Oct. 7, 1952 I. M. MALOTT ET AL 2,612,948

RACE TRACK TIMING DEVICE

Filed July 14, 1948 4 Sheets-Sheet 1

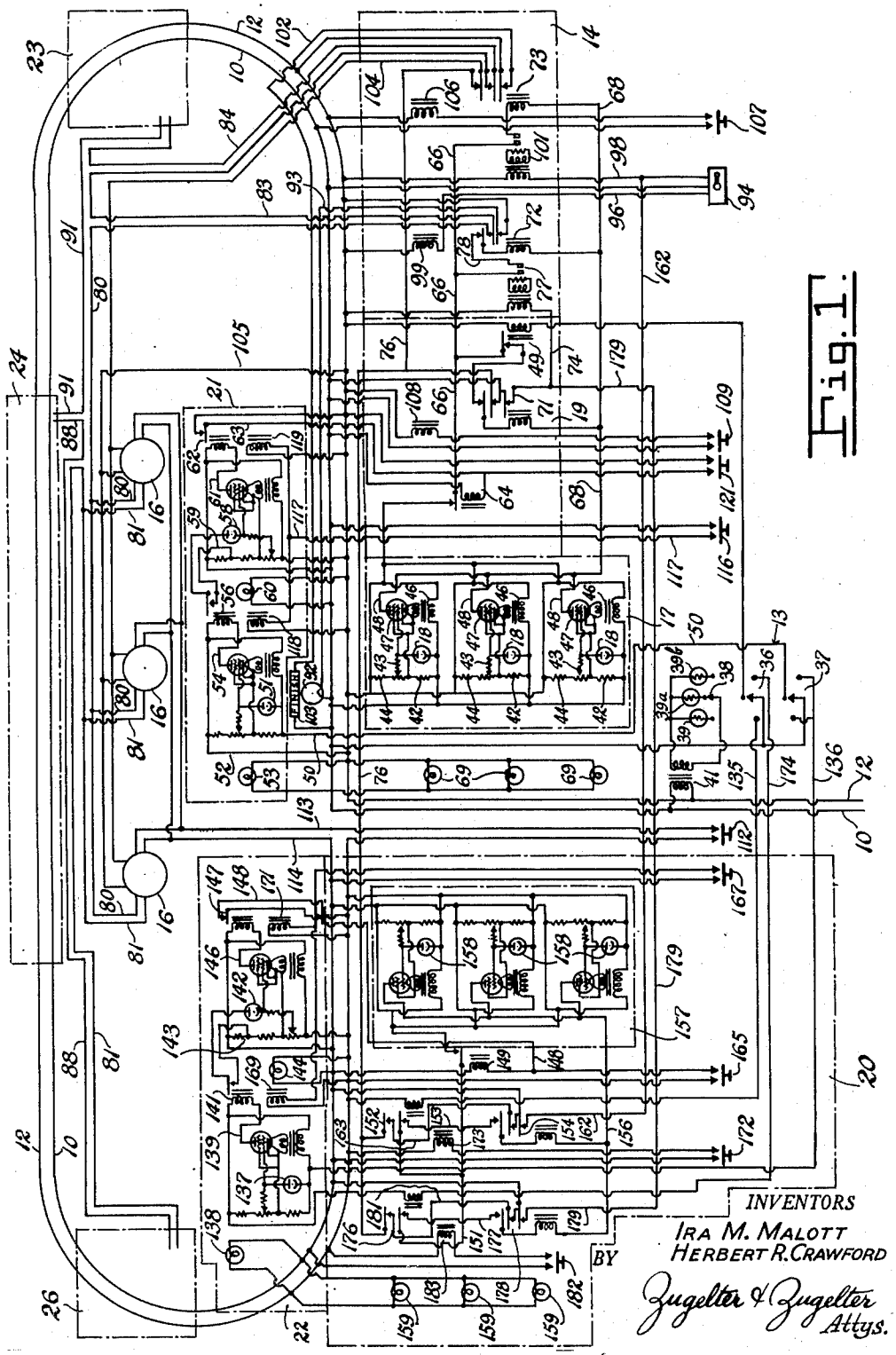


Fig. 1.

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Filed July 14, 1948 4 Sheets-Sheet 2

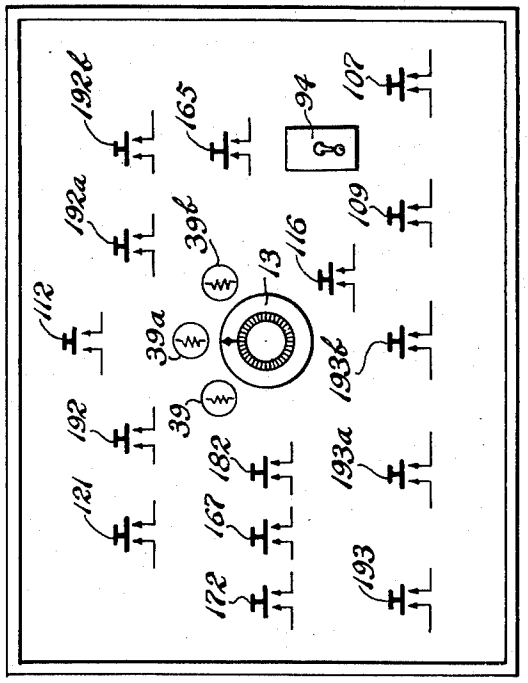


Fig. 4.

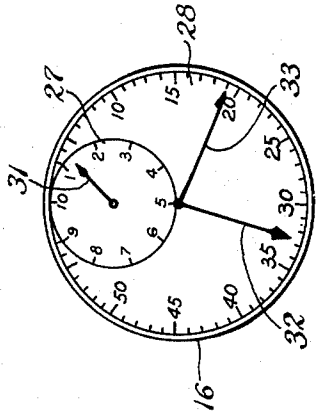


Fig. 2.

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Filed July 14, 1948 4 Sheets-Sheet 3

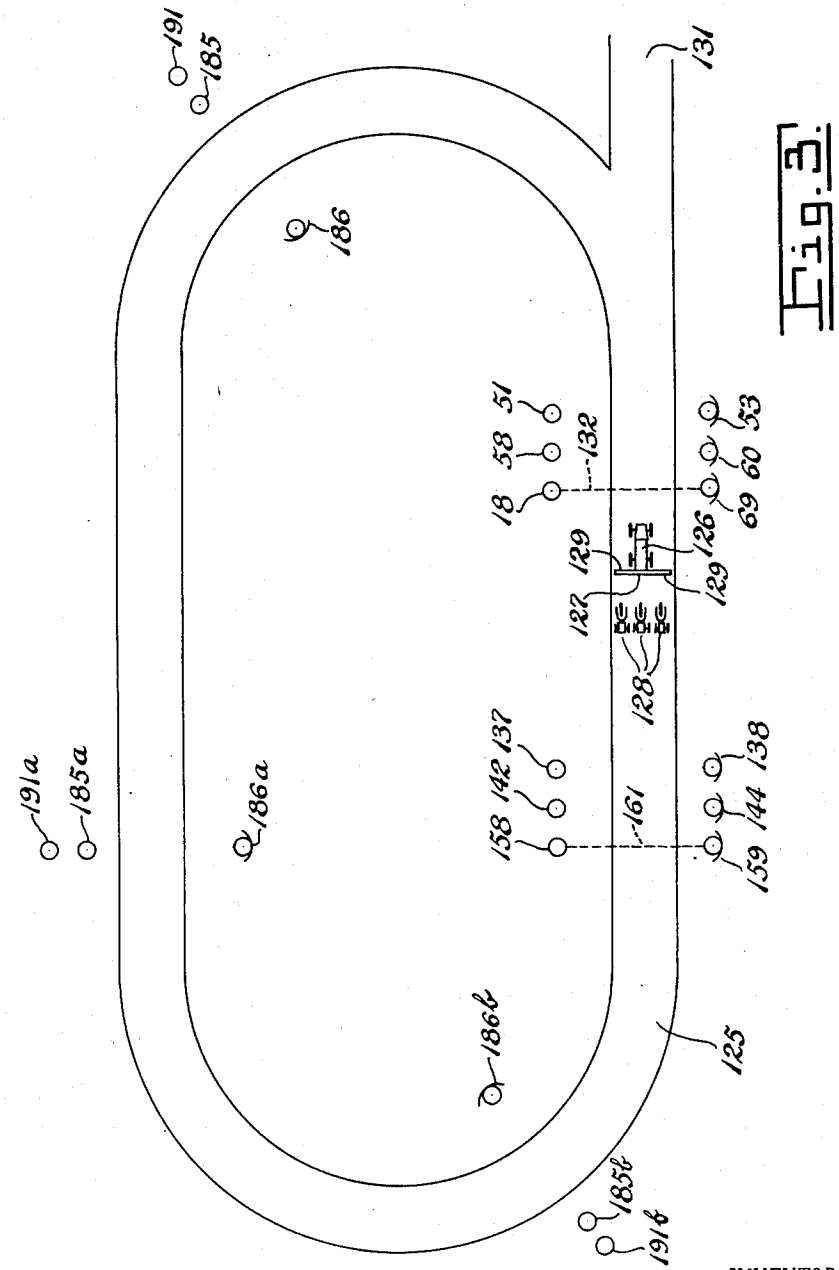


Fig. 3.

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RACE TRACK TIMING DEVICE

Filed July 14, 1948 4 Sheets-Sheet 4

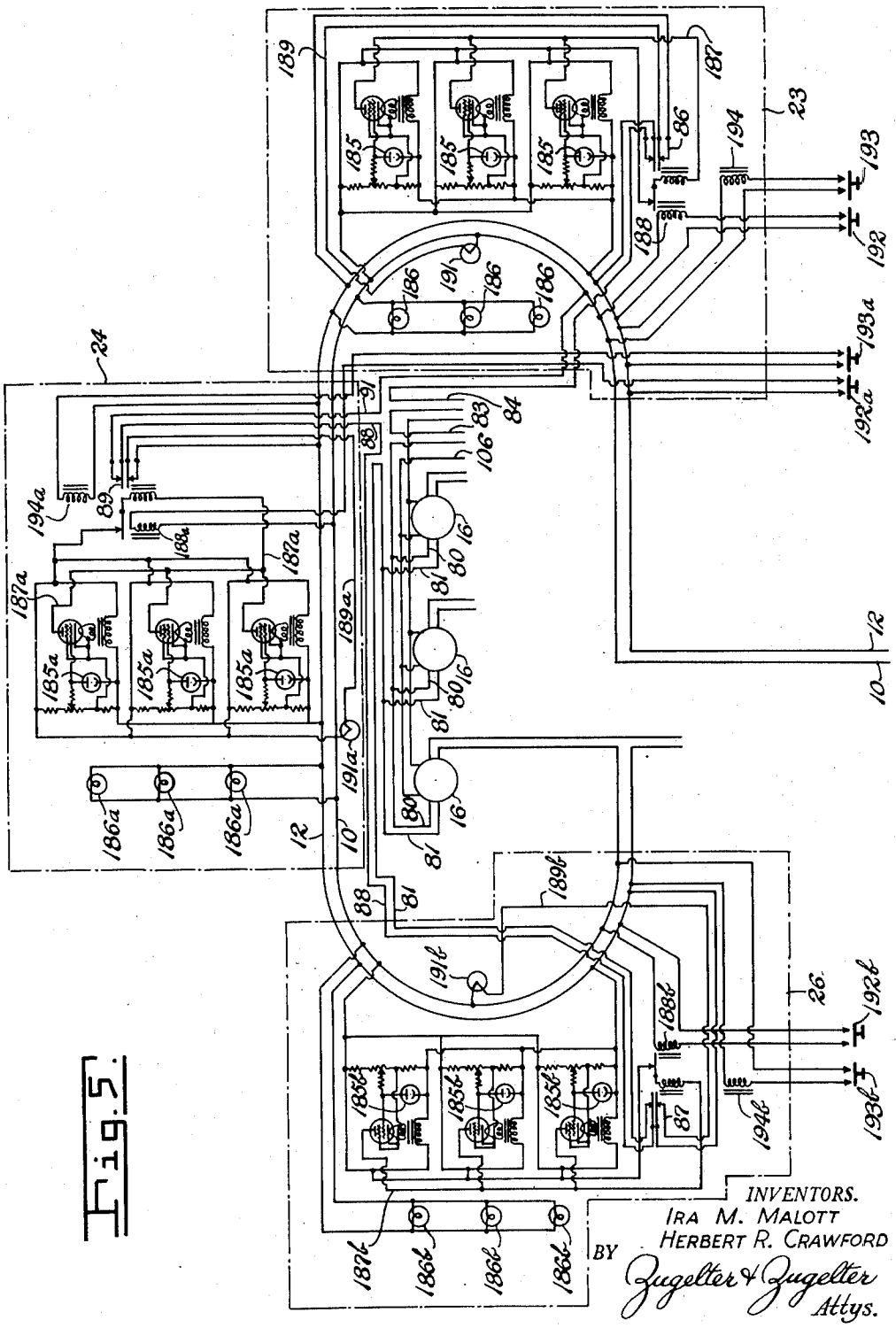


Fig. 5.

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UNITED STATES PATENT OFFICE

2,612,948

RACE TRACK TIMING DEVICE

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Application July 14, 1948, Serial No. 38,706

5 Claims. (Cl. 161—18)

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This invention relates to a device for timing races and more particularly relates to an electrical device for accurate and automatic timing of races.

An object of this invention is to provide a timing device which, by means of electrical circuits, can accurately time a race.

A further object of this invention is to provide a device capable of automatically recording the time of parts of a race.

A further object of this invention is to provide an automatic timing device suitable for use with a starting gate of the type which is advanced along a race track ahead of a start.

A further object of this invention is to provide a timing device suitable for use with races of varying lengths.

The above mentioned and other objects may be attained by the device described herein and illustrated in the accompanying drawings, in which:

Figure 1 is a schematic view showing the electrical circuit of a timing device constructed in accordance with this invention.

Figure 2 is a front elevational view showing a clock suitable for use with the timing device of this invention.

Figure 3 is a schematic plan view of a horse racing track showing the location of lights and photoelectric cells of the timing device.

Figure 4 is a front elevational view of a control panel for the timing device, schematically shown.

Figure 5 is a schematic view showing further electrical circuits of the timing device.

Briefly, the present invention provides a timing device which is actuated by photoelectric cells. The device is particularly adapted for use in timing trotting and pacing races in which it is desirable to know the time at various distances along the track and to have an exact indication of the time for a race. Photoelectric cells and appropriate electrical circuits associated therewith are located at selected points on the track. A clock or several clocks are mounted for ready view, and each clock may have a hand for recording minutes and a pair of hands for recording seconds and fractions of seconds of elapsed time. One of the second hands may move continuously during a race, while the other second hand may be halted as the horses pass each of several selected points. A series of relays is provided at the finish line which can start the clocks as horses pass the line and stop the clocks as the horses pass the finish

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line for a final time. If the horses are to pass the finsh line several times, the mechanism permits the clocks to continue running until the final time. At the starting line a circuit may be provided to permit a starting gate to pass the starting line before the clocks can be started. Alternate starting mechanisms may be provided at each of several points about the track. After the starting gate has passed the selected starting line, the passing of a horse across the starting line may automatically start the clocks, and the clocks may be stopped automatically as the first horse passes the finish line for the final time.

Referring now to the drawings and to Figures 1 and 5 which illustrate the electrical circuit of a device constructed in accordance with this invention, current to operate the device, which may be alternating current of any suitable voltage and frequency, may be introduced through two main power leads 10 and 12. The leads 10 and 12 may circle the track to supply power to all the various lights, photoelectric cells, relays, and the like which form a part of the device. For ease in reference, the circuit of the device has been divided into a number of sections having different functions. The device shown is designed for use on a half-mile track for timing races of nine-sixteenths mile, one mile, and a mile and one-sixteenth, but the device is readily adaptable for use on tracks of different sizes for timing races of various lengths. A selector switch 13 may be positioned to put the device in proper condition for timing a race of the selected length. The device may include a relay circuit 14 for operating the main circuit of clocks 16. The clocks 16, as shown, are mounted in parallel. Three clocks have been shown, but more clocks may be used, if desired, to provide clocks which can readily be observed from any desired point. During timing of a mile race, a circuit 17 including photoelectric cells 18 and associated electrical circuits together with a relay circuit 19 may control the relays of the circuit 14. On the other hand, for races of nine-sixteenths mile and a mile and one-sixteenth, a circuit 20 is employed to control the relays in the circuit 14. A circuit 21 can set the circuit 17 into action upon the passage of the starting gate by the starting point for a mile race, while a similar circuit 22 can set the circuit 14 into operation upon passage of the starting gate across the starting line for a nine-sixteenths mile and a mile and one-sixteenth race.

At the one-eighth mile, one-quarter mile, and

three-eighths mile points respectively may be located photoelectric cell actuated timing circuits 23, 24, and 26, each of which may be constructed to stop a sweep second hand of each of the clocks 16, as the horses pass each point. As the horses pass the finish line, the main circuit to the clocks 16 may be broken by the relays in the circuit 14.

Each of the clocks 16 may have a face and hands as shown in Figure 2. The clock 16 may include an inner dial 27 calibrated in minutes and an outer dial 28 calibrated in seconds and fractions of a second. A minute hand 31 and a second hand 32 may be controlled by a main clock circuit, while a sweep second hand 33 may be stopped as the horses pass each of the timing points. After the horses pass a timing point, the sweep second hand 33 may remain stopped for a sufficient time to be observed and then may be reset in alignment with the second hand 32 before the horses pass the next timing point. The operating mechanism of the clocks is not shown or described in detail as it does not form an essential feature of the invention, and the operating mechanism of the clocks may be conventional.

The circuits, which have been described above only in general terms, will now be described in more detail.

The selector switch 13 may include three layers. A central layer 36 may connect the main power lead 10 with either the one mile circuit 17 and relays 19 or alternately the nine-sixteenths and mile and one-sixteenth circuit 20. A lower layer 37 of the selector switch 13 may connect the main power lead 10 with the mile starting circuit 21 when the mile circuit 17 and relays 19 are connected or may connect the main power lead 10 with the starting circuit 22 when the nine-sixteenths mile and one mile and one-sixteenth circuit 20 is connected. An upper layer 38 of the switch 13 may light signal lamps 39, 39*a*, and 39*b* to indicate which of the circuits may be connected. Power is supplied to the layer 38 of the switch and to the signal lamps by a transformer 41 mounted across the main power leads 10 and 12. As shown in the drawings, when the selector switch 13 is turned to the left, the circuits are connected for the timing of a nine-sixteenths mile race and the left-hand signal lamp 39 is lighted, when the switch is centrally positioned, the circuits are connected for the timing of a one mile race and the central signal lamp 39*a* is lighted, and when the switch is turned to the right, the circuits are connected for the timing of a mile and one-sixteenth race and the signal lamp 39*b* is lighted.

A number of photoelectric cells are shown in the drawings and are used for recording the time of passage of horses by various starting, timing, and finish points. With each photoelectric cell is associated a conventional circuit for amplifying and transmitting an electrical impulse as a change occurs in the amount of light received by each photoelectric cell. For example, each of the cells 18 is equipped with appropriate fixed resistances 42, and 43, a variable resistance 44, a transformer 46, and a vacuum tube 47 to induce a current in a lead 48 connected to the plate of the tube 7. The current in the lead 48 is changed upon a change in the intensity of light reaching the cell 18. Each photoelectric cell is equipped with a suitable substantially similar circuit, and for simplicity other photoelectric cell circuits will not be described in detail.

One mile race start and finish timing mechanism

When the switch 13 is centrally positioned for timing a one mile race, one side of the coil of a normally open relay 49, in the circuit 19, is connected to the main power lead 10. The other side of the coil of the relay 49 is connected to the main power lead 12, and, when the switch 13 is centrally positioned, the relay 49 is closed. In addition, when the switch 13 is centrally positioned, a lead 50 is connected to the main power lead 10. The lead 50 is connected to one side of the circuit of a photoelectric cell 51 in the circuit 21. The other side of the circuit of the cell 51 is connected to the main power lead 12 by a lead 52, and, when the switch 13 is centrally positioned, the circuit of the cell 51 is energized. A lamp 53 connected between the main power leads 10 and 12 supplies a light beam for the cell 51. When the beam of light between the lamp 53 and the cell 51 is broken, current in a plate lead 54 is changed.

The lead 54 is attached to one side of the coil of a normally open latch type relay 56. The other side of the coil of the relay 56 is connected to the main power lead 12 by the lead 52, and the relay 56 closes when the beam of light between the lamp 53 and the cell 51 is broken.

Closing of the relay 56 completes a circuit between an anode of a photoelectric cell 58 and a resistance 59 in the circuit of the cell 58. Opposite sides of the circuit of the cell 58 may be connected continuously to the main power leads 10 and 12. A lamp 60, attached across the main power leads 10 and 12, can supply a light beam for the cell 58. When the light beam strikes the cell 58 after the relay 56 has been closed, current in a plate lead 61 may be changed. The lead 61 is attached to one side of the coil of a normally closed latch type relay 62. The other side of the coil of the relay 62 is attached to the main power lead 10. When, in sequence, the beam of light to the cell 51 is cut off and the beam of light from the lamp 59 strikes the cell 58, the relay 62 may be opened.

As long as the relay 62 is closed, one end of a lead 63 is attached, through the relay 62, to the main power lead 12. The other end of the lead 63 is attached to a side of the coil of a normally closed relay 64 in the circuit 19. The other side of the coil of the relay 64 is attached to the main power lead 10. As long as the relay 62 remains closed, current can flow through the coil of the relay 64 to hold it open. However, when the relay 62 is opened, the relay 64 can close to connect a lead 66 to the main power lead 12.

The cells 51 and 58 and their associated circuit and relays, all of which make up the circuit 21, make provision for setting the timing mechanism into operation upon the passage of a starting gate ahead of the horses at the start of a race. Until the starting gate has passed the cells 51 and 58, the relay 64 can remain open. Only after the starting gate has passed the cells 51 and 58, to break the light beam to the cell 51 and then permit light to hit the cell 58, does the relay 64 close. Closing of the relay 64 connects the lead 66 to the main power lead 12 to provide power for the relay circuits 14 and 19.

The photoelectric cells 18 are located at the finish line, which is also the starting line for a mile race. The cells 18 may be mounted in a vertical row, one above the other, to provide cells at various levels. The circuits of the cells 18 are connected in parallel, and the plate lead 48

from the circuit of each of the cells 18 is connected to a common lead 68. Lamps 69, mounted across the main power leads 10 and 12 are provided to direct a light beam toward each of the cells 18. The number of the lamps 69 may be same as the number of the cells 18, and the lamps 69 may be mounted in a vertical row, one above the other to provide a series of parallel, substantially horizontal beams across the finish line. If desired, additional cells and lamps may be provided to ensure a light beam at proper height to be broken by the nose of a horse as it passes the finish line.

As the nose of a horse breaks the beam of light to one of the cells 18, current in the lead 68 may be changed. The lead 68 is attached to a side of the coil of each of three relays 71, 72, and 73, which are in the circuits 19 and 14.

The relay 71 is a main starting relay. It may be of a latch type and may include one normally closed leaf and two normally open leaves. As long as the relays 49 and 64 are closed, the other side of the coil of the relay 71 may be connected to the main power lead 12 through the normally closed leaf of the relay 71. When, at the start of the race, a horse passes the cells 18, the current in the lead 68 may be changed to actuate the relay 71, to open the normally closed leaf and close the normally open leaves of the relay 71. Opening of the normally closed leaf removes the load of the relay 71 from the plate circuit of the cells 18.

Closing of the normally open leaves connects leads 74 and 76 to the main power line 10. The lead 74 is attached to a side of a thermal time delay relay 77. The other side of the time delay relay 77 is attached to the main power lead 12, and, a selected time interval after the start of the race, the relay 77 can close. The length of the time delay may be sufficient to permit all the horses to pass the starting line before the relay 77 can close.

The lead 76 may be connected, through a normally closed leaf of the relay 73, to a pole of a main circuit of the clocks 16. The other pole of the main circuit of each of the clocks 16 may be attached to the main power lead 12 so that, upon actuation of the relay 71, the clocks 16 are set in operation, and the clocks 16 can operate until the relay 73 is actuated.

When the time delay relay 77 closes, a selected time after actuation of the relay 71, a lead 78 is connected to the lead 66. As already pointed out, the lead 66 is connected to the main power lead 12 as long as the relay 64 remains closed. Thus, the lead 78 may be connected to the main power lead 12 through the lead 66.

The relay 72 may be a latch type relay having three leaves, two of which may be normally closed and one of which may be normally open. The lead 78 may be attached, through one of the normally closed leaves, to a side of the coil of the relay 72. The other side of the coil of the relay 72, as already pointed out, is attached to the lead 68, which carries plate current from the circuits of the cells 18. When, subsequent to operation of the time delay relay 77, a horse passes between the cells 18 and the lamps 69, the relay 72 may be actuated. Actuation of the relay 72 opens the normally closed leaf connected to the coil of the relay to remove the lead of the relay from the plate circuit of the cells 18.

The other normally closed leaf of the relay 72 is connected in series in a circuit for controlling the sweep second hands 33 of the clocks 16. The sweep second hands 33 are controlled by a circuit which includes leads 80 and 81 attached to the clocks 16. The lead 80 may be connected in series with the aforementioned normally closed leaf of the relay 72, a lead 83, a normally closed leaf of the relay 73, a lead 84, a normally closed leaf of a relay 86, and the main power lead 12. The lead 81 may be connected in series with a normally closed leaf of a relay 87, a lead 88, a normally closed leaf of a relay 89, a lead 91, and the main power line 10. When any one of the relays 72, 73, 86, 87, and 89 is actuated, the circuit through the leads 80 and 81 may be broken and the sweep second hands 33 may be stopped. Thus, when the relay 72 is actuated by horses passing the finish line for a second time, the sweep second hands 33 of the clocks are stopped.

The normally open leaf of the relay 72, when closed, may light a lamp 92 at the finish line to indicate that the time shown by the sweep second hands 33 of the clocks 16 is the time of passing the finish line the second time, i. e., for the half mile. One side of the lamp 92 may be attached to the main power lead 10, while the other side of the lamp 92 may be attached, through a lead 93 and the normally open leaf of the relay 72, to the main power lead 12, and the lamp 92 may be illuminated upon actuation of the relay 72.

When the horses pass the finish line for the last time before the finish of the race, a double pole single throw switch 94 may be engaged to connect leads 96 and 98 to the main power lead 10. The lead 96 may be connected to one side of a release coil 99 for the relay 72. The other side of the coil 99 is attached to the main power lead 12. The lead 98 is attached to a side of the coil of a thermal time delay relay 101. The other side of the coil of the relay 101 is attached to the main power lead 12. Upon engagement of the switch 94, the relay 72 is released to extinguish the lamp 92 and restore the circuit to the sweep second hands 33 of the clocks 16. At the same time, the thermal delay relay 101 starts to function, and after a sufficient time delay to permit all horses to pass the finish line, the relay 101 may engage.

When the relay 101 is engaged, a side of the coil of the relay 73 is attached to the lead 66. The relay 73 is a finish line relay. It may be of a latch type having two normally closed leaves and a normally open leaf. The other side of the coil of the relay 73, as already pointed out, is attached to the lead 68, which carries plate current from the circuit of the cells 18. When the first horse passes the finish line for the final time, the relay 73 is actuated. A lead 102 may be linked to the main power lead 12 when the normally open leaf is closed. The lead 102 is attached to a side of an illuminated sign 103, shown schematically, which may be lighted at the finish of the race. The other side of the sign 103 is attached to the main power line 10, and the finish sign 103 may be lighted upon actuation of the relay 73.

As already pointed out, one of the normally closed leaves of the relay 73 is attached in series with the main clock circuit and the other normally closed leaf is connected in series with the sweep second circuit. The lead 76 of the main clock circuit joins a normally open leaf of the relay 71 and a normally closed leaf of the relay 73. When both these leaves are closed, after actuation of the relay 71 and before actuation

of the relay 73, the lead 76 may be connected to the main power lead 10 through the relay 71, and also may be connected to a lead 104 through the relay 73. The lead 104, in turn, is attached to a side of the main circuit of each of the clocks 16. The other side of the main circuit of each of the clocks is attached to a lead 105, which lead 105 is attached to the main power lead 12. Only after the main starting relay 71 has been actuated and before the finish relay 73 is actuated do the clocks 16 operate. Upon actuation of the relay 73, both the main circuit of the clocks 16 and the sweep second circuit of the clocks 16 are stopped and the finish sign 103 is illuminated to indicate the finish of a race.

After the finish of a race, the various relays and clocks must be reset before a new race can be started. A release coil 106 is provided for releasing the finish relay 73. The release coil 106 may be energized upon the closing of a push button 107. One side of the coil 106 is attached to the main power lead 12, and the other side of the coil is attached to a side of the push button 107. The other side of the push button is attached to the main power lead 10. Upon closing of the push button 107, the release coil 106 may be energized to release the latch of the relay 73. A release coil 108 serves to release the main starting relay 71. A side of the release coil 108 is attached to the main power lead 12. The other side of the release coil 108 is attached to a side of the push button 109. The other side of the push button 109 is attached to the main power lead 10. When the push button 109 is closed, the latch of the relay 71 may be released.

A clock reset circuit is actuated by a push button 112. One side of the push button 112 is attached to the main power lead 12. The other side of the push button 112 is attached to a lead 113, which lead 113 is attached to resetting mechanism of the clocks, not shown in detail. The other side of the clock resetting mechanism is attached, by means of a lead 114, to the main power line 10. Upon closing of the push button 112, all the clocks may be reset.

A gate release push button 116 provides for resetting the circuit 21 prior to the start of a race. One side of the push button 116 is attached to the main power lead 10, while the other side of the push button 116 is attached, by means of a lead 117, to a side of each of two relay release coils 118 and 119, provided for releasing the relays 56 and 62 respectively. The other side of each of the release coils 118 and 119 is attached to the main power lead 12. When the push button 116 is closed, both the relay 56 and the relay 62 may be released.

Provision is made for preventing premature operation of one of the relays of the circuits 14 and 19 by a balking horse which may refuse to proceed with the rest of the horses. A balk push button 121 is provided, which can disconnect the lead 66 from the main power lead 12 if a balking horse interferes at the starting line. One side of the balk push button 121 is attached to the main power lead 12. The other side of the balk push button 121 is attached to the lead 63. When the push button 121 is closed, the relay 56 opens, and a balking horse cannot cause premature actuation of the relay 72 or of the relay 73.

For better understanding of the timing device as used for timing the start and finish of a one mile race, reference is made to Figure 3. In Figure 3, a horse racing track is indicated schematically at 125. A truck 126 or the like carries a starting gate 127, which is carried ahead of horses 128 at the start of a race. The gate 127 may be of usual construction having outwardly extending wings 129 which may be folded inwardly after a race has started. After the start, the truck 126 can move along the track at a greater speed than the horses 128 and can leave the track 125 through a side drive 131, while the horses proceed along the track. As shown, the photoelectric cells 18, 58, and 51 may be located in order on a side of the track 125 at and near the finish line 132, indicated by a dotted line, between the cells 18 and the lamps 69. The cells 18 and lamps 69 may be located on opposite sides of the track 125. The cell 58 may be located a short distance, for example a foot, along the track beyond the finish line 132 and cells 18, and the lamp 60 may be located an equal distance along the track 125 beyond the finish line 132 and on the opposite side of the track from the cell 58. The distance between the finish line 132 and the lamp 60 and cell 58 may be just sufficient to permit the truck 126 and gate 127 to pass between the lamp 60 and the cell 58 before a horse passes the finish line 132 for the first time. The lamp 53 and cell 51 may be located a convenient short distance along the track 125 beyond the lamp 60 and the cell 58 and on opposite sides of the track. The distance between the cells 58 and 51 and the distance between the lamps 60 and 53 may be any suitable distance but should not be as great as the effective length of the truck 126.

Nine-sixteenths mile race start and finish timing mechanism

When the selector switch 13 is positioned to the left, the device may be used to time a race for nine-sixteenths of a mile, and when the switch 13 is positioned to the right, the device may be used to time a race for a mile and one-sixteenth. For timing the start of these races, the circuits 20 and 22 are employed. For timing a race for nine-sixteenths of a mile, the switch 13 is positioned to the left to illuminate the lamp 39 and to connect leads 135 and 136 with the main power lead 10.

The lead 136 is attached to a side of the circuit of a photoelectric cell 137, which is in the circuit 22. A lamp 138, connected between the main power leads 10 and 12, supplies a light beam for the cell 137. When the light beam between the lamp 138 and the cell 137 is broken, current in a plate lead 139 of the circuit of the cell 137 may be changed. The plate lead 139 is attached to a side of the coil of a normally open latch type relay 141. The other side of the coil of the relay 141 is attached to the main power lead 12. When the light beam between the lamp 138 and the cell 137 is broken, the relay 141 closes.

Closing of the relay 141 completes a circuit between the anode of a photoelectric cell 142 and a resistance 143 in the circuit of the cell 142. Opposite sides of the circuit of the cell 142 are continuously connnected to the main power leads 10 and 12. A lamp 144 attached across the main power leads 10 and 12 supplies a light beam for the cell 142. When the light beam strikes the cell 142, after the relay 141 has been closed, current in a plate lead 146 of the circuit of the cell 142 is changed. The lead 146 is attached to one side of the coil of a normally closed latch type relay 147. The other side of the coil of the relay 147 is attached to the main power lead 10. When the current in the plate lead 146 is changed in response to light from the lamp 144 striking the

cell 142, the relay 147 may be opened. Opening of the relay 147 disconnects a lead 148 from the main power lead 12. The lead 148 is attached to a side of the coil of a normally closed relay 149, which is in the circuit 20. The other side of the coil of the relay 149 is attached to the main power lead 10, and, as long as the relay 147 is closed, the relay 149 is held open. A lead 151 is connected to the main power lead 10 when the relay 149 is closed. The relays, cells, etc. of the circuit 22 perform the same function at the start of a nine-sixteenths mile race as does the circuit 21 at the start of a mile race to permit initiation of the timing mechanism only after the starting gate has crossed the starting line.

The lead 135 which, as already pointed out, is connected to the main power lead 10 when the switch 13 is positioned to the left, is attached to a side of the coil of a two leaf normally open relay 152. The other side of the coil of the relay 152 is attached to the main power lead 12, and the relay 152 is closed when the switch 13 is positioned to the left. When both the relay 149 and the relay 152 are closed, a lead 153 is connected through the relays 152 and 149 and the lead 151 to the main power lead 10. The lead 153 is connected to a normally closed leaf of a relay 154.

The relay 154 is a main starting relay for a nine-sixteenth mile race and may be of a latch type and may have two normally open leaves and one normally closed leaf. One side of the coil of the relay 154 is attached to the normally closed leaf of the relay 154. The other side of the coil of the relay 154 is attached to a lead 156 which is a plate lead from a bank 157 of photoelectric cells 158. Each of the cells 158 has associated with it an appropriate circuit for producing a change of current in the plate lead 156 when the light to one of the cells 158 is cut off. The circuit of each of the cells 158 may be essentially similar to the circuit of each of the cells 18 at the finish line. With each of the cells 158 is associated a lamp 159 which can direct a beam of light toward one of the cells 158.

The cells 158 and the lamps 159 may be on opposite sides of the track at the starting line 161 for a nine-sixteenths mile or for a mile and one-sixteenth race, as shown in Figure 3. The cells 158 and the lamps 159 may be mounted in vertical banks, a lamp 159 opposite each cell 158 on opposite sides of the track 125. Three cells 158 and three lamps 159 are shown but additional similar lamps and cells may be added, if desired, to ensure breaking of a beam by the nose of a horse as it passes the starting line 161. The cell 142 and the lamp 144 may, as shown, be mounted on opposite sides of the track a short distance along the track beyond the starting line 161, the distance being only sufficient to permit the starting gate 127 to pass the beam of light between the lamp 144 and the cell 142 before the first horse crosses the starting line 161. The lamp 138 and cell 137 may be mounted on opposite sides of the track a suitable distance further down the track but a distance from the lamp 144 and the cell 142 which is less than the length of the truck 126.

When a horse passes the starting line 161, after the beam of light to the cell 137 has been broken and a beam of light has struck the cell 142 in sequence, the beam of light between one of the lamps 159 and one of the cells 158 may be broken to change the current in the lead 156 (Figure 1). The lead 156 is attached to a side of the coil of the relay 154. The other side of the coil of the relay 154 is attached to the normally closed leaf of the relay, and, as already pointed out, this leaf, when closed, connects the other side of the coil with the lead 153 which, through the relays 149 and 152 and the lead 151, is connected to the main power lead 10. When the light beam to one of the cells 158 is broken, the relay 154 may be actuated. When the relay 154 is actuated, the normally closed leaf is opened to disconnect the coil of the relay from the main power lead 10 and remove the load of the relay 154 from the plate lead 156. At the same time, the normally open leaves close to connect leads 162 and 163 to the main power lead 10. The lead 162 is attached through the lead 98 to a side of the coil of the thermal time delay relay 101 in the circuit 14. As already pointed out, the other side of the relay 101 is attached to the main power lead 12, so that the relay 101 may close a predetermined time after the start of the race to energize the main finish relay 73 after the horses have passed the finish line for the first time. The lead 163 is connected through a normally open leaf of the relay 152, the lead 76, and a normally closed leaf of the relay 73 to the lead 104, which, as already pointed out, is on one side of the main starting and stopping circuit of the clocks 16, and the clocks 16 may be started upon actuation of the relay 154.

Once a nine-sixteenths mile race has started, the clocks 16 can continue in operation until the main finish relay 73 operates to break the main clock circuits by disconnecting the lead 104 from the lead 76. After the start of a race, the circuits 20 and 22 have no further operation. When the horses pass the finish line for the first time, the finish line circuits 14, 17, 19, and 21 do not function, and the thermal time delay relay 101 may be set at a delay to close only after the horses have passed the finish line for the first time but before they can pass for the second time, for example a time thirty seconds after the start. When the first horse passes the finish line for the second time, the relay 101 can have closed to attach the lead 66 to one side of the coil of the relay 73. As already pointed out, the lead 66 is connected to the main power lead 12 through the normally closed relay 64, and thus the side of the relay 73 may be attached to the main power lead 12 as long as the relays 64 and 101 are closed. The other side of the relay 73 is attached to the plate lead 68 of the circuits of the cells 18, and when the horses pass the finish line for the second time, the relay 73 may be actuated to stop the clocks 16 and light the finish sign 103 in the same manner as at the finish of a mile race. The relays 71 and 72 may be unaffected at the finish of a nine-sixteenths mile race because the relay 49, which energizes the relay 71, and the thermal time delay relay 77, which energizes the relay 72, are not closed.

In the event that it is desired to prevent the functioning of the relays 154 as soon as a horse can pass the nine-sixteenths mile starting point, a nine-sixteenths mile and mile and one-sixteenth balk button 165 may be closed. The push button 165 can connect the main power lead 12 with the lead 148 which, as already pointed out, is attached to a side of the relay 149. The other side of the relay 149 is attached to the main power lead 10, and when the push button 165 is closed, the relay 149 is opened to disconnect the lead 151 from the main power lead 10.

A gate release button 167 may be provided for resetting the relays 141 and 147 in the circuit

22. When the push button 167 is closed, the main power lead 10 is connected to a lead 168, which lead 168 is connected to a side of each of two release coils 169 and 171 associated respectively with the relays 141 and 147. The other side of each of the coils 169 and 171 is attached to the main power lead 12, and both of the relays 141 and 147 may be released and reset by closing the push button 167.

A nine-sixteenths mile release button 172 serves to energize a release coil 173 associated with the relay 154. The push button 172 connects one side of the coil 173 with the main power lead 10. The other side of the coil 173 is attached to the main power lead 12, and the relay 154 may be released by closing the push button 172.

Mile and one-sixteenth race start and finish timing mechanism

A mile and one-sixteenth race requires much the same circuits as the nine-sixteenths mile race. When a race of this distance is to be timed, the selector switch 13 is positioned to the right to light the signal lamp 39b and to connect the main power lead 10 with the lead 136 and with a lead 174.

The lead 174 is attached to a side of the coil of a two leaf normally open relay 176. The other side of the coil of the relay 176 is connected to the main power lead 12, and the relay 176 is closed when the switch 13 is positioned to the right. The circuit 22 is energized through the lead 136 in the same manner as described with reference to a nine-sixteenths mile race.

When a race of a mile and one-sixteenth is to start, the cells 137 and 142 may operate in sequence in the manner already described in connection with the start of a nine-sixteenths mile race to permit the relay 149 to close connecting the lead 151 to the main power lead 10. The lead 151 is connected through a leaf of the relay 176 to a lead 177, which lead 177 is attached to a side of a normally closed leaf of a relay 178.

The relay 178 is a main starting relay for a mile and one-sixteenth race. The other side of the aforementioned normally closed leaf of the relay 178 is attached to a side of the coil of the relay 178, and the other side of the coil of the relay 178 is attached to the plate lead 156 of the circuits of the cells 158 so that when the relays 176 and 149 are closed, the relay 178 may be actuated as the beam of light to one of the cells 158 is broken.

The relay 178 may be a latch type relay having the one normally closed leaf already described and two normally open leaves. When the relay 178 is actuated, the normally open leaves of the relay close to connect the main power lead 10 to leads 179 and 181 and at the same time the normally closed leaf opens to remove the load of the relay 178 from the plate circuit.

The lead 179 is connected through the lead 74 to a side of the coil of the thermal time delay relay 77 in the circuit 14. The other side of the coil of the thermal time delay relay 77 is attached to the main power lead 12, and the relay 77 may be set in operation with a sufficient delay to permit the horses to proceed past the finish line for the first time before the relay 77 closes, for example 45 seconds after the start of a race. After the relay 77 has been set in operation, the timing of the race at the finish line can proceed in the manner described in connection with a one mile race, and the relays 72, 101, and 73 and the switch 94 may function in the manner already described.

The lead 181 is attached through a leaf of the relay 176, the lead 76, and a normally closed leaf of the relay 73 to the lead 104 to start the clocks 16 when the relay 178 is closed.

The push button 165 can be used to prevent activation of the relay 178 upon breaking of a light beam to one of the cells 158, if desired, in a manner similar to that described in connection with a nine-sixteenths mile race. The push button 165 can energize the relay 149 to break the contact between the lead 151 and the main power lead 10 to cut off the power supply for the coil of the relay 178 preventing activation of the relay 178 as long as the push button 165 is closed.

The gate release button 167 can be used at the end of a mile and one-sixteenth race to release the relays 141 and 147 in the same manner as described with relation to a nine-sixteenths mile race.

A push button 182 serves to actuate a release coil 183 associated with the relay 178. One side of the push button 182 is attached to the main power lead 10 while the other side of the push button 182 is attached to a side of the release coil 183. The other side of the coil 183 is attached to the main power lead 12, and the coil 183 may be energized when the push button 182 is closed to release and reset the relay 178.

Timing of one-eighth, one-quarter, and three-eighths mile positions

At points one-eighth mile, one-quarter mile, and three-eighths mile from the starting line 132 (Figure 3) may be located devices for recording the time of the race at these points, and the circuits 23, 24, and 26 may be actuated as the horses pass points located respectively one-eighth mile, one-quarter mile, and three-eighths mile from the starting line 132. The relays 86, 89, and 87, located respectively in the circuits 23, 24, and 26, are connected in series between leads 80 and 81 in a circuit (Figure 5) which stops the sweep second hand 33 (Figure 2) of the clocks 16 when any one of the relays 86, 87 and 89 is opened.

The circuits 23, 24, and 26 are similar, and only the circuit 23 will be described in detail. Corresponding parts of the circuits 24 and 26 have been indicated with the same numbers as the parts of the circuit 23, but the letter *a* has been added to designations of parts of the circuit 24 and the letter *b* has been added to the designations of parts of the circuit 26.

The circuit 23 includes photoelectric cells 185. Each of the cells 185 has associated with it a suitable circuit which may be similar to the circuit associated with each of the cells 18 in the circuit 17. Opposite sides of the circuit of each cell 185 are connected to the main power leads 10 and 12. Light beams for the cells 185 are provided by lamps 186 which are mounted across the main power leads 10 and 12. A plate lead 187 attached to the circuit of each of the cells 185 can provide a current which is changed when the light beam to one of the cells 185 is broken. The lead 187 is attached to a side of the coil of the relay 86. The other side of the coil of the relay 86 is connected through a normally closed relay 188 to the main power line 10. When the beam between one of the lamps 186 and one of the cells 185 is broken, the relay 86 may be actuated if the relay 188 is closed.

The relay 86 may be of the latch type and may include a normally open leaf and a normally

closed leaf. It is the normally closed leaf which is in the circuit of the sweep second hands of the clocks 16 so that when the relay 86 is actuated, the sweep second hands may be stopped. The normally open leaf of the relay 86 serves to connect a lead 189 with the main power lead 12 when the relay 86 is actuated. The lead 189 is attached to a side of a lamp 191, which, if desired, may be mounted at the one-eighth mile post. The other side of the lamp 191 is attached to the main power lead 10, and the lamp 191 may be lighted when the relay 86 is actuated.

The relay 188 provides a means for preventing premature actuation of the relay 86 in the event that a horse balks at or near the one-eighth mile post. A push button 192 is provided to actuate the relay 188. One side of the push button 192 is attached to the main power lead 12. The other side of the push button 192 is attached to a side of the coil of the relay 188. The other side of the coil of the relay 188 is attached to the main power lead 10. When the push button 192 is closed, the relay 188 is opened to sever the connection between the main power lead 10 and the coil of the relay 86. Thus, the relay 86 cannot be actuated by a horse passing between the lamps 186 and the cells 185 if the push button 192 is closed.

After horses have passed the one-eighth mile post, the lamp 191 may be left burning and the sweep second hand 33 may remain stopped a sufficient time for it to be observed. Then a release button 193 may be pushed to energize a release coil 194 for release of the relay 86. One side of the push button 193 is attached to the main power lead 10 and the other side of the push button 193 is attached to a side of the coil 194. The other side of the coil 194 is attached to the main power lead 12. When the push button is closed, the coil 194 may be energized to release the relay 86 to extinguish the lamp 191 and reset the sweep second hands 33.

The lamps 186 and cells 185 may be arranged in vertical banks on opposite sides of the track 125 (Figure 3) with a lamp 186 opposite each cell 185 to define a series of vertically spaced beams across the track 125. If desired, additional lamps and cells may be added to ensure a beam at the height of a horse's nose.

At the quarter-mile post, the circuit 24 serves a similar purpose. When horses pass the quarter-mile post, they can break a beam of light between lamps 186*a* and cells 185*a* to cause actuation of the relay 89. Actuation of the relay 89 halts a second hand 33 of each of the clocks 16 and also lights the lamp 191*a* to indicate that the second hands 33 have been stopped to indicate time at the quarter mile post.

At the three-eighths mile post, the circuit 26 can operate in a similar manner to stop the sweep second hands 33 of the clocks 16 and light a lamp 191*b* for indicating that the time shown by the second hands is for the three-eighths of a mile.

The lamps 191, 191*a*, and 191*b* may be located at or near the one-eighth, one-quarter, and three-eighths mile posts, as shown, or may be located at any other point desired to identify the location for which time is recorded by the sweep second hands 33. The circuits 23, 24, and 26 operate wholly independently of the main clock circuit and control only the sweep second hands 33 of the clocks 16. Thus, even if a mistake is made and one of the relays 86, 87, and 89 is not properly reset, the timing of the entire race can be accurate.

Operation of the device for timing a one mile race

When a one mile race is to be timed, the selector switch 13 may be centrally positioned to light the signal lamp 39*a*, to close the relay 49, and to energize the circuit 21. If any of the lamps 191, 191*a*, and 191*b* is lighted, the appropriate release buttons 193, 193*a*, and 193*b* may be pushed to release the relays 86, 87, and 89. The push button 112 may be pushed to reset the clocks 16, and the start release push button 109, finish release push button 107, and gate release push button 116 may be pushed to release the relays 71, 73, 56, and 62, and the switch 94 may be disconnected to release the thermal time delay relay 101.

The mechanism is then ready for the start of a mile race. At the start of the race, the truck 126 (Figure 3) may precede the horses 128 across the starting line 132. As the truck intercepts the beam of light between the lamp 53 and the cell 51, the relay 56 closes (Figure 1). Then, when the starting gate 127 crosses the starting line 132, the relay 62 opens to permit the relay 64 to close. Thereafter, when the first horse passes the finish line 132, the relay 71 is actuated to start the clocks 16 and to initiate the operation of the time delay relay 77. An appropriate time interval after the start of the race, the relay 77 closes to permit actuation of the relay 72 the next time the horses pass the finish line. If a horse balks or remains at or near the starting line an unusually long time so that it may cross the finish line after closing of the time delay relay 77 but before the horses have gone around the track for the first time, the balk push button 121 may be closed to prevent premature activation of the relay 72 before the horses can reach the finish line for the second time.

When the horses pass the one-eighth mile post, the relay 86 is actuated to stop the sweep second hands 33 of the clocks 16 and to light the lamp 191. The sweep second hands indicate the time required by the horses to travel the one-eighth mile, and the lamp 191 serves to indicate that the time shown by the sweep second hands is for the one-eighth mile. The sweep second hands 33 may remain stopped and the lamp 191 may remain lighted as the horses proceed from the one-eighth mile post toward the one-quarter mile post for a sufficient time to permit ready observation. Then, before the horses reach the one-quarter mile post, the one-eighth mile release push button 193 may be closed to release the relay 86 and complete the circuits required to energize the leads 80 and 81 causing the sweep second hands 33 to realign with the second hands 32 (Figure 2) of the clocks 16. Then, when the horses reach the one-quarter mile post, the relay 89 may be actuated to light the lamp 191*a* and again break the circuit controlling the sweep second hands 33 of the clocks 16 stopping the sweep second hands. If a balking horse remains at or near the one-eighth mile post an unusually long time, the one-eighth mile balk push button 192 may be closed to prevent premature halting of the sweep second hands.

As the horses pass the one-quarter mile post and the three-eighths mile post, operation is similar to that already described for the one-eighth mile post.

Before the horses pass the finish line for the second time, the thermal time delay relay 71 may have time to close to connect one side of the coil

of the relay 72, through the lead 66, to the main power lead 12. When the horses pass the finish line for the second time, the relay 72 can operate to light the lamp 92 and stop the sweep second hands 33 of the clocks 16. After the horses pass the finish line for the second time but before the horses reach the one-eighth mile post for the second time, the switch 94 may be connected to release the relay 72, extinguishing the lamp 92 and reenergizing the sweep second circuit leads 80 and 81, and to initiate operation of the thermal time delay relay 101.

Thereafter, the operation at the one-eighth, one-quarter, and three-eighth mile posts as the horses pass for the second time repeats the operation during the first time around the track.

Before the horses can pass the finish line for the third and last time, the thermal time delay relay 101 has sufficient time to operate to permit energizing of the coil of the relay 73. When the first horse passes the finish line for the third time, the relay 73 can close to light the illuminated finish sign 103 and to halt all the hands of the clocks 16 indicating the time for the mile race.

In the event a horse balks near the starting line for a sufficient time to permit operation of the time delay relay 101, the balk push button 121 may be closed to prevent premature operation of the relay 73.

Operation of the device for timing a nine-sixteenths mile race

When a nine-sixteenths mile race is to be timed, the selector switch 13 is positioned to the left to light the signal lamp 39, to close the relay 152, and to energize the circuit 22. Release buttons 193, 193*a*, and 193*b* may be closed momentarily to ensure release of the relays 86, 87, and 89. The push button 112 may be pushed to reset the clocks 16, and the release buttons 172, 167, and 107 may be pushed to release the relays 154, 141, 147, and 73, and the switch 94 may be reset to release the thermal time delay relay 101.

The mechanism is then ready for timing the start of a nine-sixteenths mile race. As the truck 126 intercepts the beam of light between the lamp 138 and the cell 137, the relay 141 closes. Then, when the starting gate 127 crosses the starting line 161, the relay 147 is opened to permit the relay 149 to close. Thereafter, when the first horse passes the finish line 132, the relay 154 may be actuated to start the clocks 16 and to initiate the operation of the thermal time delay relay 101. Only after the horses have passed the finish line for the first time does the relay 101 close to permit energizing of the relay 73. Operation as the horses pass the various fractional mile posts is the same as for a mile race. When the horses pass the finish line for the second time, the relay 73 is actuated to halt the clocks 16 and to light the illuminated finish sign 103 in the same manner as for a mile race.

Operation of the device for timing a mile and one-sixteenth race

Prior to the start of a mile and one-sixteenth race, the release buttons and switch 94 are operated, as prior to a nine-sixteenths mile race, to release the various relays and reset the clocks. In addition, the release push button 182 may be closed momentarily to release the relay 176.

The selector switch 13 is positioned to the right to light the signal lamp 39*b*, to close the relay 176, and to energize the circuit 22. The operation of the relays 141 and 147 during passage of the truck 126 and the starting gate 127 by the starting line 161 is the same as for the nine-sixteenths mile race. After the starting gate 127 has passed the starting line 161, when a horse crosses the starting line, the relay 178 may be actuated to start the clocks 16 and to initiate the operation of the thermal time delay relay 77. After the horses have passed the finish line for the first time, the operation of the device follows the sequence set forth above for a one mile race, time being recorded at the fractional mile posts by the sweep second hands 33 of the clocks 16 and the clocks 16 being stopped and the sign 103 being lighted at the finish of the race.

Conclusion

As will be apparent, the timing device makes it possible for the time at each of several points about the track to be shown where readily visible to a large number of persons viewing a race while the race is in progress. The timing is automatic and may be fully accurate. No human factor enters the timing, and the timing may be much more accurate than is possible with manually operated stop watches.

The use of the time delay relays makes it possible to record the time of passage by the finish line at each of several times at which horses pass the finish line. The time delay relays permit the timing relay 72 and the finish relay 73 to be actuated only after horses have had time to pass the finish line. The delay permits horses which follow the first horse to pass the finish line without affecting the relays. The various balk switches are provided for use ordinarily only when a horse balks at the finish line or at a timing post for an unduly long time, whereupon the appropriate balk switch may be closed to prevent premature operation of the timing device.

The use of the manually operated switch 94 for initiating the operation of the time delay relay 101 for timing a mile and a mile and one-sixteenth race makes it possible to time longer races with the device. For example, if a mile and a half race were to be timed, horses could be started as for a mile race, but the horses could be permitted to pass the finish line three times before the switch 94 is closed. When a race of more than a mile and one-sixteenth is to be timed, the switch 94 may be in two parts, one of which may be a push button for energizing the release coil 99 to release the relay 78, while the other is a single throw switch for initiating the operation of the time delay relay 101. For long races, the time delay relay 101 may be started only after the horses pass the finish line for the last time prior to the finish of the race, while the release coil 99 may be energized each time the horses pass the finish line for resetting the second hands 33 after the horses pass the finish line.

The circuits 20 and 22 permit timing of a race which starts at a line other than the finish line. In the event that races were to be started at additional points, additional similar circuits may be added for use at starts at the additional points.

The device has been described particularly with reference to the timing of races for nine-sixteenths mile, one mile, and a mile and one-sixteenth on a half mile track. It will be apparent that the device may readily be adapted for timing races of other lengths and on tracks of various sizes.

The device has been described particularly for use with races in which a starting gate precedes

horses along the track at the start of a race, but the device can also be used with equal effect for timing races in which horses are started in other manners. If no starting gate is to precede the horses at a start, the circuits 21 and 22 may be omitted, or the relays of the circuits 21 and 22 may be left closed and the clocks may be started as the first horse crosses the starting line.

Many variations are possible in the construction of the device, and the invention is not intended to be limited by the foregoing detailed description and the drawings but only as set out in the appended claims.

What is claimed is:

1. The combination of a device for timing a race on a continuous track in which objects circle the track at least once and mechanism for energizing the timing device at a start of a race after starting apparatus crosses a starting line, the mechanism for energizing the timing device comprising, a first and a second photo-electric device, means for directing a separate light beam into each device, a first relay means operable when the light beam to the first photo-electric device is broken, a second relay means for operation when the second light beam strikes said second photo-electric device, said second relay means being operable after operation of said first relay means to energize the timing device, the light beam to said second photo-electric device crossing the track adjacent the starting line, the light beam to the first photo-electric device being at least as far along the track in the direction of the race as the beam to the second photo-electric device, the distance along the track between the light beams being less than the length of the starting apparatus, whereby the first relay means is operated as the starting apparatus starts to cross the light beam to the first photo-electric device, and the second relay is operated thereafter as the starting apparatus finishes crossing the light beam to the second photo-electric device to energize the timing device, the timing device comprising, a time indicating means, means for starting the time indicating means when a first object passes the starting line after operation of the second relay means, a time delay relay startable when said time indicating means is started, said time delay relay operating a sufficient time after the first object passes the starting line to permit all objects in the race to clear a finish line for an initial time before operation of said time delay relay, and means at the finish line for stopping the time indicating means, the means for stopping the time indicating means being operable after operation of the time delay relay as objects pass the finish line a final time.

2. In a device for timing a race on a continuous track in which objects circle a track a plurality of times and where a starting line and a finish line coincide, the combination of a photo-electric device, means for directing a light beam into said photo-electric device, said beam being at the starting line for the race, a first relay operable when the light beam is broken, a first time indicating means operable throughout the race and a second time indicating means arrestable at selected times during the race, means for starting both said time indicating means upon operation of said first relay, a first time delay relay, said first time delay relay being started upon operation of said first relay, said first time delay relay operating a sufficient time after operation of said first relay to permit all objects in the race to clear the starting line before the first time delay relay operates, a second relay operable when the light beam is broken after operation of the time delay relay to stop the arrestable time indicating means without stopping the first time indicating means, a second time delay relay, manually operable means for restoring said arrestable time indicating means in line with the first time indicating means and for starting said second time delay relay, a third relay operable when the light beam is broken, said third relay being operable after operation of the second time delay relay, the first time indicating means being stopped upon operation of said third relay to indicate the time of the race, a plurality of cooperating light beams and photo-electric devices disposed at spaced lines across the track, a plurality of intermediate latch type timing relays, one for each line, each of said intermediate timing relays being operable as one of the light beams is broken to stop the arrestable time indicating means, and means for resetting said intermediate timing relays and restoring said arrestable time indicating means in line with the first time indicating means.

3. In a device for timing a race on a continuous track in which race objects circle the track a plurality of times and where a starting line and a finish line coincide, the combination of a photo-electric device, means for directing a light beam into said photo-electric device, said beam being at the starting line for the race, a first relay operable when the light beam is broken, a first time indicating means operable throughout the race and a second time indicating means arrestable at selected times during the race, means for starting both said time indicating means upon operation of said relay, a first time delay relay, said first time delay relay being started upon operation of said first relay, said first time delay relay operating a sufficient time after operation of said first relay to permit all objects in the race to clear the starting line before said first time delay relay operates, a second relay operable when the light beam is broken after operation of the time delay relay to stop the arrestable time indicating means without stopping the first time indicating means, a second time delay relay, manually operable means for restoring said arrestable time indicating means in line with the first time indicating means and for starting said second time delay relay, a third relay operable when the light beam is broken, said third relay being operable after operation of the second time delay relay, the first time indicating means being stopped upon operation of said third relay to indicate the time of the race, a plurality of cooperating light beams and photo-electric devices disposed at spaced lines across the track, a plurality of intermediate latch type timing relays, one for each line, each of said intermediate timing relays being operable as one of the light beams is broken to stop the arrestable time indicating means, manually operated means for resetting said intermediate timing relays and restoring said arrestable time indicating means in line with the first time indicating means, and manually operated means for preventing premature operation of said relays.

4. In a device for timing a race on a continuous track in which objects circle the track at least once, the combination of a first photo-electric device, means for directing a first light beam into said photo-electric device, said beam

being at a starting line for the race, a first relay operable when the first beam is broken, a first time indicating means operable throughout the race and a second time indicating means arrestable at selected time during the race, means for starting both said indicating means upon operation of said first relay, a time delay relay, said time delay relay being started upon operation of said first relay, said time delay relay operating a sufficient time after operation of said first relay to permit all objects in the race to clear a finish line for an initial time before said time delay relay operates, a second photo-electric device, means for directing a second beam of light into said second photo-electric device, said second beam of light being at the finish line, a second relay operable when the second light beam is broken after operation of the time delay relay to stop the first time indicating means to indicate the time of the race, a plurality of co-operating photo-electric devices and light beams across the track disposed at spaced lines about the track, a plurality of latch type intermediate timing relays, one for each line, each of said intermediate timing relays being operable as one of the light beams is broken to stop the arrestable time indicating means, and means for resetting said intermediate timing relays and restoring said arrestable time indicating means in line with the first time indicating means.

5. In a device for timing a race on a continuous track in which objects circle the track at least once, the combination of a first photo-electric device, means for directing a first light beam into said photo-electric device, said beam being at a starting line for the race, a first relay operable when the first beam is broken, a first time indicating means operable throughout the race and a second time indicating means arrestable at selected times during the race, means for starting both said indicating means upon operation of said first relay, a time delay relay, said time delay relay being started upon operation of said first relay, said time delay relay operating a sufficient time after operation of said first relay to permit all objects in the race to clear a finish line for an initial time before said time delay relay operates, a second photo-electric device, means for directing a second beam of light into said second photo-electric device, said second beam of light being at the finish line, a second relay operable when the second light beam is broken after operation of the time delay relay to stop the first time indicating means to indicate the time of the race, a plurality of co-operating photo-electric devices and light beams across the track disposed at spaced lines about the track, a plurality of intermediate latch-type timing relays, one for each line, each of said intermediate timing relays being operable as one of the light beams is broken to stop the arrestable time indicating means, manually operated means for resetting said intermediate timing relays and restoring said arrestable time indicating means in line with the first time indicating means, and manually operated means for preventing premature operation of said relays.

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