imparts to the amplifying tube. Interception of the light beam by the runners following has no effect. This is also true of the microphone which is cut out by the opening of relay 8 upon the first impulse from the microphone. The shifting from the microphone to the photo-cell and vice versa is, therefore, accomplished automatically by the opening and closing of relay 8. Although the operation of the timing system during the race is entirely automatic, it is necessary to turn the hand of the indicating device back to the starting point to prepare for the next race. This may be accomplished by repeated pressure on a button to advance the hand to the desired position.

As previously stated, a single potentiometer could be used to obtain the various operating potentials of the system, and a disclosure of such a simplified modification will probably afford a clearer understanding of the invention. Fig. 3 shows this simplified arrangement, it being understood that the portion of the system not shown in this figure is identical with and operates in the same manner as the corresponding portion of the system of Fig. 2. In Fig. 3, a single potentiometer 7*a* is used in conjunction with source 12, and the various movable contacts of the system are associated with the single potentiometer resistance at suitable points. A negative biasing potential may be established upon the grid of tube 9 by relative adjustment of contacts *a* and *c*, the potential across the portion of the potentiometer between these points being effective to give the desired potential. Likewise, a negative biasing potential may be established upon the anode of photo-cell 4 by relative adjustment of contacts *a* and *b*. By virtue of the circuit through resistor 16 parallel paths containing opposing potentials exist between the cell and tube electrodes as before. The portions *c*, *d* and *b*, *d* of the potentiometer which tend to place positive biases on the tube and cell respectively are such, however, that they do not balance or overcome the negative biasing potentials. Furthermore, such tendency is opposed by the potential drop across resistor 16.

In operation of the system, relay 8 (not shown) is normally closed and the desired negative biasing potentials are, therefore, established upon the tube and cell as described above. Practically zero plate current flows in the output circuit of the tube and the cell is rendered inoperative. When sound from the starting gun actuates the microphone, the positive impulse across the secondary of transformer 6 overcomes the bias of the tube and causes a rise in plate current, thereby operating relay 20. The timing device and associated circuits (not shown) which are associated with relay 20 in the same manner as in the system of Fig. 2, function as previously described when the relay operates. Relay 8 is energized as previously explained and opens the circuit of the transformer secondary, thereby removing the bias from the tube and the photo-cell. The voltage drop across resistor 16, due to the electron flow in the photo-cell then causes a negative potential to be applied to the grid of the amplifying tube and causes a drop in its plate current to deenergize relay 20.

When the light of the photo-cell is intercepted at the finish of a race, the electron emission of the cell is less and the voltage drop across resistor 16 decreases. A less negative or more positive potential is, therefore, applied to the grid of the tube and an increase of its plate current takes place to again operate relay 20 and stop the timing device as before. Thus, it is seen that this modified system operates upon the same principle as that of Fig. 2, but is simplified to a great extent. However, it affords less flexibility of control and less fine adjustment.

Were it not for the fact that relay 20 operates both at the start and at the finish of the race, a large source of error would be caused by the relay action in the closing of its contacts. However, the closing of the contacts of the relay is caused by precisely the same amount of current in each instance, and any time lag at the start is exactly duplicated at the finish. Relay 22 which controls the clock introduces a small time lag while its contacts are closing. This lag can hardly be duplicated at the opening of the contacts, since the clock circuit is broken before the contacts have opened to the full width of the gap. An error is, therefore, present depending upon the distance between the contacts. This error may be reduced by adjusting the width of the gap to .01 inch.

In order to eliminate the undesired error just mentioned, which is caused by relay 22, the timing device system of Fig. 4 may be incorporated into the systems of Figs. 2 and 3. In this figure, only the modified portion of the system is shown, since the remainder may be identical with either that of Fig. 2 or Fig. 3 and functions in the same manner. In this instance, an additional double-throw polarized relay 30 is included in the circuit controlled by relay 20. A slow-acting relay 31 is connected in parallel with the windings of relays 8 and 23 to a suitable A. C. source of potential 32 through the contacts of polarized relay 22. The contacts of relay 31 control the circuit of the timing device 26. The operation of the timing device is also controlled by polarized relay 30 and resistor 33.

Considering the operation of this modification, the timing device is started upon the breaking of the contacts of relay 30 on the right and stopped upon the breaking of its left hand contact. Thus, the timing device is started and stopped bp precisely the same motion of the relay contacts in each case, viz., by the breaking of the contacts. Initially, the contacts of relays 30 and 31 are closed on the right. The effect of the contacts of relay 30 is to shunt resistance 33 directly across the timing device. Current from source 27 passes through the resistance and the timing device remains inoperative.

Upon energization of the winding of relay 30, due to the momentary closing of contacts of relay 20, as previously explained, the contacts of relay 30 are broken at the right as the movable contact moves from right to left. Resistance 33 is, therefore, cut out so that current passes through the closed contacts of relay 31 to the timing device, which starts immediately. The movable contact of relay 30 continues to move to the left and closes. The slow-acting relay 31 then opens its contacts, allowing the current to the timing device to pass through the contacts of relay 30, which are closed on the left. Relay 31 is operated by having its winding energized through the contacts of relay 22, whose winding is energized simultaneously with that of relay 30. The current then passes through the closed contacts of relay 30 to the clock which continues running.

When the contacts of relay 20 again close and energize relays 30 and 22, the movable contact of relay 30 moves to the right, thereby breaking the circuit to the timing device which stops immediately. This contact continues to the right, closing the shunt circuit through resistance 33 about the timing device. Relay 31 is no longer energized through the contacts of relay 22 and its contacts are, therefore, closed. The initial condition is, therefore, instituted and the mechanism is ready to repeat operation. It is essential that relay 31 and its contacts be closed while the movable contact of relay 30 is moved from right to left, since if the contacts of relay 31 were opened during this time, the circuit to the timing device would not be completed until the movable contact of relay 30 engaged the left-hand contact. The breaking of the left-hand contacts of relay 30 stops the timing device, and, therefore, the contacts of relay 31 must remain open, while the movable contact of relay 30 moves from left to right. If the contacts of relay 31 should close during this time, the circuit to the timing device would be completed, causing it to again start running. Relay 31 must, therefore, have a time lag such that it operates two seconds after relay 30 in each case. By having the timing device stopped and started by the breaking of contacts, time lag due to the motion of moving parts is eliminated. It is, therefore, seen that the modified system eliminates the previously discussed objectionable error due to the operation of the contacts of relay 22.

In the case of long races where the runners proceed around an oval track several times, a slight change in the operation of the systems described is necessary. After the timing device has started, switch 21 must be opened. When the light beam is intercepted after the first lap of the race, the contacts of relay 20 close but complete no circuit, due to the break at the switch. Hence, the timing device continues running. On the last lap, when the leading runner is perhaps fifty yards from the finish, switch 21 may be closed by the operator and the mechanism is ready to function to stop the timing device when the light beam is intercepted, as previously explained. For short dashes, however, such as 100, 220 and 440 yard races, no manual operation is necessary. It is in these short races that an accurate timer is most needed.

It is also important to note that in using the system with oval tracks, which are commonly used for automobile or horse races, the timing device may be started and stopped entirely by the interception of a light beam. If switch 15 is opened, the microphone circuit is permanently disabled and the only impulses which would operate the clock would be those from the photo-cell whenever its beam of light is intercepted. It is important to note that successive interception will alternately stop and start the timing device automatically. Therefore, in races on oval tracks, the operation of the system could be initiated by interception of the light beam and stopped by a second interception of the light beam. While it hardly seems likely that any instance would arise in which it would be desired to use the microphone alone to start and stop the device, such operation is possible merely by opening the circuit of the photo-cell and short circuiting the contacts of relay 8 permanently.

In Fig. 5 there is shown a modified system in which a single relay 34 is utilized to take the place of relays 8 and 20 of the previously described systems. This modified system also differs slightly in the operation of the photo-cell and also eliminates the necessity for a plurality of relays and circuits in connection with the timing device. In this system, a single potentiometer 7*a* has been utilized to obtain the various potentials for clarity of illustration, but it will be apparent that a plurality of potentiometers may be used as in the system of Fig. 2. The connections of the photo-cell electrodes are reversed in this instance, the anode being connected by means of a variable contact to the potentiometer, while the cathode is connected to grid conductor 17. A short-circuiting switch 35 and a current limiting resistor 36 are shunted about the photo-cell for a purpose to be described later. Relay 34 is a double-acting relay having both left hand and right hand contacts, and when deenergized, the right hand contacts are closed by virtue of a suitable biasing spring 37 or the like.

Considering the operation of this system, relay 34 is normally deenergized and its right hand contacts are closed. The closure of these contacts corresponds to the normal closed condition of relay 8 of the previously described systems, and suitable biasing potentials may be placed upon the tube and cell electrodes. A negative biasing

potential may be established upon the grid of tube 9 by relative adjustment of contacts a' and c', while an operating potential for the electrodes of the photo-cell may be established by suitable adjustment of contacts a' and d'. It will be noted that in this case a positive potential is established on the photo-cell anode with respect to its cathode. However, the cell is rendered practically inoperative, due to the potential drop across resistor 16 caused by the constant flow of current therethrough, such potential drop opposing the potential tending to render the cell operative. The negative bias upon the grid of tube 9 is sufficiently high that the potential drop across resistor 16 cannot overcome the bias to cause energization of the tube even if a variation in light intensity on the tube should cause a variation in the potential drop.

When the microphone is actuated by the sound of the starting gun as before, the positive impulse across the secondary of transformer 6 overcomes the negative grid bias of the tube, causing an increase in plate current of the tube. Relay 34 is, therefore, energized and opens its right hand contacts and closes its left hand contacts. Thus, the circuit of the transformer secondary is opened and the circuit of the timing device 26 is closed. The opening of the transformer secondary circuit removes the negative bias from the grid of the tube and a positive potential is established thereon by the potential drop across resistor 16, due to the cell current. This positive potential is sufficiently great to insure sufficient plate current through the output circuit of the tube to maintain relay 34 energized. The timing device, therefore, continues to operate until the finish of the race when it is rendered inoperative as follows. Interception of light to the photo-cell at the finish of the race causes a decrease in the cell current through resistor 16, and the potential drop thereacross is accordingly less. A less positive or more negative potential is, therefore, applied to the grid of tube 9, reducing the plate current through relay 34 sufficiently to deenergize the same. Relay 34 then opens its left hand and closes its right hand contacts, thus stopping the timing device and closing the circuit of the secondary transformer 6. The original starting condition is, therefore, obtained, the system automatically resetting itself for repeated operation.

Switch 35 and resistor 36 are provided for operation in the case of oval tracks where the light beam upon the photo-cell is interrupted several times before the end of the race. In such case, switch 35 may be closed by the operator after the timing device has been started in the manner described. This switch short circuits the photo-cell through the current limiting resistor, and when the light beam is intercepted at the end of each successive lap of the race, the cell current change causes no change in potential applied to the grid of tube 9. The plate current of the tube, therefore, continues to be of sufficient amplitude to maintain relay 34 energized. During the last lap of the race when the racers are approaching the finish line, switch 35 may be opened and the cell thereby rendered operative and functions to stop the timing device, as above described.

While I have disclosed herein for the purpose of illustration the specific details of several embodiments of the invention, it will be apparent that various changes within the scope of the invention are possible without departing from the spirit of the same. Therefore, it is to be understood that only such limitations as are contained within the appended claims are to be imposed upon the invention.

I claim:

1. A timing system for measuring the time of travel of a body over a certain path, comprising a timing device, means comprising a device responsive to a certain form of atmospheric wave energy for starting said device at the beginning and stopping it at the end of travel of said body over said path.

2. A timing system for measuring the time of travel of a body over a certain path, comprising a timing device, means for controlling said device, means normally operative for controlling said first means to start said device at the beginning of travel of said body over said path, means normally inoperative for controlling said first means to stop said device at the end of travel of said body over said path, means for rendering said second means inoperative and said third means operative simultaneously with the starting of said device, and means for returning each of said means to normal condition simultaneously with the stopping of said device.

3. A timing system for measuring the time of travel of a body over a certain path, comprising a timing device, means for controlling said device, and means responsive to a certain form of atmospheric wave energy for controlling said first means to start said device at the beginning and to stop it at the end of travel of said body over said path.

4. A timing system for measuring the time of travel of a body over a certain path, comprising a timing device, means for controlling said device, means normally operative for controlling said first means to start said device at the beginning of travel of said body over said path, means normally inoperative for controlling said first means to stop said device at the end of travel of said body over said path, and means controlled by said first means for rendering said second means inoperative and said third means operative simultaneously with the starting of said device.

5. A timing system for measuring the time of travel of a body over a certain path, comprising a timing device, means for controlling said device, means normally operative and responsive to one form of wave energy for controlling said first means to start said device at the beginning of travel of said body over said path, means normally inoperative and responsive to a different form of wave energy for controlling said first means to stop said device at the end of travel of said body over said path, and means controlled by said first means for rendering said second means inoperative and said third means operative simultaneously with the starting of said device.

6. A timing system for measuring the time of travel of a body over a certain path, comprising a timing device, means for controlling said device, means normally operative and responsive to sound for controlling said first means to start said device at the beginning of travel of said body over said path, means normally inoperative and responsive to light for controlling said first means to stop said device at the end of travel of said body over said path, and means controlled by said first means for rendering said second

means inoperative and said third means operative simultaneously with the starting of said device.

7. A timing system, comprising a timing device, means comprising a pair of electric discharge devices one controllable by the other for controlling the operation of said timing device, means for normally rendering said devices ineffective, means for rendering one of said devices effective to start said timing device, and means for rendering the other of said devices effective to control said one device to stop said timing device.

8. A timing system, comprising a timing device, means comprising a pair of electric discharge devices one controllable by the other for controlling the operation of said timing device, means for normally rendering said devices ineffective, means for rendering one of said devices effective to start said timing device, and means controllable at will for rendering the other of said devices effective to control said one device to stop said timing device.

9. A timing system, comprising a timing device, means comprising a pair of devices for controlling the operation of said timing device, means for applying a non-operating potential to said devices to normally render the same ineffective, means for applying a greater operating potential to one of said devices to render the same effective to start said timing device, means for removing said non-operating potential, and means responsive to said removal for applying an operating potential to the other of said pair of devices to render it effective to control said one device to stop said timing device.

10. In a timing system, an electrically controlled timing device, means normally rendering said device inoperative, a slow-acting circuit control device normally tending to render said timing device operative, a double-throw circuit control device normally maintaining said means effective, and adapted when energized to render said means ineffective and to subsequently close the circuit of said timing device, and means for simultaneously energizing said circuit control devices, whereby said timing device is immediately operated and is maintained operative by said slow-acting device until said double-throw device has closed the circuit of said timing device.

11. In a timing system, an electrically controlled timing device, means normally rendering said device inoperative, a slow-acting circuit control device normally tending to render said timing device operative, a double-throw polarized relay normally maintaining said means effective, and adapted when energized to render said means ineffective and to subsequently close the circuit of said timing device, a control circuit including the energizing winding of said polarized relay, a source of voltage for said control circuit, means for reversing the polarity of said source, a second polarized relay included in said control circuit, and an energizing circuit for said slow-acting device and said reversing means controlled by said second polarized relay.

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