Dec. 8, 1959 I. C. DAVEY 2,916,287

REMOTELY CONTROLLED FENCING SCORE REGISTER

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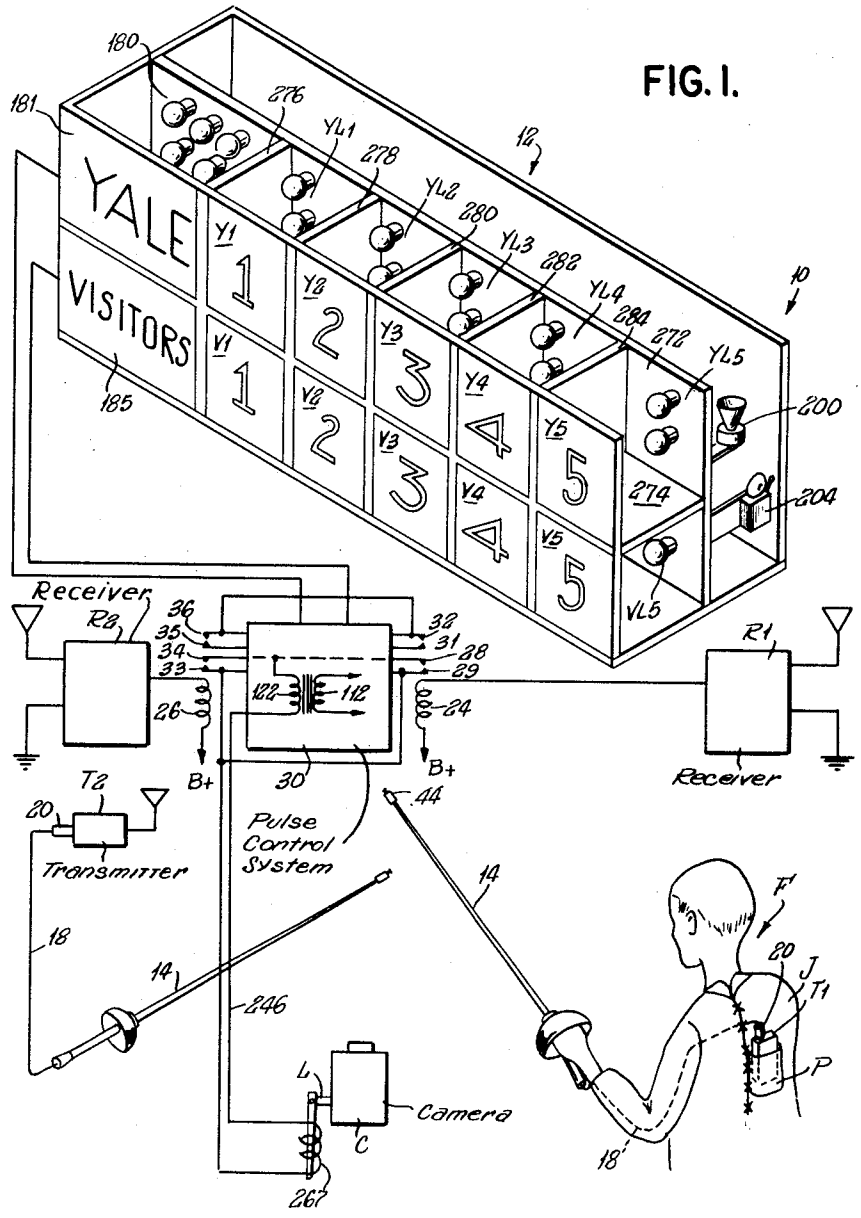
FIG. I.



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REMOTELY CONTROLLED FENCING SCORE REGISTER

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FIG. 2.

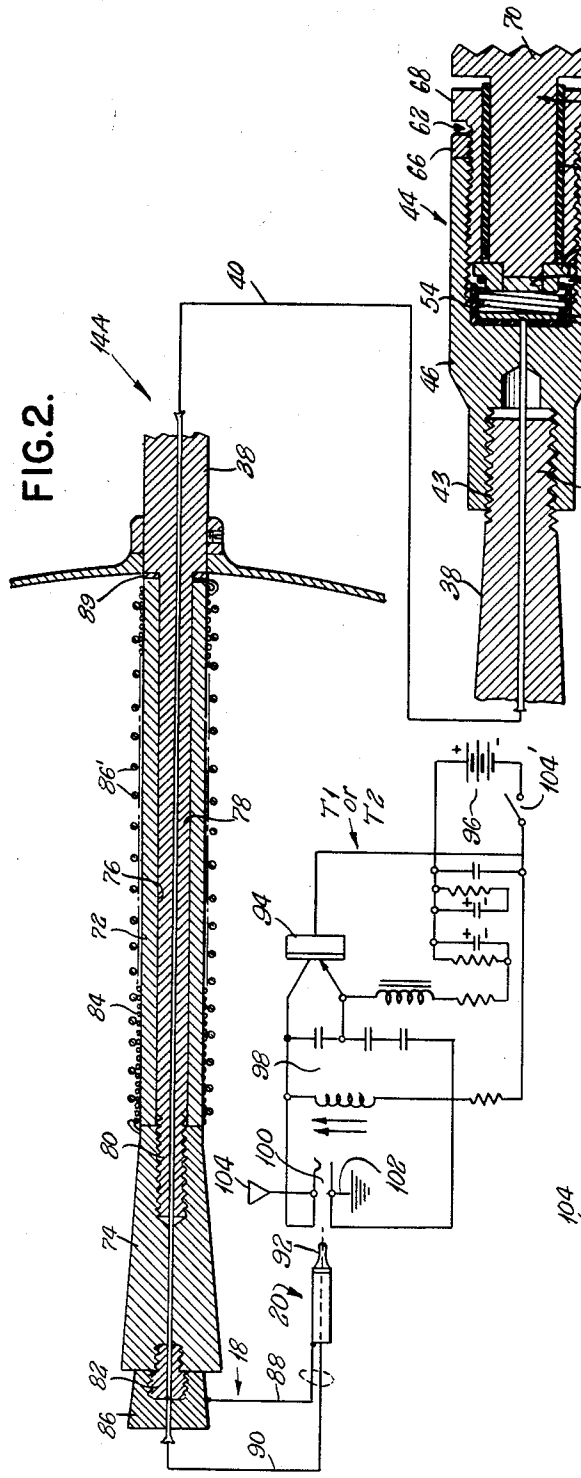

FIG. 3.

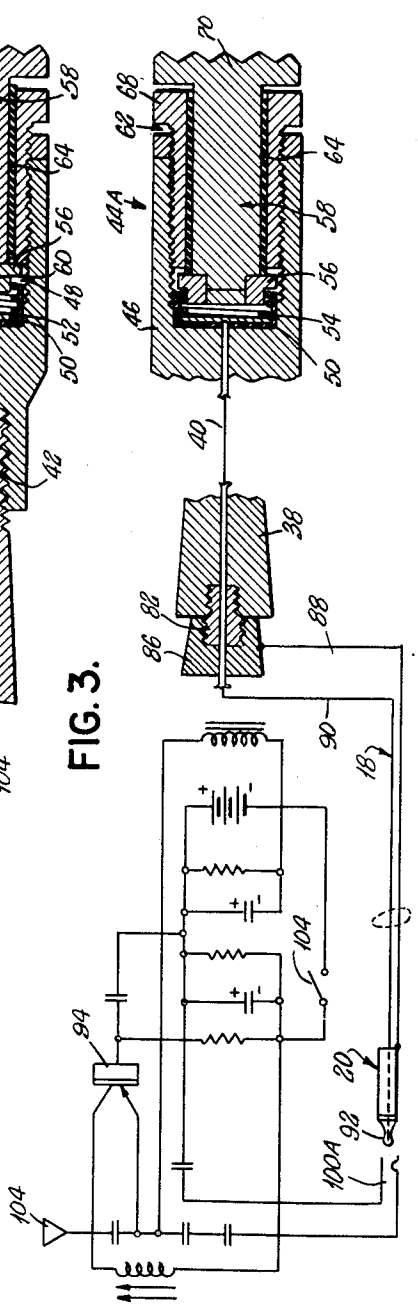

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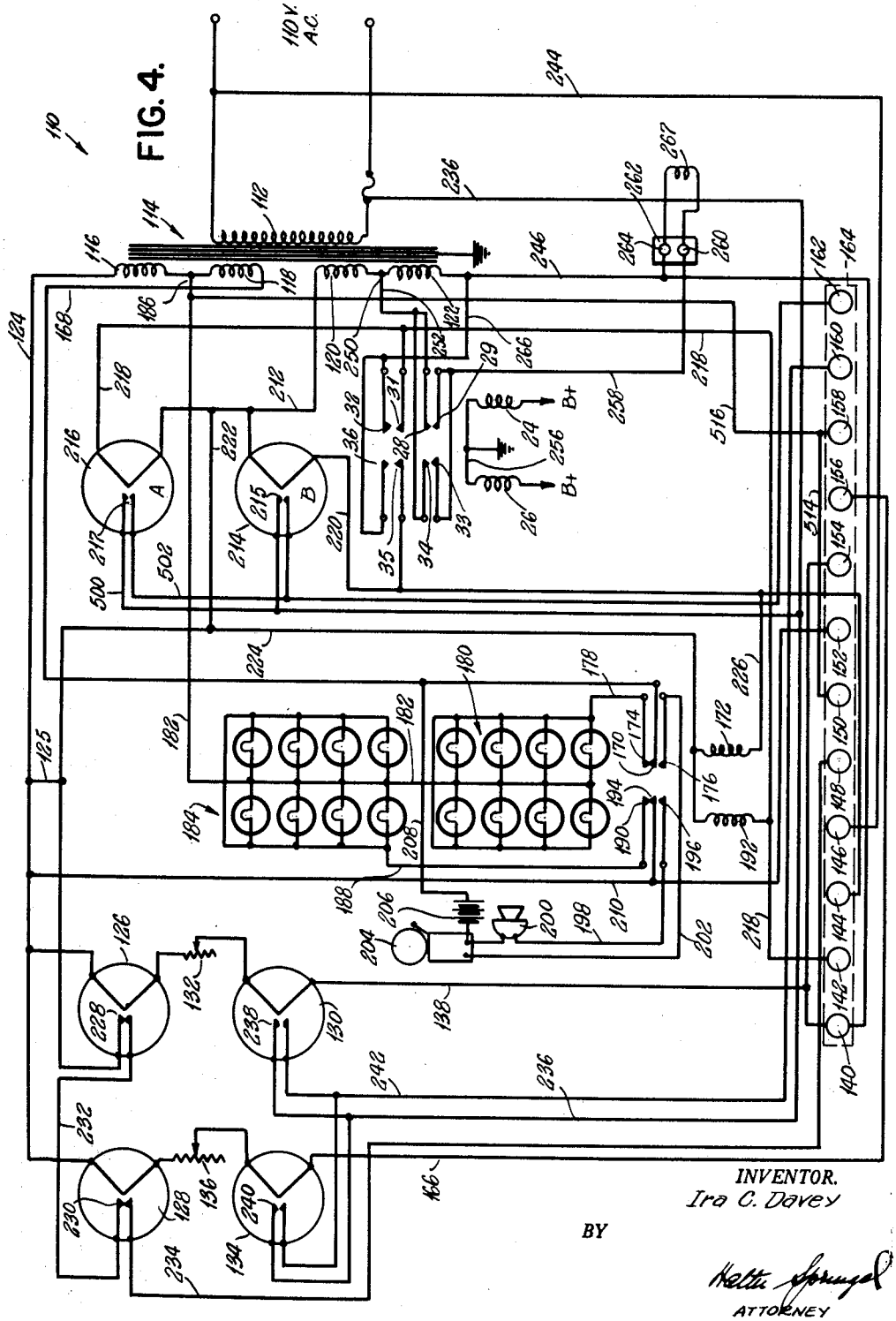
FIG. 4.



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REMOTELY CONTROLLED FENCING SCORE REGISTER

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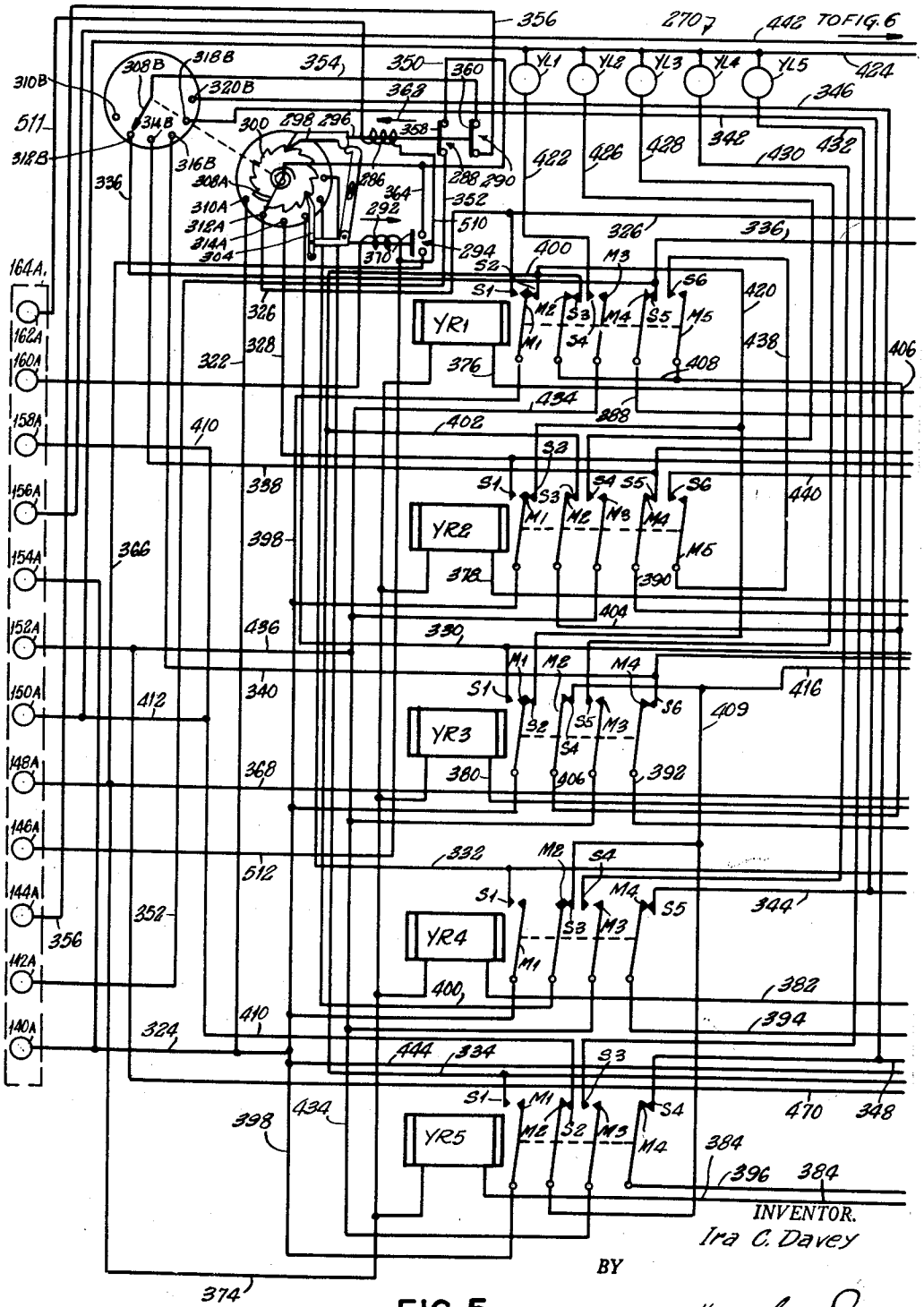

FIG. 5.

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REMOTELY CONTROLLED FENCING SCORE REGISTER

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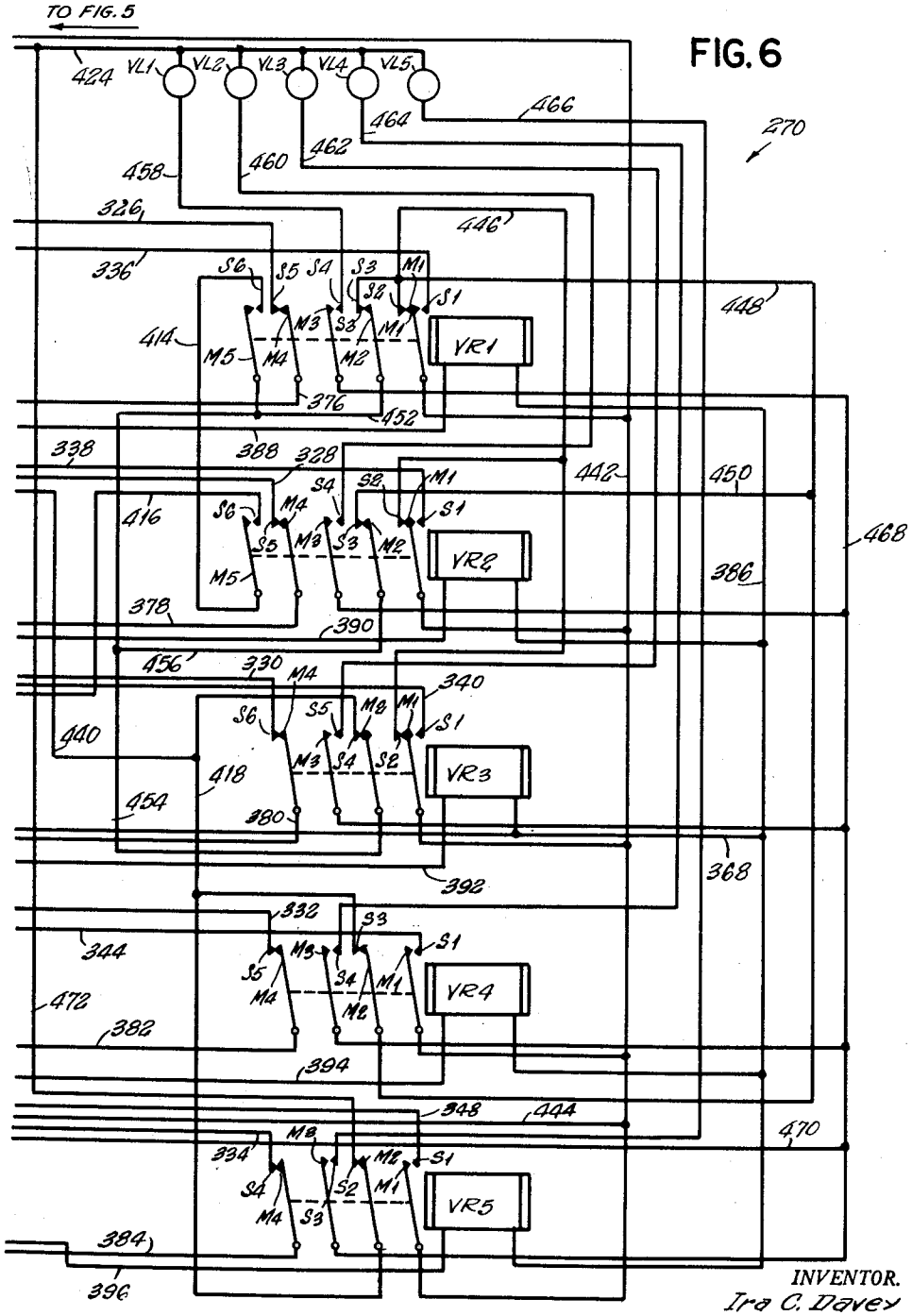

FIG. 6

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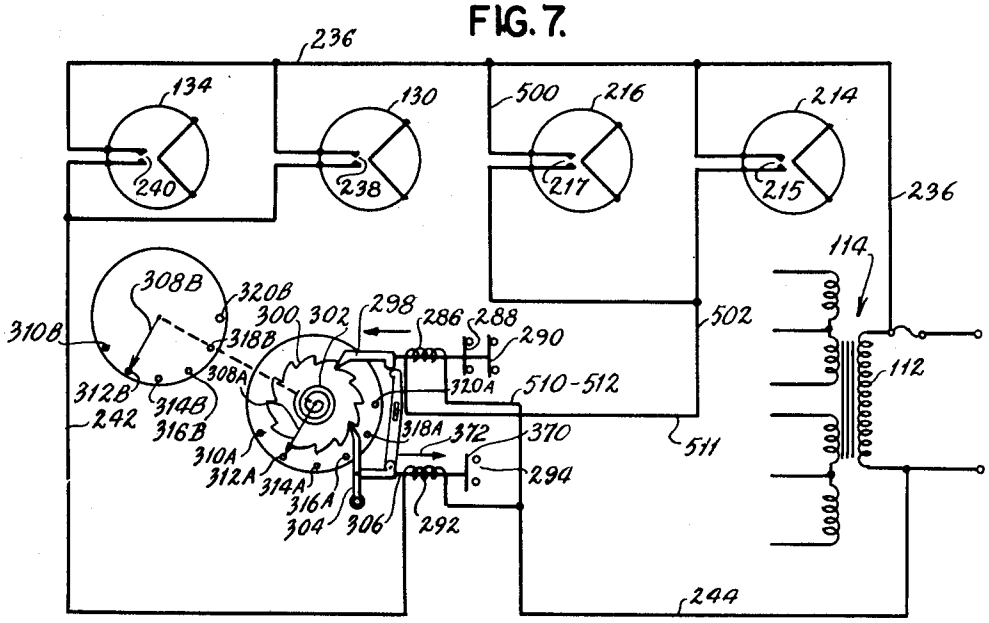
FIG. 7.



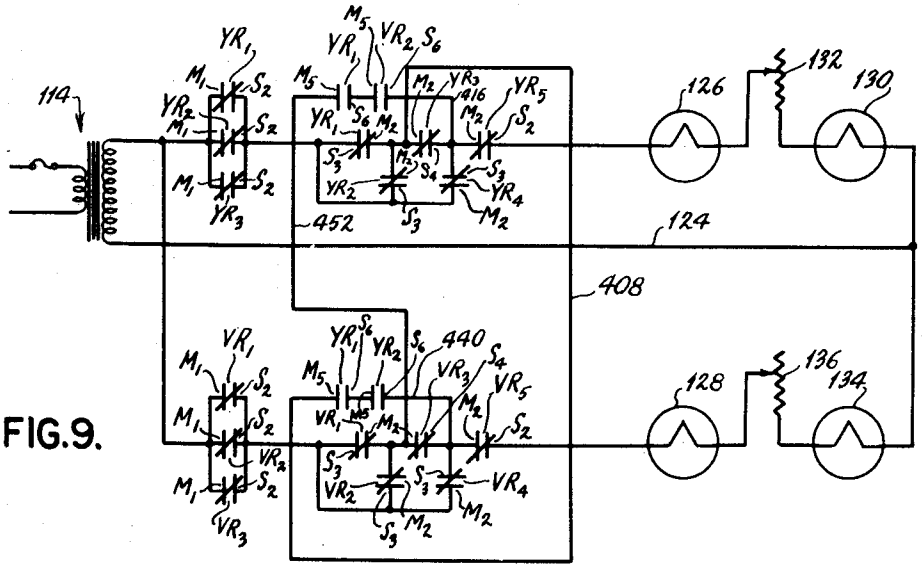


FIG. 9.

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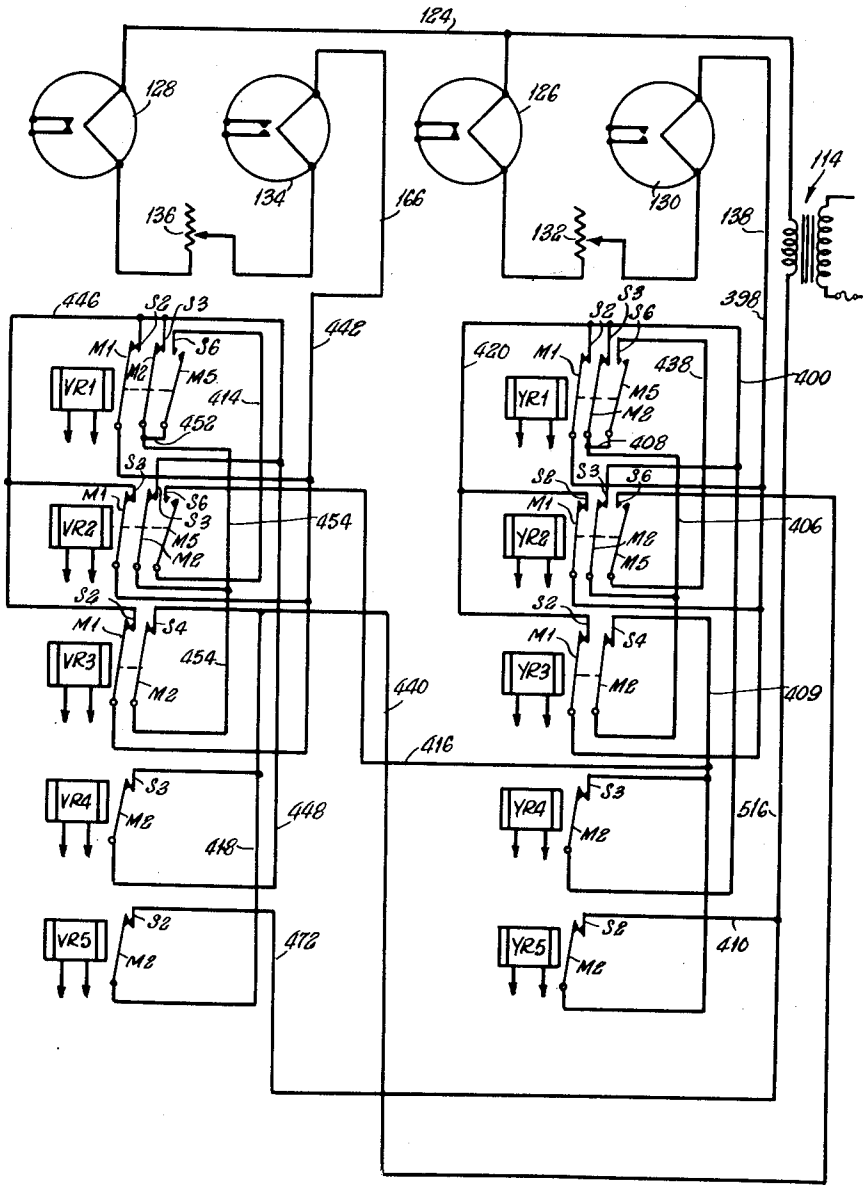
FIG. 8.



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United States Patent Office 2,916,287 Patented Dec. 8, 1959

2,916,287

REMOTELY CONTROLLED FENCING SCORE REGISTER

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Application March 14, 1956, Serial No. 571,551

4 Claims. (Cl. 273—1)

The present invention relates, in general, to the art of fencing and, in particular, to automatic scoring apparatus for use in the conventional sport of fencing, as in épée, for instance.

The usual procedure in fencing contests or épée matches is to have one or more judges who call the touch or score, and owing to the extreme speed of the foil or épée in the hand of an expert fencer, it is frequently difficult for the judges to determine whether a touch has been made or not. Also, in the case of two touches in rapid succession, the fencers themselves, and also the judges, often disagree as to who had made the first touch, and the spectators frequently disagree with both the fencers and the judges. Attempts have been made to record the touches electrically but such apparatus required the use of electric lines running from each fencer, which interfered with the fencers' movements during the match.

Therefore, the primary object of the present invention is to provide an automatic scoring apparatus for use in a fencing match which obviates the disadvantages of the prior art apparatus.

Another object is the provision of an automatic scoring apparatus which does not hinder the movements of the fencers.

Another object is the provision of an automatic scoring apparatus in which the need for electric lines running from the fencers to a score-board is obviated.

Another object is the provision of an automatic score-board which records the touches made during the match by each fencer and which, upon the occurrence of the winning touch, erases the score and name of the losing fencer from the score-board.

Another object is the provision of an electric score-board which provides both an audible and visual indication of each touch, the audible indications being distinguishable for each fencer, and which extinguishes the name of the touched fencer whenever a score is made.

Another object is the provision of an automatic scoring apparatus which, at the end of each match, provides an audible sound indicative of the winner of the match, and which thereafter automatically resets itself for the next match, providing an audible indication that the apparatus is reset and ready for the next match.

Another object is the provision of a foil for use in fencing or in épée, in combination with a transmitter to be carried on the person of the fencer, to transmit a pulse of radio frequency energy each time that a touch is made.

Another object is the provision of a scoring apparatus which will not indicate scores upon the occurrence of simultaneous touches, but will provide both an audible and visual indication of such touches.

A further object is the provision of means for operating a camera under the control of a fencing foil to provide a permanent recording of the touch.

Other and further objects of the present invention will be apparent from the following specification considered in connection with the drawings herein.

In the drawings, which illustrate the best mode presently contemplated of carrying out the present invention:

Fig. 1 is a more or less diagrammatic and schematic illustration of an automatic scoring apparatus for fencing or épée, pursuant to the present invention;

Fig. 2 illustrates a foil and transmitter assembly of the automatic scoring system, the foil being illustrated in longitudinal section with a portion thereof being omitted, the illustrated parts of the foil being drawn on different scales, and the transmitter being illustrated in schematic form;

Fig. 3 is a view similar to Fig. 2 and illustrates another form of foil and transmitter assembly;

Figs. 4, 5 and 6 constitute the complete schematic diagram of the pulse control and scoring system which operates under the control of the foil and transmitter assemblies, the terminals of Fig. 4 being interconnected with the terminals of Fig. 5, and the leads from the right side of Fig. 5 being continuous with the corresponding leads at the left side of Fig. 6, viewing said figures, the apparatus being illustrated in the energized condition thereof;

Fig. 7 illustrates the step and reset control circuit of the pulse control and scoring system;

Fig. 8 is a portion of the complete circuit and illustrates the inverse function three path zero continuity circuit of the pulse control and scoring system; and

Fig. 9 illustrates a simplified electrical equivalent for the circuit of Fig. 8.

Briefly described, the apparatus of the present invention, generally indicated by the reference numeral **10**, is adapted to automatically register, both visually and audibly, and to record the scores in a fencing match. In an épée match, the fencer who first touches his opponent three out of five times wins the match. The touchés or scores are indicated and recorded on a score-board **12** having a name panel and five score panels for each fencer. At the start of the match, the name panel for each fencer is illuminated. Whenever a fencer touches his opponent, the opponent's name panel is extinguished and one score panel for the successful fencer is illuminated. Provision is also made for an audible signal for each fencer, said signals differing in tone and, at each touché, the audible signal for the fencer who has scored is energized to allow the fencers to observe the visual indication of the score. In addition, provision is made for cameras which are operated at each touché to record the actual touch on the body of the fencer and the score indication for said touch. The match is terminated as soon as one fencer has scored three times on his opponent's body. When this occurs, the score panels are extinguished and an audio signal remains energized for a longer period than during the match. After a predetermined period, the apparatus is automatically reset for the next match, all score panels being extinguished and the name plates for each fencer being illuminated, the audible signals being momentarily energized to indicate that the apparatus is reset. Provision is also made to prevent the registry of scores if each fencer scores a touché at the same time. In such an event, both name panels are extinguished and both audio signals are energized, but no scores of the touchés are registered on the score-board **12**.

Referring now to Fig. 1 of the drawings in detail, each fencer F is provided with a foil or épée **14** (hereinafter described in detail) which is electrically connected to a conventional transmitter T which is carried on his person. As here shown each fencer wears a fencing jacket J provided with a rear pocket P in which his transmitter is carried. A twin conductor electric wire or cable **18** extends from the foil **14** through the sleeve of the jacket J and out of the rear of the jacket into a plug **20** through

which the transmitter is releasably connected to the foil. Each foil is provided with a tip 44. Whenever a fencer touches his opponent's body with his foil tip 44, his transmitter radiates a pulse of radio-frequency energy. Each transmitter operates on a different frequency.

Provision is made for a pair of receivers R1 and R2, receiver R1 being tuned to transmitter T1, and receiver R2 being tuned to transmitter T2. In the plate circuits of their output stages, the receivers are provided with the relay coils 24 and 26, respectively, which are energized when the associated receiver receives a pulse from the associated transmitter. When relay coil 24 is energized it closes the normally open relay contacts 28—29 and 31—32 in the pulse control system 30 to operate both the score-board assembly 12 and the camera C. Similarly, when relay coil 26 is energized, it closes the normally open relay contacts 33—34 and 35—36 in the pulse control system to operate both the score-board assembly 12 and the camera C.

Referring now to Fig. 2 in detail, there is illustrated one form of foil and transmitter assembly, pursuant to the present invention. The foil 14A has a metal blade 38 provided with a longitudinal groove for an insulated wire 40 which extends throughout the length of the blade. At the tip 42 thereof, the blade is threaded, as at 43, to threadedly receive a tip assembly 44. The assembly 44 is provided with a housing or outer casing 46, preferably formed of steel, and threaded on the tip 42. The housing 46 has a hollow interiorly threaded portion 48 in which there is seated an insulated cup 50. A contact plate 52, of electrically conductive material, is seated in the cup 50 and the lead 40 is connected to the plate 52. A compression spring 54, of electrically conductive material, is disposed within the cup 50 and abuts the contact plate 52. The other end of the spring seats on the base 56 of a piston 58 which is provided with a stud 60 soldered to the base. The piston and its base are formed of electrically conductive material. A cylinder 62 of electrically conductive material is threaded into the threaded portion 48 of the housing 46 and an insulated sleeve 64 is interposed between the cylinder and the piston. A lock nut 66 threaded on the cylinder 62 locks the latter in position within the housing 46. The cylinder has an enlarged collar 68 which is normally spaced from the tip 70 of the piston 58 and it will be noted that the insulated sleeve 64 extends above the collar 68.

The parts of the switch tip 44 are illustrated in the normal condition thereof, it being noted that the wire 40 is in electric contact with the housing or shell 46 through the engaged conductive contact plate 52, spring 54 and piston base 56, the latter being biased by the spring into contact with the electrically conductive cylinder 62 which is engaged with the shell 46. When the tip 70 touches the body of the opposing fencer, the piston is moved inwardly of the shell 46 to disengage its base 56 from the cylinder 62 to interrupt the circuit between the wire 40 and the shell 46, it being noted that the wire is insulated from the shell and from the blade 38 to which the shell is secured. The portion of the sleeve 64 which projects above the cylinder collar 68 prevents the tip 70 from making contact with the collar 68 when the tip moves inwardly of the shell 46. When the foil tip 70 is removed from the fencer's body, the compressed spring 54 expands to return the piston 58 to its projected position wherein its base is in contact with the cylinder 62.

The cylinder 62 may be adjusted within the shell 46 to regulate the spring pressure applied by the spring against the piston 58, the lock nut 66 retaining the cylinder in position for the calibrated spring pressure. In this manner, the spring pressure on the pistons 58 of opposing fencers may be equalized, for example at 750 grams as required by present regulations for amateur fencing competition.

The blade 38 extends into the handle 72 and pommel 74 of the foil 14A, it being noted that, for purposes of illustration, the switch tip 44 and the associated end of the blade 38 have been drawn on a scale different from the handle and the other end of the blade. The handle 72 is preferably made of wood, or other suitable material, and has a longitudinal bore 76 through which a reduced diameter blade extension 78 extends. Said extension has a threaded end 80 which is threaded into the metal pommel 74, the insulated wire 40 extending through the bore 76 and through the pommel into a male connector or plug 82 provided on the pommel. The handle 72 is provided with a conventional string grip 84 wound thereabout and a bare or uninsulated wire 86', preferably of copper, is wound over the string grip. One end of the wire 86' is secured to a metallic grounding disc 89 which is interposed between the wood handle 72 and the metallic blade 38 at the bottom of the blade extension 78. The other end of the wire 86' is secured to the metallic pommel 74.

A female connector or socket 86 is adapted to be releasably engaged by the male connector 82. The previously mentioned plug 20 is connected to the socket 86 through the previously mentioned flexible cable 18 which has the twin leads 88 and 90. The lead 88 is connected between the shell of plug 20 and the shell of the socket 86. The lead 90 is connected between the tip 92 of plug 20 and the inner terminal of the socket 86 so that the tip 92 is in circuit with the lead 40 when the plug 82 is engaged in the socket 86, the body of the plug 82 being in circuit with the body of plug 20 through the shell of socket 86 and the lead 88.

The transmitters utilized with the foils 14 are of conventional construction. As here shown, the transmitter, indicated at T1 or T2, is a Hartley oscillator which utilizes a grounded base transistor 94 and a battery 96 to provide a compact, small and light package which can be carried on the person of the fencer. The tank circuit 98 of the oscillator includes a jack 100. One side of the jack is at ground potential, as at 102, and the other side is connected to the antenna 104. When the plug 20 is inserted in the jack 100, the antenna 104 and the radio frequency voltage end of the tank circuit 98 are connected through the lead 90 to the lead 40, and through the latter to the switch tip 44. However, with the piston 58 in its projected position, the switch tip 44 is closed, the lead 40 being in electrical circuit with the shell 46 and the blade 38. The latter is connected through the disc 89 and the conductor 86' to the pommel 74 which is in contact with the body of plug 82, the latter being in contact with the shell of socket 86. The lead 88 from the shell of socket 86 to the body of plug 20, which is grounded at 102, effectively completes a circuit whereby the antenna 104 is grounded. The closing of the manual switch 104' applies power to the transmitter and renders the latter operative. However, as long as the switch tip 44 is closed, as illustrated, the antenna and the radio frequency voltage side of the tank circuit are grounded, the closed switch being effectively connected between antenna 104 and ground point 102, and there is no radiation. When a fencer touches his opponent with the tip 70 at the end of his foil, the switch 44 opens to interrupt the circuit between the antenna 104 and ground 102, and the transmitter radiates. As soon as the tip 70 is removed from the opposing fencer, spring 54 closes switch 44. The opening and closing of switch 44 provides for the radiation of a pulse of radio frequency energy from the transmitter of the fencer who has touched the body of his opponent.

It will be noted that the body of each fencer is grounded since he grasps the wire 86' on the handle 72, said wire being at ground potential when the switch 44 is closed. However, when said switch is opened, the transmitter radiates not only through the antenna but also through the fencer's body and through the foil.

Referring now to Fig. 3 in detail, there is illustrated a modification in the transmitter-foil assembly. Pursuant

to this modification, provision is made for a normally open switch tip 44A in lieu of the normally closed switch tip 44. In the present embodiment, the sole difference in the switch tip is that the insulated sleeve 64 is moved inwardly of the cylinder 62 so that its outer end is below the outer surface of collar 68 and its inner end projects beyond the inner end of the cylinder. Consequently, the base 56 of the piston 58 is spaced from the cylinder 62 by the insulated sleeve. Also, as illustrated, the tip 70 is spaced from the collar 68. Consequently, the switch 44A is normally open. However, when the piston 58 is moved into the shell 46, the tip 70 engages the collar 68 to complete a circuit between the lead 40 and the blade 38. Said circuit extends from the lead 40, through the contact plate 52, through the spring 54, through the body of piston 58, from piston tip 70 to cylinder 68, to shell 46 and from the latter to the blade 38.

In the present embodiment a conventional grounded base transistor oscillator is also used. However, the socket 100A is inserted in the B+ line of the oscillator. With the plug 20 inserted in the socket, the open switch 44A is effectively in the B+ circuit so that the oscillator is inoperative. However, when a touch is made, switch 44A closes and the energized oscillator radiates. As soon as the tip 70 is disengaged from the fencer's body, the compressed spring 54 disengages tip 70 from collar 68 to open the switch. The closing and opening of the switch 44A produces a pulse of radio-frequency energy.

Referring now to Fig. 4 in detail, there is illustrated the power supply circuit, generally indicated by the reference numeral 110, of the pulse control and registry system 30. The primary winding 112 of transformer 114 is connected to a suitable 110 volt A.C. supply. There are four secondary windings, 116, 118, 120 and 122. The winding 116 is connected through the lead 124 to the filaments of the thermal delay relays 126 and 128. The contacts of these relays are normally open but are closed when their filaments are energized. The filament of relay 126 is in series with the filament of a thermal delay relay 130, through the variable resistor 132. The filament of relay 128 is in series with the filament of thermal delay relay 134 through the variable resistor 136. Thermal relays 130 and 134 are of the type in which their contacts are normally closed but are opened when their filaments are energized. The filament of relay 130 is connected through the lead 138 to the terminals 140 and 154 of a terminal strip 164. The filament of relay 134 is connected through the lead 166 to the terminal 156. Therefore, it will be apparent that the filaments of relays 126, 128, 130 and 134 are connected through lead 124 to the upper end of secondary 116. As hereinafter described, the filament circuit is completed to the other end of secondary 116, so that said filaments are normally energized during operation of the apparatus.

At its other end, the secondary 116 is connected to one end of the secondary 118 and the latter is connected through the lead 168 to the movable relay contact 170 of the relay 172. The contact 170 is normally engaged with the contact 174 and, upon energization of relay 172, engages the contact 176. The contact 174 is connected through lead 178 to one end of a bank of lights 180 connected in a series-parallel circuit. Referring to Fig. 1, it will be noted that the lights 180 are mounted in the score-board 12 behind the translucent name panel 181, used to identify one of the fencers. The cover and one end of the score-board have been removed from the drawing for purposes of illustration.

To complete the circuit for the lights 180, the lead 182 extends to a similar bank of lights 184 and through the latter to a point of connection 186 between the windings 116 and 118. The bank of lights 184 is provided in the score-board 12 behind the translucent name panel 185, which identifies the other fencer. To complete the circuit for the lights 184, the lead 188 is connected from the bank 184 to the relay contact 190 of the relay 192.

The movable relay contact 194 is normally engaged with the contact 190 and upon energization of relay 192 engages relay contact 196. Relay contact 196 is connected by lead 198 to one end of an audible signal device 200, here shown as a horn, which is mounted in the score-board. The contact 176 is connected by lead 202 to one end of an audible signal device 204, here shown as a bell, which is mounted in the score-board 12. It will be understood that both signal devices may be of the same kind provided that their signals are distinguishable from each other, as by sound, volume or pitch.

The other end of each signal device is connected to one end of a battery 206 and the other end of the battery is connected by lead 208 to the lead 168. The relay contact 194 is connected by lead 210 which connects between lead 124 and terminal 152.

One end of the secondary winding 120 is connected by lead 212 to one end of each of the filaments of the thermal delay relays 214 and 216. The relays 214 and 216 are similar to relays 126 and 128, their contacts being normally open and being closed only when their filaments are energized. The other end of the filament of relay 216 is connected through lead 218 to the terminal 142. The other end of the filament of relay 214 is connected by lead 220 to terminal 144. The lead 212 is connected through the lead 222 to the lead 224. Lead 224 runs from the closed contacts 228 of the thermal relay 126 to one end of each of the relay coils 172 and 192. The other end of coil 172 is connected by lead 226 to lead 220. The other end of relay coil 192 is connected to lead 218.

The closed thermal relay contacts 228 are connected in series with the closed contacts 230 of thermal relay 128 by lead 232. Said contacts 230 are connected by lead 234 to terminal 148. A lead 236 extends from one side of the primary winding 112 to the open contacts of thermal relay 130 and to the open contacts 240 of thermal relay 134. Contacts 238 and 240 are also connected through lead 242 to terminal 160. A lead 244 extends from the other side of primary winding 112 to terminal 146.

The secondary winding 122 is connected by lead 246 to terminal 140. From the connection point 250, the lead 252 is connected to the previously mentioned relay contacts 28 and 34. The relay contacts 29 and 33 are interconnected by the lead 258 which extends from one terminal 260 of a socket 262. The other terminal 264 of the socket 262 is connected by lead 246 to one end of secondary 122. The relay contact 31 is connected to the lead 218 and the relay contact 35 is connected to the lead 220. Line 266 connects contacts 32 and 36 to the bottom of secondary 122. As previously indicated, normally open contacts 28—29 and 31—32 are closed upon energization of plate relay 24 of receiver R1 and normally open contacts 33—34 and 35—36 are closed upon energization of plate relay 26 of receiver R2.

The secondary windings 116 and 118, which together provide 12 volts, are phased with the secondary windings 120 and 122, which also together provide 12 volts. In this connection it will be noted that the upper ends of the secondaries 116 and 120 are interconnected by the lead 125 which interconnects the leads 124 and 224. Consequently, the current flow in secondaries 116—118 is in phase with the current flow in secondaries 120—122, with the lead 124 acting as a common for both secondary coils 116—118 and 120—122, as hereinafter described in detail.

One or more solenoids 267 can be connected in parallel to the socket terminals 260—264 for operating one or more cameras, as hereinafter described in detail.

The remainder of the pulse circuit of the pulse control system 30 is illustrated in Figs. 5 and 6, being generally indicated by the reference numeral 270. Provsion is made for a terminal strip 164A having the terminals 140A, 142A, 144A, 146A, 148A, 150A, 152A, 154A,

156A, 158A, 160A and 162A which are electrically connected to the corresponding similarly numbered terminals of the terminal strip 164 in the power supply circuit 110.

The pulse selector circuit is provided with two banks of relays for controlling the score indications on the score-board. Since the score-board has provision for five translucent score indicating panels for each fencer, provision is made for five relays for each fencer to control the energization of the lights behind each of the score panels. The five translucent score panels in the upper row of the score-board for the fencer of the team or school indicated by the name panel 181, are designated by the reference numerals Y1, Y2, Y3, Y4 and Y5. The lights or score indicators on the score-board behind this row of panels are indicated at YL1, YL2, YL3, YL4 and YL5 both in Figs. 1 and 5. The relays controlling the energization of these score lights are indicated in Fig. 5 at YR1, YR2, YR3, YR4 and YR5, respectively.

The translucent score panels for the opposing fencer are indicated at V1, V2, V3, V4 and V5. Each of these panels has an associated light assembly or score indicator, one of which is shown in Fig. 1, and which are indicated at VL1, VL2, VL3, VL4 and VL5 in Fig. 6. It will be understood that the lights in the lower row are mounted behind their associated score panels in the same manner as in the upper row. In this connection, provision is made for a mounting member 272 (Fig. 1) spaced rearwardly of the name and score panels of the score-board 12, for mounting the light assemblies 180 and 184 behind the associated name panels and for mounting the light assemblies YL1 through YL5 and VL1 through VL5 behind the associated score panels. An opaque partition member 274 separates the light assemblies in the upper and lower rows and opaque partition members 276, 278, 280, 282 and 284 separate the light assemblies in each row so that each panel can be illuminated only by its associated light assembly. The relays controlling the energization of the score lights in the lower row are indicated at VR1, VR2, VR3, VR4 and VR5 in Fig. 6.

The circuit also includes a step-relay 286 which operates mute switches 288 and 290, and a reset relay 292 which operates a trigger switch 294, the functions of said switches being hereinafter explained in detail. The step and reset relays are of conventional construction, the mechanical components thereof being illustrated more or less schematically in Figs. 5 and 7 herein.

As here shown, the armature 296 of step-relay 286 operates the step pawl 298 to advance the ratchet 300, counter-clockwise, each time that the relay 286 is pulsed. A coiled spring 302 has one end secured to the ratchet 300 so that the spring is stressed or contracted with each counterclockwise step of the ratchet. The ratchet is retained in each stepped position thereof by the pivoted lock arm 304. The lock arm is operated by the armature 306 of reset relay 292 so that when the reset relay is pulsed the lock arm is withdrawn from the ratchet which is rotated in a clockwise direction to its starting position by the stressed spring 302. The ratchet mounts a sweep-contact arm 308A which is moved thereby to make successive contact with the stationary contacts 310A, 312A, 314A, 316A, 318A and 320A, which except for contact 310A, are in circuit with relays YR1 through YR5, respectively.

Contact 310A is connected by leads 322 and 324 to terminal 140A. Contact 312A is connected by lead 326 to stationary contact S1 of relay YR1. Contact 314A is connected by lead 328 to stationary contact S1 of relay YR2. Contact 316A is connected by lead 330 to stationary contact S1 of relay YR3. Contact 318A is connected by lead 332 to stationary contact S1 of relay YR4. Contact 320A is connected by lead 334 to stationary contact S1 of relay YR5.

A sweep contact 308B is ganged for movement with the sweep contact 308A. Contact 308B is successively moved into engagement with the stationary contacts 310B, 312B, 314B, 316B, 318B and 320B. Contact 310B is a blank position and contacts 312B, 314B, 316B, 318B and 320B are connected to relays VR1 through VR5, respectively. Contact 312B is connected through lead 336 to stationary contact S1 of relay VR1. Contact 314B is connected through lead 338 to stationary contact S1 of relay VR2. Contact 316B is connected through lead 340 to stationary contact S1 of relay VR3. Contact 318B is connected through leads 342 and 344 to stationary contact S1 of relay VR4. Contact 320B is connected through leads 346 and 348 to stationary contact S1 of relay VR5.

The sweep contact 308A is connected through lead 350 to one stationary contact of the mute switch 288, the other stationary contact of which is connected through lead 352 to terminal 142A. The sweep contact 308B is connected through lead 354 to one stationary contact of the mute switch 290, the other stationary contact of which is connected through lead 356 to terminal 144A. The movable contacts 358 and 360 of the mute switches 288 and 290, respectively, are operated by the armature 296 of the step relay 286. When the step relay is pulsed and energized for advancing the sweep arms 308A and 308B one step, the normally closed mute switches are opened by movement of their movable bridging contacts 358 and 360 by the armature 296 in the direction of arrow 362. Upon passage of the pulse through the relay and the deenergization thereof, the armature returns to its normal position to close the mute switches.

The trigger switch 294 is connected from one of its stationary contacts through leads 364 and 350 to the sweep contact 308A and from its other stationary contact it is connected through the leads 366 and 368 to the terminal 148A. The movable bridging contact 370 of the trigger switch is mounted by armature 306 of the reset relay 292 to close the trigger switch when the reset relay is energized to move its armature in the direction of the arrow 372. Consequently, energization of the reset relay releases the ratchet 300 for resetting the sweep contacts 308A and 308B to the illustrated positions thereof and to close the trigger switch.

At one side thereof, each of the relays YR1, YR2, YR3, YR4 and YR5 is connected to the terminal 148A through the leads 374 and 368. At its other side, relay YR1 is connected by lead 376 to movable contact M4 of relay VR1 which is normally engaged with stationary contact S5 of said latter relay. The other side of relay YR2 is connected through lead 378 to movable contact M4 of relay VR2 which is normally engaged with stationary contact S5 of said latter relay. The other side of relay YR3 is connected through lead 380 to movable contact M4 of relay VR3 which is normally engaged with stationary contact S6 of said latter relay. The other side of relay YR4 is connected through lead 382 to movable contact M4 of relay VR4 which is engaged with stationary contact S5 of said latter relay. The other side of relay YR5 is connected through lead 384 to movable contact M4 of relay VR5 which is normally engaged with stationary contact S4 of said latter relay.

One side of each of relays VR1, VR2, VR3, VR4 and VR5 is connected to the lead 386 which through the lead 368 is connected to terminal 148A. The other side of relay VR1 is connected by lead 388 to movable contact M4 of relay YR1 which is normally engaged with stationary contact S5 of the latter relay, which is connected to the previously identified lead 336. The other side of relay VR2 is connected through lead 390 to movable contact M4 of relay YR2 which is normally engaged with stationary contact S5 of said latter relay, which is connected to the previously identified lead 338. The other side of relay VR3 is connected through lead 392 to movable contact M4 of relay YR3 which is normally engaged

with stationary contact S6 of said latter relay, which is connected to the previously identified lead 340. The other side of relay VR4 is connected by lead 394 to movable contact M4 of relay YR4 which is normally engaged with stationary contact S5 of said latter relay, which is connected to the previously identified lead 344. The other side of relay VR5 is connected through lead 396 to movable contact M4 of relay YR5, which is normally engaged with stationary contact S4 of said latter relay, which is connected to the previously identified lead 348.

To complete the circuit connections for the remaining contacts of each of the relays YR1 through YR5, it will be noted that the movable contacts M1 of each of said relays are interconnected by the lead 398. Contact M1 of relay YR1 is normally engaged with stationary contact S2 of said relay which is connected by lead 400 to the stationary contact S3 of the same relay; by leads 400 and 402 to stationary contact S3 of relay YR2; and by said lead 400 to movable contact M2 of relay YR4. The stationary contact S3 of relay YR2 is normally engaged by the movable contact M2 of said relay which is connected by lead 404 to the lead 406. Lead 406 is connected to lead 408 which runs between movable contact M2 of relay YR1 and movable contact M5 of relay YR1. The lead 406 is also connected to the movable contact M2 of relay YR3 which is normally engaged with stationary contact S4 of said relay. Said contact S4 is connected by lead 409 to stationary contact S3 of relay YR4 and to movable contact M2 of relay YR5. Contact M2 of relay YR5 is normally engaged with stationary contact S2 of said relay which is connected by lead 410 to terminal 158A and by leads 410 and 412 to terminal 150A.

Contact M5 of relay VR1 is connected to contact M2 thereof by lead 452, and said contact M5, upon energization of said relay, engages stationary contact S6 of the latter, which is connected by lead 414 to movable contact M5 of relay VR2. Upon energization of relay VR2, contact M5 thereof engages stationary contact S6 thereof which is connected, by lead 416, to stationary contact S4 of relay YR3.

Contact S2 of relay YR1 is connected by lead 420 to contacts S2 of relays YR2 and YR3, respectively.

Contact S4 of relay YR1 is connected by lead 422 to one side of lamp YL1, the other side of which is connected to lead 424 which extends from terminal 150A. Lamp YL2 is connected between lead 424 and contact S4 of relay YR2 by lead 426. Lamp YL3 is connected between lead 424 and contact S5 of relay YR3 by lead 428. Lamp YL4 is connected between lead 424 and contact S4 of relay YR4 by lead 430. Lamp YL5 is connected between lead 424 and contact S3 of relay YR5 by lead 432.

Contacts M3 of relays YR1, YR2, YR3, YR4 and YR5 are interconnected by lead 434 which is connected to terminal 152A by lead 436.

Contact S6 of relay YR1 is connected by lead 438 to contact M5 of relay YR2. Contact S6 of relay YR2 is connected by leads 440 and 418 to contact S4 of relay VR3. Lead 418 interconnects said contact S4 with contact S3 of VR4 and contact M2 of VR5.

Referring now to the remaining contacts of relays VR1 through VR5, the movable contacts M1 thereof are all connected to the lead 442. Said lead is connected to terminal 156A and is connected by lead 444 to the previously identified lead 398. The stationary contacts S2 of relays VR1, VR2 and VR3 are interconnected by lead 446. The stationary contacts S2 and S3 of relay VR1 are connected together by lead 448 which is also connected to movable contact M2 of relay VR4 and through lead 450 to stationary contact S3 of relay VR2.

Movable contact M2 of relay VR1 is normally engaged with stationary contact S3 thereof and is connected by lead 452 to movable contact M5 of relay VR1. Lead 452 is also connected by lead 454 to movable contact M2 of relay VR3 and by leads 454 and 456 to movable contact M2 of relay VR2. Stationary contact S4 of relay VR1 is connected by lead 458 to lamp VL1 which also is connected to the previously identified lead 424. Lamp VL2 is connected to lead 424 and through lead 460 to contact S4 of relay VR2. Lamp VL3 is connected to lead 424 and through lead 462 to contact S5 of relay VR3. Lamp VL4 is connected to lead 424 and through lead 464 to contact S4 of relay VR4. Lamp VL5 is connected to lead 424 and through lead 466 to contact S3 of relay VR5. Contacts M3 of relays VR1 through VR5 are all connected to lead 468 which is connected by leads 470 and 436 to terminal 152A. Contact S2 of relay VR5 is connected through lead 472 to lead 424.

At the start of a match, all the lights on the score-board 12 are out, except the lights 180 and 184 behind the name panels 181 and 185, respectively. By reference to Fig. 4, it will be noted that the bank of lights 184 is connected across the secondary winding 116, one end of the light bank being connected through lead 182 to the tap 136 and the other end of the bank being connected through lead 188, normally closed relay contacts 190—194, and leads 210 and 124 to the other end of the winding. Similarly, one end of light bank 180 is connected through lead 182 to tap 186 and from the other end of the light bank through lead 178, normally closed relay contacts 170—174 and lead 168 to the other end of winding 118. The circuit is in the condition thereof illustrated in Figs. 4, 5 and 6, the sweep arms 308A and 308B being in the indicated position preparatory to the first score.

The apparatus 10 operates as follows:

Assume now that a fencing match is in progress and that the fencer represented by the name plate 181 touches his opponent with the tip of his foil. A pulse is transmitted from the transmitter T1 on his person, as previously explained, and is received only by the receiver R1 which is tuned to the frequency of his transmitter. Receiver output relay 24 is energized by the pulse. In this connection, it will be understood that each receiver output circuit includes a conventional time delay circuit to provide an R-C time constant to hold its receiver relay energized for a predetermined period, for example, for 2500 milliseconds. The energized relay 24 closes its paired contacts 28—29 and 31—32.

Provision is made to photograph the actual scoring touch. In this connection, as previously indicated, a solenoid 267 is connected to the socket terminals 260—264 to operate a camera C focused on the fencing area, or a plurality of solenoids may be connected in parallel to said terminals to operate different cameras. A few cameras could be focused on the fencing area and one or more could be focused on the score-board 12, suitable flood lights being used to provide the necessary light.

Conventional cameras are available for such use, for example, a "Bolex" H–16 or a "Robot" Royal. In each of these cameras, provision is made, upon exposure of a film frame, to automatically advance an unexposed frame into exposure position upon closing of the shutter and movement of the exposed frame of film out of exposure position. For example, in the "Bolex" H–16, when set up for taking still pictures, rather than motion pictures, movement of a control lever L (Fig. 1) from its inoperative position trips the shutter to expose the film. Upon release of the lever, it moves back to its inoperative position and automatically advances an unexposed film frame into exposure position. As here shown, the lever L is connected to the armature of the solenoid 267 so that energization of the solenoid would move the lever L to trip the shutter and upon deenergization of the solenoid the lever L is returned to its inoperative position and automatically moves an unexposed frame into exposure position.

The end of solenoid 267, at terminal 264, being con-

nected to the bottom of the secondary 122, the closing of contacts 28—29, when receiver R1 receives a pulse, energizes the solenoid by connecting its end at terminal 260 to tap 250 at the upper end of secondary 122. Similarly when receiver R2 receives a pulse to energize relay 26, the closing of contacts 33—34 completes the energizing circuit for solenoid 267 from terminal 260 to tap 250.

One end of the filament of relay 216 is connected through lead 212 to the top of secondary winding 120. Upon closing of relay contacts 31—32, the filament circuit is completed to the bottom of secondary 122 through lead 266, engaged contacts 31—32 and lead 218, to energize said filament.

The energization of relay 24 also results in the energization of the sound relay 192. More specifically, one end of relay 192 is connected through the leads 224, 222 and 212 to the top of secondary 120. The other end of the relay 192 is connected through lead 218, closed contacts 31—32, and lead 266 to the bottom of secondary 122. Energization of relay 192 opens its contacts 190—194 and closes its contacts 194—196. The opening of contacts 190—194 interrupts the circuit through the light bank 184 for the loser's name plate 185.

The closing of contacts 194—196 completes a circuit to energize the sound device or horn 200. One side of the horn is connected to one end of the battery 206. The other end of the battery is connected to the other side of the horn through leads 208, 168, windings 118, 116, leads 124 and 210 through closed contacts 194—196 and through lead 198 to the other side of the audio device 200 which is identified with the winner's name plate 181.

The energization of receiver relay 24 resulting in the closing of its contacts 31–32, energizes the relay YR1. The bottom of secondary 122 is now connected through lead 266 and closed contacts 31–32 to lead 218 and through the latter to terminals 142–142A. From the latter the circuit includes leads 352, the closed mute switch 288, lead 350, sweep contact 308A engaged with contact 312A, lead 326, engaged contacts S5—M4 of relay VR1, lead 376, to one side of relay YR1. The other side of relay YR1 is connected to the top end of secondary 120 through lead 374, terminals 148A–148, lead 234, engaged contacts 230 of thermal relay 128, lead 232, engaged contacts 228 of thermal relay 126, and leads 224, 222 and 212. In this connection, it will be noted that, as previously indicated, the contacts of said thermal relays are closed when their filaments are energized, and these filaments are normally energized when the apparatus 10 is first turned on for the beginning of a match, as hereinafter described.

The relay YR1 being energized, its movable contacts M1 through M5 are operated, contact M1 engaging contact S1 to provide a holding or stick circuit for the relay as follows: One side of the relay is connected through lead 374 to the upper end of transformer winding 120, as previously described. The other side of relay YR1 is now connected to the bottom of winding 122, as follows: through lead 376, engaged contacts M4—S5 of relay VR1, lead 326, engaged contacts S1—M1 of relay YR1, leads 398, 324, terminals 140A—140 and lead 246.

Thermal relay 216 is of the same type as relays 126 and 128, its contacts 217 closing only after its filament is heated. One side of the filament of relay 216 is connected through lead 212 to the top end of winding 120. The other side of this filament is now connected through lead 218, through terminals 142—142A, lead 352, through mute switch 288, lead 350, engaged contacts 308A—312A, lead 326, engaged contacts S1—M1 of relay YR1, lead 398, terminals 140A—140 and lead 246 to the bottom of winding 122. Current flow heats the filament of relay 216 and closes its contacts 217.

The closing of contacts 217 energizes the step relay 286. More specifically, and as best shown in Fig. 7, it will be noted that one end of relay 286 is connected through leads 510 and 512 to terminals 146A—146, and through lead 244 to one side of the 110 v. A.C. source. The other side of said source is connected through leads 236 and 500, closed contacts 217 of relay 216, lead 502, terminals 162—162A, and lead 511 to the other side of relay 286, the latter relay being energized, so that both sweep contacts are stepped in a conuterclockwise direction to engage the next contacts. The stepping of sweep contact arm 308A interrupts the filament heating circuit of relay 216 to open its engaged contacts 217 and thereby to deenergize the step-relay 286.

Relay YR1 having been energized, contact M3 engages contact S4 to energize the light YL1 behind the score panel Y1. This circuit can be traced from light YL1 through lead 422, engaged contacts S4—M3 of relay YR1, leads 434 and 436, terminals 152A—152, leads 210 and 124 to one side of winding 116. From the other side of light YL1, the circuit includes leads 424, 412, terminals 150A—150, and leads 514, 516 and 182 to tap 186 at the other end of winding 116.

From the foregoing, it will be apparent that the momentary pulsing of plate relay 24 by the transmitter carried by the scoring fencer had extinguished the lights behind the name panel 185 of the touched fencer, had energized the scoring fencer's noisemaker 200 and had illuminated the light YL1 behind score panel Y1 of the winner, to provide both a visual and audible indication that a score had been made. In addition, the energization of the camera C resulted in an actual picture of the touch being made and a picture of each fencer plus the score-board, if the requisite number of cameras is used.

If in lieu of the foregoing, the opposing fencer had scored so as to pulse the plate relay 26, its contacts 33—34 would close to energize the camera relay 267, as previously described. The closing of its other contacts 35—36 completes the filament circuit of thermal relay 214 across the transformer windings 120 and 122 and results in the closing of contacts 215 of said relay. In addition, the energizing circuit for the relay 172 across windings 120 and 122 is completed so that its contact 170 disengages contact 174 and engages contact 176. This interrupts the circuit of the light bank 180 at contact 174 so that the name plate 181 is extinguished. The closing of contacts 170—176 completes the circuit between noisemaker or bell 204 and battery 206 so as to energize the bell.

The energization of relay 26 results in the energization of relay VR1. One side of said relay is connected to the upper side of transformer winding 120, as follows: through leads 386, 368, terminals 148A—148, lead 234, closed contacts 230 of relay 128, lead 232, closed contacts 228 of relay 126, leads 224, 222 and 212. The other side of relay VR1 is connected to the bottom of winding 122, as follows: lead 388, engaged contacts M4—S5 of relay YR1, lead 336, engaged contacts 312B—308B, lead 354, closed mute switch 290, lead 356, terminals 144A—144, lead 220, closed contacts 35—36 and lead 266.

Relay VR1 being energized its movable contacts M1 through M5 are operated, contact M1 engaging contact S1 to provide a holding or stick circuit for the relay as follows: one side of the relay is connected through lead 386 to the upper side of transformer winding 120, as described previously. The other side of relay VR1 is connected to the lower side of transformer winding 122 through lead 388, engaged contacts M4—S5 of relay YR1, lead 336, engaged contacts S1—M1 of VR1, leads 442, 444, 324, terminals 140A—140 and lead 246.

The closing of contacts M3—S4 of relay VR1 energizes light VL1 behind score panel V1. One end of VL1 is connected through lead 424, terminals 150A—150,

leads **514** and **516** to the bottom of transformer winding **116**. The other side of VL1 is connected to the top of winding **116** as follows: lead **458**, closed contacts S4—M3 of VR1, leads **468**, **470**, terminals **152A—152**, leads **210** and **124**.

Thermal relay **214** is of the same type as relay **216**, its contacts closing upon heating of the filament. The filament of relay **214** now has a steady supply of current. One end of the filament is connected through lead **212** to the top of transformer winding **120**. The other end of the filament is connected to the bottom of winding **122**, as follows: through lead **220**, terminals **144—144A**, lead **356**, closed mute switch **290**, lead **354**, closed contacts **308A—312B**, lead **336**, and through engaged contacts S1—M1 of relay VR1, as previously described. The closing of the contacts **215** of relay **214** energizes the step relay **286** over the same circuit as previously described in connection with the closing of contacts **217** of relay **216**, as best shown in Fig. 7. This steps the sweep contacts **308A** and **308B**, as previously described, the stepping of sweep contact **308B** interrupting the filament heating circuit for relay **214** to open its engaged contacts and thereby to deenergize the step-relay **286**.

As previously described, whenever a score is made by touching the opposing fencer, one of the relays in the YR relay bank or in the VR relay bank is energized, depending upon the setting of the sweep arms **308A** and **308B** of the stepping relay **286**, and depending upon which of the fencers made the score. In any event, the energization of one of the relays in either bank of five relays opens the energizing circuit for the corresponding relay in the other bank, it being noted that the energizing circuit for each relay includes the other relay in the same channel, it being understood that there are five channels, each including one relay of each bank. For example, considering the first channel comprising relays YR1 and VR1, the energizing circuit for YR1 includes contacts S5 and M4 of VR1, and the energizing circuit of VR1, includes contacts S5 and M4 of YR1. Consequently, if either YR1 or VR1 is energized, it operates to open the energizing circuit of the other of said relays. This action is the same in each of the other four relay channels.

Upon energization of one of said VR or YR relays, the step-relay **286** is energized through the closing of the contacts of either of the thermal relays **214** or **216**, as the case may be, and advances the sweep arms **308A** and **308B** to the next step so as to condition the two relays in the next channel for operation by the next scoring pulse. However, it takes time for the filaments of said thermal relays, after their energization, to cool sufficiently to open the corresponding relay contacts to interrupt the energizing circuit for the step-relay. During this cooling period of the filaments, which, for example, may be about two seconds, the energizing circuit of the step-relay is complete and an accidental pulse could get through to provide a score indication in the next channel, as well as activate one of the noisemakers, since the step-relay has already been stepped. Such a pulse could get through for example by one of the fencers hitting the tip of his foil against the floor or by dropping his foil, accidentally or in disgust, after a score against him. However, since the step-relay remains energized until the relay contacts **215** or **217**, as the case may be, open, the mute switches **288** or **290** also remain open until said contacts close so as to prevent any accidental pulse from energizing a relay in the channel to which the sweep arms have been stepped.

Assuming that each fencer scores against his opponent at the same time, both receiver relays **24** and **26** would be energized and, depending upon the setting or step of the step-relay **286**, the corresponding YR and VR relays in each relay bank would be energized and their respective armatures would begin to pull in. However, as previously noted, the energizing circuit for each of said relays includes the pair of normally closed contacts S5—M4 in the other relay in the same channel. Consequently, the movement of the armature in each relay in the same channel would result in opening the energizing circuit of the other relay in the same channel so that neither relay could lock in to energize its score indicator light. Consequently, in the event of a simultaneous touch by each fencer, no score is registered on the score-board. In the apparatus as now constructed, any time difference of less than approximately $\frac{1}{10}$ of a second between two touchés is considered as being simultaneous.

However, the pulsing of both receiver relays **24** and **26** results in the pulsing of both relays **172** and **192** so that both noisemakers **200** and **204** are energized and the light banks behind both name panels **181** and **185** go out. Consequently, the present apparatus provides an audible and visual indication of simultaneous touchés, without, however, changing the score indication.

In view of the foregoing, it will be apparent that the dual signals from both of the transmitters are not accepted by the apparatus. In the apparatus, as presently constructed, if two signals are separated by at least approximately $\frac{1}{10}$ of a second, only the first signal will cause a score indication. The magnetic pull-in of the YR or VR relay activated by the first signal will have been completed in approximately $\frac{1}{10}$ of a second so as to destroy the energizing circuit through the corresponding relay in the same channel so that the latter cannot activate its score light. Therefore, it will be apparent that in the case of what to the observed appears to be simultaneous touchés, if a score is indicated on the score-board, the scoring fencer touched his opponent at least $\frac{1}{10}$ of a second before he was touched. If no score is recorded, but both name panels **181** and **185** become dark and both noisemakers are energized, the interval between the two touchés is less than $\frac{1}{10}$ of a second.

The winner of a fencing match is the fencer who first scores three out of five touchés. The apparatus of the present invention indicates the winner of the match as soon as three scores have been indicated for one of the fencers. Since there are five scoring positions on the score-board 12 for each fencer, there are ten possible score combinations which can be achieved by either fencer in winning the match. Referring to the score numerals 1 through 5, the following are the ten score combinations that are possible for each fencer: 1-2-3; 1-2-4; 1-2-5; 1-3-4; 1-3-5; 1-4-5; 2-3-4; 2-3-5; 2-4-5; and 3-4-5.

Referring now to Figs. 8 and 9 in detail, it being noted that Fig. 8 represents the actual wired circuit of the inverse binary circuit and Fig. 9 represents a simplified equivalent thereof in which the positions of the thermal relays **126**, **128**, **130** and **134** in the circuit have been changed for purposes of illustration and explanation, both figures represent the condition of the apparatus after it has been reset and the stepping relay **286** has stepped the sweep arms **308A** and **308B** to the starting positions thereof, as illustrated in Fig. 5.

As previously explained, all of the YR and VR relays in both banks are connected, at one end thereof, to the upper end of the secondary winding **120** through the series connected contacts **228** and **230** of thermal relays **126** and **128**, respectively. These contacts are closed when the filaments of their respective relays are energized. As previously explained, in order to effect the energization of a VR or YR relay, one of the receiver relays **24** or **26**, as the case may be, must be energized by a pulse from the associated transmitter so as to complete a circuit from the other end of the VR or YR relay, as the case may be, to the bottom of transformer secondary winding **122**. However, since the circuit for each energized VR or YR relay includes the closed contacts of the thermal relays **126** and **128**, it will be apparent that if the filament voltage is removed from these thermal relays, their contacts will open so as to deenergize all previously locked in or energized VR and/or YR relays. Conse-

quently, as long as there is a completed filament circuit for the thermal relays **126** and **128**, there is a completed common return path for all the VR and YR relays through the closed contacts of said thermal relays.

Pursuant to the present invention, as soon as either fencer scores three touchés on his opponent, the filament circuit for either the thermal relay **126** or the thermal relay **128**, as the case may be, is interrupted. This opens the closed contacts of the deenergized thermal relay and interrupts the common return path of all the energized VR and/or YR relays, whereby to terminate the scoring and to reset the apparatus for the next match, due to the closing of one of the thermal relays **130** or **134**, as previously explained, since the filaments of the thermal relays **130** and **134** are in series with the filaments of thermal relays **126** and **128**, respectively.

As best seen in Fig. 8, the series connected filaments of thermal relays **126** and **130** are directly connected to one end of the transformer **114** at the output side thereof through the line **124**, being connected to the other end of the output winding of the transformer through the relays of the YR bank. The filament continuity circuit includes the normally closed M1—S2 contacts of relays YR1, YR2 and YR3, connected in parallel to the closed S3—M2 contacts of YR1, the closed M2—S4 contacts of YR3 and the closed M2—S2 contacts of YR5, which are connected in series to said parallel connection. In addition, the closed M2—S3 contacts of relay YR2 are connected between the parallel YR1, YR2 and YR3 M1—S2 connection and the connected M2 contacts of YR1 and YR3. The closed S3—M2 contacts of relay YR4 are connected from the connected S4 contact of YR3 and the M2 contact of YR5 to the S3 contact of YR2 and the three S2 contacts of relays YR1, YR2 and YR3. The corresponding similarly numbered contacts of the VR relays are connected in exactly the same manner in the filament continuity circuit of the thermal relays **128** and **134**, as best seen in Fig. 9.

In addition, the normally open contacts M5—S6 of relay YR1 are connected in series with the normally open contacts M5—S6 of relay YR2. These sets of series connected contacts interconnect the relay banks. More specifically, they are connected between a point of connection to contact S4 of YR3, contact S3 of YR4 and contact M2 of YR5 in the YR relay bank and a point of connection to contacts M2 of relays VR1, VR2 and VR3 of the VR relay bank. Similarly, the normally open sets of contacts M5—S6 of relay VR1 and M5—S6 of relay VR2 are connected in series and interconnect the VR and YR relay banks in the same manner, as will be apparent from Figs. 8 and 9.

It will be apparent from Fig. 9 that if either fencer makes the first three touchés of the match in succession to make the scores numbered 1, 2 and 3, the first three relays in his relay bank will be energized and operate their corresponding contacts. For example, assuming that relays YR1, YR2 and YR3 are energized in that order, the circuit for the filament of relays **126** and **130** will be interrupted by the opening of the respective three sets of parallel contacts M1—S2. The same would occur in the VR relay bank if the corresponding fencer made the scores numbered 1, 2 and 3 by achieving the first three touchés of the match.

Assume now that the fencer who has the VR relay bank makes score number 1, and the other fencer makes scores 2, 3 and 4. This will interrupt the filament circuit for relays **126** and **130** by opening the circuit between contact M2 of YR1 and contact M2 of YR5 since contacts M2—S3 of YR2 will open, as will contacts M2—S4 of YR3 and M2—S3 of YR4. Note that although contacts M5—S6 of YR2 will close, the circuit through line **408** will remain open at M5—S6 of YR1. The same situation will prevail if the fencer who has the YR relay bank makes score number 1 and the other fencer makes scores 2, 3 and 4.

The circuits through lines **452** and **408** are utilized to maintain the continuity of the filament circuits when one fencer has made scores 1 and 2 and the other has made scores 3 and 4. Assume now that scores 1 and 2 have been made in the VR relay bank to open the various closed contact sets of relays VR1 and VR2 and to close the open contact sets M5—S6 of relays VR1 and VR2, a circuit is completed between the relay banks which circuit includes lines **416** and **452** and the closed contact sets M5—S6 in relays VR1 and VR2. Assume now that the next two scores are made in the YR bank so that the closed contacts of relays YR3 and YR4 open. It will be noted that the opening of contacts M2—S4, of relay YR3, and the opening of contacts M2—S3 of relay YR4 would interrupt the filament circuit for thermal relays **126** and **130** between contact M2 of relay YR5 and the transformer **114**. However, due to the closing of contacts M5—S6 in each of relays VR1 and VR2, the circuit from contact M2 of relay YR5 to the transformer is completed through the other relay bank. This circuit continues from relay VR1 through lead **452** through the closed contacts M2—S4 of relay VR3, the closed contacts S3—M2 of relay VR4 and the closed contacts S2—M1 of relay VR3 to the transformer.

Thereafter, a third touch in the VR relay bank would open the closed contacts of VR5 to open the filament circuit for the thermal relays **128** and **134**. In the alternative, a third touch in the YR relay bank would open the closed contacts M2—S2 of relay YR5 so as to interrupt the filament circuit for thermal relays **126** and **130** through the described circuit which includes the leads **416** and **452**.

If the scores 1 and 2 are first made in the YR relay bank and the scores 3 and 4 are then made in the VR relay bank, the filament circuit for thermal relays **128** and **134** would be maintained through the line **440**, the closed contacts M5—S6 of each of relays YR2 and YR1, the line **408**, the closed contacts M2—S4 of YR3, the closed contacts S3—M2 of YR4, and the closed contacts M1—S2 of YR3 to the transformer. A third score in either bank would then open the associated filament circuit.

From the foregoing, it will be apparent that the first fencer who scores three touchés, in any sequence, opens the filament circuit for the thermal relays in his relay bank so as to complete the match. When the third score registers, the loser's name lights go out, the apparatus then resets and then steps to the first position, ready for the next match.

When either fencer has scored three hits, the circuit for energizing the filaments of thermal relays **126** and **130**, or **128** and **134**, as the case may be, is interrupted, as previously described. This results in the opening of the contacts of relays **126** and **128**, and the closing of the contacts of relays **130** and **134**. As previously explained, opening of the contacts of relays **126** and **128** interrupts the holding or stick circuits for all the YR and VR relays. However, closing of the circuits of thermal relays **130** and **134** completes the energizing circuit for the reset relay **292**. As best shown in Fig. 7, one end of relay **292** is connected directly to the 110 volt A.C. source and the other end is connected to said source through the contacts of either relay **130** or **134**, which are now closed, depending upon which fencer has made three touchés. The energization of relay **292** pulls in its armature **306** to disengage the detent **304** from the ratchet **300** and the stressed spring **302** returns the ratchet to its reset position in which sweep arm **308A** engages contact **310A**.

The interruption of the stick or holding circuits for all the VR and YR relays opens all the light circuits, erasing all scores, and also again completes the filament circuit for thermal relays **126—128—130—134**, causing the contacts of relays **126** and **128** to close, and the contacts of relays **130** and **134** to open. It will be noted that the energization of the reset relay **292** caused the bridging

contact of the trigger switch to close the latter. The timing of the thermal relays is so established that at this point the relays **126** and **128** have been sufficiently heated to close their contacts while the trigger switch is closed so as to complete the filament circuits of the relays **214** and **216**. More specifically, operation of the reset coil to close the trigger switch brings the sweep arm **308A** in engagement with contact **310A** to complete an energizing circuit for the filaments of relays **214** and **216** through the closed trigger switch, as follows: from one side of the switch **294** through the engaged sweep arm **308A** and contact **310A**, lead **322**, terminals **140A—140**, and lead **246** to the bottom of secondary **122**; from the other side of switch **294** through lead **366**, terminals **148A—148**, lead **234**, engaged contacts **230**, lead **232**, engaged contacts **228**, lead **224**. At this point the circuit goes through both relays **172** and **192**, from relay **172** through leads **226** and **220** through the filament of relay **214** to the top of secondary **120** to energize the latter filament; from relay **192** through lead **218** through the filament of relay **216** to the top of secondary **120** to energize the latter filament. The energization of the relays **172** and **192** causes both soundmakers to be energized and also removes the light from both name panels to indicate that the apparatus has reset. The energization of both filaments causes both the contacts **215** and **217** to close. This energizes the stepping coil **286**, as previously described, to move the sweep arms to the starting position thereof illustrated in Fig. 5. This interrupts the circuit through the trigger switch **294** to interrupt the filament circuit of relays **214** and **216** and to deenergize the relays **172** and **192**, whereby to discontinue the energization of the noisemakers and to restore the lights to the name panels. The apparatus is now set up for another match, the cycle being repeated when three pulses in either relay bank interrupt the filament circuit through the relays **126—130** and **128—134** to reset the apparatus.

A normally cold apparatus when first turned on will reset the sweep arms to positions **310A** and **310B**, respectively, and close the trigger switch **294**. This is because the contacts of the reset relays **130** and **134** are closed when their filaments are cold. Upon said filaments warming up, contacts **238** and **240** open and contacts **215** and **217** close, the apparatus being stepped to its starting position, and an audible tone being heard until the apparatus is stepped, as previously described. It will be apparent that the energization of the filaments of relays **214** and **216** effects the first stepping from the reset position, the name panels lighting up, the apparatus being in the condition thereof illustrated in Figs. 4, 5 and 6.

It will be understood that the term "foil" as used in the appended claims includes, without limitation, the implement used in conventional fencing or in épée.

While I have shown and described the presently preferred embodiments of my invention, it will be understood that changes and modifications may be made therein without departing from the nature and principle of my invention.

What is claimed is:

1. Apparatus for scoring a fencing match or the like comprising, a pair of transmitters each operable at a different frequency, a pair of foils in circuit with said transmitters, respectively, each foil having means operable in response to the making of a touch thereby to effect radiation from its associated transmitter, a pair of receivers tuned to said transmitters, respectively, score-board indicator means having a first series of score indicators for touches made by one of said foils and a second series of score indicators for touches made by the other of said foils, and control means automatically operable under the control of said receivers for energizing the score indicators in each of said series in response to touches made by the respective foils, said control means having provision to prevent the energization of said score indicators upon the occurrence of substantially simultaneous touches, and a noisemaker associated with each receiver and energized in response to the energization of the associated receiver, said noisemakers differing in tone, and said control means having provision to effect the energization of both of said noisemakers upon said occurrence of substantially simultaneous touches.

2. Apparatus for scoring a fencing match or the like comprising, a pair of transmitters each operable at a different frequency, a pair of foils in circuit with said transmitters, respectively, each foil having means operable in response to the making of a touch thereby to effect radiation from its associated transmitter, a pair of receivers tuned to said transmitters, respectively, score-board indicator means having a first series of score indicators for touches made by one of said foils and a second series of score indicators for touches made by the other of said foils, and control means automatically operable under the control of said receivers for energizing the score indicators in each of said series in response to touches made by the respective foils, said control means having provision to prevent the energization of said score indicators upon the occurrence of substantially simultaneous touches, said score-board indicator means having a name panel for each of said foils, said control means having provision to illuminate the name panel of a touch-making foil and to extinguish the name panel of the other foil, and said control means having provision to extinguish an illuminated name panel upon said occurrence of substantially simultaneous touches.

3. Apparatus for scoring a fencing match or the like comprising, a pair of transmitters each operable at a different frequency, a pair of foils in circuit with said transmitters, respectively, each foil having means operable in response to the making of a touch thereby to effect radiation from its associated transmitter, a pair of receivers tuned to said transmitters, respectively, score-board indicator means having a first series of score indicators for touches made by one of said foils and a second series of score indicators for touches made by other of said foils, and control means automatically operable under the control of said receivers for energizing the score indicators in each of said series in response to touches made by the respective foils, said control means having provision to prevent the energization of said score indicators upon the occurrence of substantially simultaneous touches, and a noisemaker associated with each receiver and energized in response to the energization of the associated receiver, said noisemakers differing in tone, and said control means having provision to effect the energization of both of said noisemakers upon said occurrence of substantially simultaneous touches, said score-board indicator means having a name panel for each of said foils, said control means having provision to illuminate the name panel of a touch-making foil and to extinguish the name panel of the other foil, and said control means having provision to extinguish an illuminated name panel upon said occurrence of substantially simultaneous touches.

4. In combination, a first foil, a first transmitter associated with said first foil and operable at a first frequency, a second foil, a second transmitter associated with said second foil and operable at a second frequency, means for effecting the radiation of a pulse of energy from said first transmitter in response to a touch made by said first foil, means for effecting the radiation of a pulse of energy from said second transmitter in response to a touch made by said second foil, scoring apparatus having a first and a second series of normally deenergized score indicators, means for energizing said first series in response to pulses from said first transmitter and said second series in response to pulses from said second transmitter, a first normally energized name-panel lighting means associated with said first series and a second normally energized name-panel lighting means associated with said second series, means for de-

energizing said first panel lighting means in response to each pulse from said second transmitter, means to deenergize said second panel lighting means in response to each pulse from said first transmitter, and means to deenergize one of said name-panel lighting means and the energized score indicators of its associated series in response to the attainment of a predetermined plurality of energized score indicators in the other series.

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