

[54] BATTERY OPERATED SCOREBOARD

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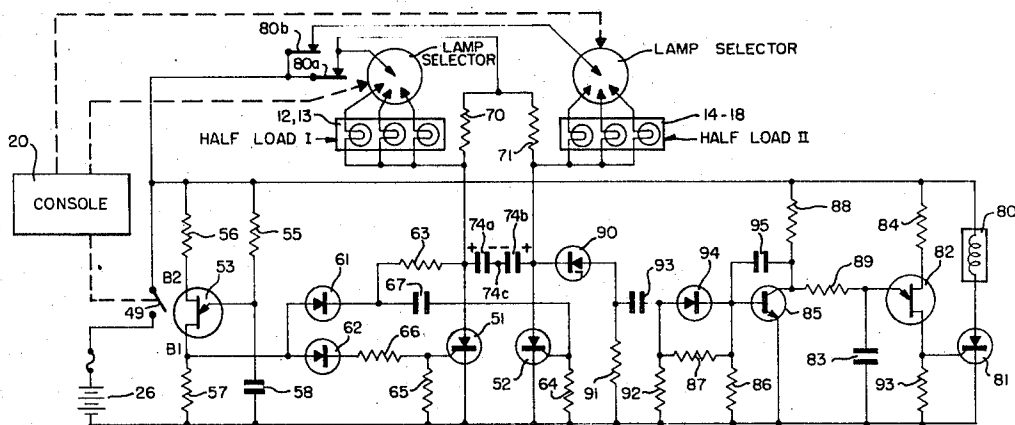
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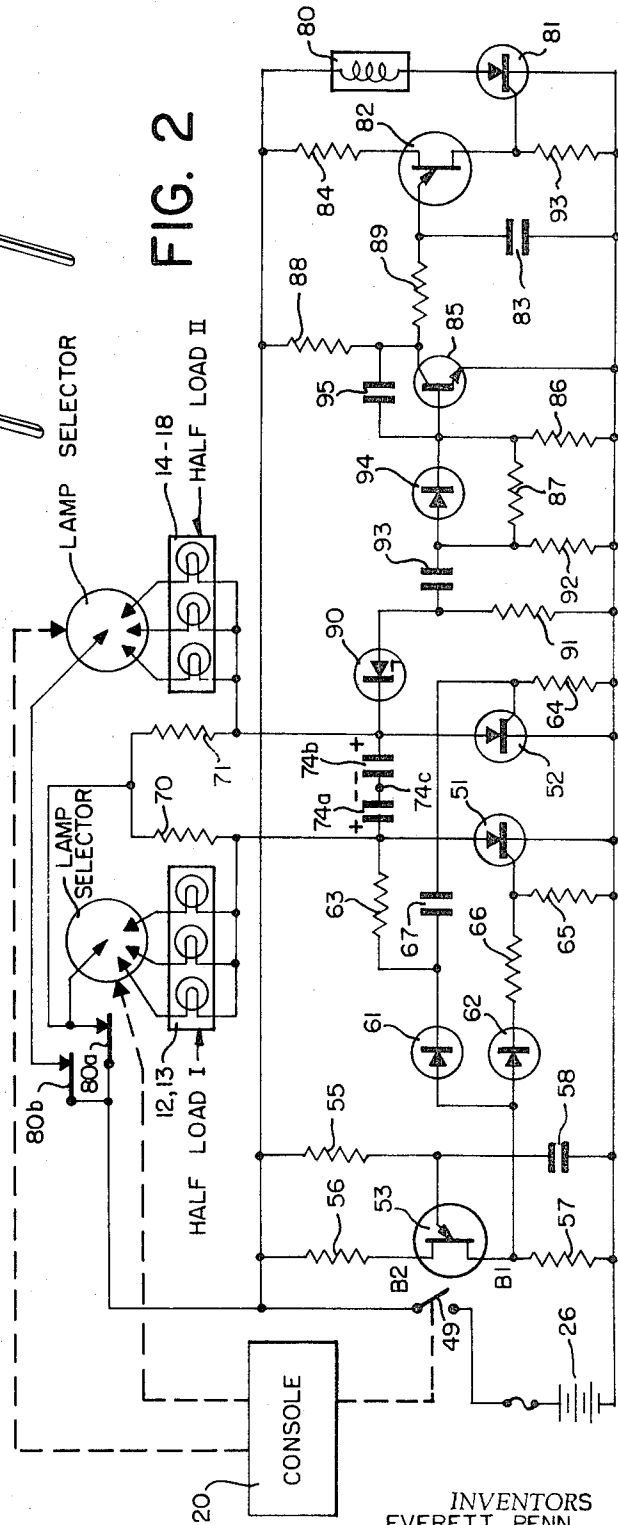
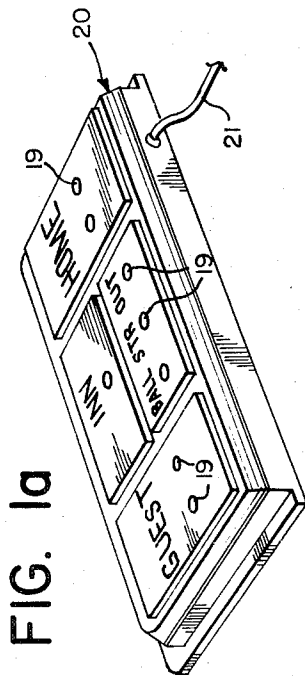
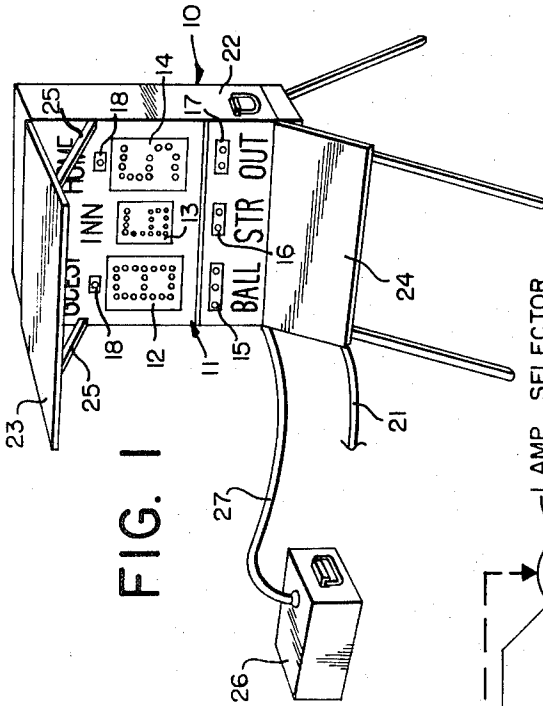
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ABSTRACT

The present invention relates to the battery operation of display devices and the like, including scoreboards for sports events. More particularly, the invention is directed to a unique circuit for efficiently operating a bank of display lamps in a display board with extra light output and for operating the lamps for comparatively lengthy durations without recharging of the batteries. The new and improved operation of remotely situated display boards is effected through the novel manner in which the lamps, of a predetermined voltage rating, are energized with excess voltage or "overenergized." The display lamps are divided into two separate loads, and the "overenergization" of the overall display is alternated rapidly between the two loads of the divided display at a frequency (i.e., 50–70 Hz) carefully selected to provide adequate and regular cooling of the "overenergized, extra intensely burning" lamps while providing the appearance to the eye of being constantly energized. The desired display of information is obtained by a novel "scintillating" energization of the lamps of the board, which energization is effected through a new circuit which includes an oscillator circuit, a switching circuit, and a guard circuit for automatically terminating operation of the board when the DC battery source has reduced itself to a predetermined level or when the oscillator is not properly functioning.

7 Claims, 3 Drawing Figures





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BATTERY OPERATED SCOREBOARD

BACKGROUND OF THE INVENTION

With the ever increasing proliferation of sports activities and spectator interest therein, there has been a concomitant requirement for the provision of adequate scoreboard displays to apprise participants and spectators of the essential particulars at any time. To that end, there have been a substantial number of improvements in the design and operation of scoreboards and, more particularly, of electric scoreboards of the type utilizing matrixes of lamps which are selectively lighted to indicate game scores; game times; game conditions (balls, strikes, period, etc.); and the like. Heretofore, virtually all of these electric scoreboards have been placed in permanent or relatively permanent installations, such as gymnasiums and stadiums, where a readily available AC power source exists. However, with the increase of the number of small neighborhood playing fields on which well attended athletic contests take place, on which fields the installation of conventional AC operated scoreboards is impracticable or is unduly expensive, there has been a growing need for a more portable type of display board which can be used at a plurality of locations and which may be used independently of the degree of accessibility of an AC power source. Accordingly, it is to the end of providing a readily portable scoreboard having an especially visible display, which scoreboard may be used at remote locations (independently of an AC supply) by operation of the same from a portable DC storage battery source, that the present invention is directed.

SUMMARY OF THE PRESENT INVENTION

In accordance with the principles of the present invention, a portable scoreboard having an electrical load essentially comprising a large plurality of comparatively low voltage lamps (14 volts) may be readily, efficiently, and reliably operated for extended periods of time from a comparatively high voltage DC battery source (24 volts) by the "scintillating, overenergization" thereof. Specifically, the load of a portable scoreboard comprises several banks or matrixes of lamps which are used to indicate the score for the home team and the visiting team, and sets of lamps which are used to indicate game conditions, such as "at bat"; "balls"; "strikes"; period of play; and the like, which load is divided into two or more load segments, as required. The load segments are sequentially energized at a frequency which permits the lamps to cool sufficiently between each applied pulse to extend filament life and which frequency is great enough to give the lamp the appearance of being steadily energized but which is not so great as to cause an apparent dimming of the lamps. For ease of description, the invention will be described hereinafter in terms of two load segments which are alternately energized, although it is to be understood that more segments may be employed. Scintillating frequencies of 50-70 Hz are suitable for the purposes of this invention. This type of alternate DC energization of two load segments enables smaller and cheaper power supplies to be used, since the power requirements are substantially reduced (e.g., halved for two load segments; quartered for four load segments).

In accordance with a specific aspect of the invention, the lamps are selected for "overenergization" so that

they produce more light and are therefore more readily visible outdoors. The overenergizing of 14 volt lamps with a 24 volt source has been found particularly advantageous in limiting the effect of sunlight and increasing the visibility and readability of the information displayed by the lamps.

Advantageously, the individual lamps are energized by DC pulses delivered at a rate of approximately 60 Hz. This is very important, since pulses supplied at a rate substantially slower than 60 Hz, i.e., below 50, are observable through the lamps as a disconcerting "flicker", and pulses provided at a substantially greater rate than 60 Hz, i.e., above 70 Hz, result in the lamps having a "dimmed" appearance. The 60 Hz pulses, in accordance with the principles of the invention, are scintillated or alternated between each of the two load segments so that a portion of the board (advantageously approximately "half") is energized while the other portion or "half" cools off and vice versa. With 60 Hz scintillation, and in accordance with the invention, the entire board always appears lighted due to optical illusory effects.

As a more specific aspect of the present invention, the scintillating circuitry includes associated guard circuitry which removes the lamp loads from the energizing circuit if the generation of scintillation pulses should cease or if the battery voltage drops below a predetermined level, e.g., 22 volts for a 24 volt battery source.

DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 1a are schematic, perspective views of a portable scoreboard and control console therefor (drawn to a larger scale) embodying the principles of the present invention; and

FIG. 2 is a circuit diagram for operating a portable scoreboard or the like in accordance with the principles of the present invention.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

Referring now to FIG. 1, a portable scoreboard 10, designed for battery operation in accordance with the principles of the invention and adapted for use in the scoring of "Little League" baseball contests, includes an information display panel 11 having three matrixes of lamps 12-14 to indicate the "guest score"; "inning"; and "home score", respectively, as well as groups of lamps 15-17 to indicate, respectively, "balls", "strikes", and "outs"; and a pair of lamps 18 to indicate the team at bat. In accordance with common practice, these lamps are remotely controlled from appropriate switches 19 on a control console 20 (FIG. 1a) connected to the scoreboard by a cable 21. To enhance its portability, the display panel and its associated circuitry are enclosed in an aluminum frame 22 of reduced size, e.g., approximately 38 by 38 by 6 inches. To facilitate the handling of the scoreboard, the frame includes a carrying handle and removable tubular aluminum legs which advantageously may be stored within hollow lower portions of the scoreboard frame when the scoreboard is not in use. Advantageously, the scoreboard frame 22 includes hinged display panel cover members 23, 24 which protect the lamps and the face of the scoreboard when the board is being carried

or is otherwise not in use. The hinged covers 23, 24 may be opened, as shown in FIG. 1, with the upper cover supported by brackets 25 in a sunshading relationship to the face of the scoreboard. The cover 23 is most useful, as will be appreciated, for those occasions when the scoreboard is operated in bright sunlight, and it greatly contributes to enhancing the visibility of the lighted lamps. The lower cover 24 depends generally downwardly from the scoreboard frame and may be used to advantage to carry an advertising message or the like. The scoreboard is, of course, powered from a DC battery source 26, e.g., a pair of lightweight, rechargeable 12 volt storage batteries, connected thereto by a short cable 27.

As an important aspect of the present invention, the scoreboard lamps 12-18 are 14 volt lamps which are energized at a substantially greater voltage, i.e., approximately 24 volts, than the normal voltage rating for which the lamps are designed to operate to ensure that the filaments of the lamps produce more light than they would otherwise produce if energized at rated voltage. This enhances visibility in the daylight environment in which the portable scoreboard 10 is most often to be used. However, as will be understood, the mere "overenergization" of a DC lamp will ordinarily tend to so overheat the lamp filament that it will be destroyed in very short order. The 14 volt DC lamps of the type contemplated for use in the present invention, when constantly or steadily energized by a 24 volt source, tend to have a life of approximately 5 minutes. On the other hand, when such a lamp is intermittently energized in accordance with the principles of the invention with short pulses and allowed to cool down between the application of pulses, the lamp life will be extended to approximately 300 hours, a lamp life of more than a typical "Little League" season, for example. Thus it should be appreciated that intermittent "overenergization" is of substantial importance to the efficacy of the present invention, and the "overenergization" of the 14 volt lamps with 24 volts provides a display having "extra light" which is very readily visible in sunlight and pronouncedly more visible than would be the case if the lamps were energized by rated voltage or even if higher voltage lamps, e.g., 24 volt lamps, were "properly" or conventionally energized by a 24 volt source.

More specifically and in accordance with the principles of the present invention, the lamps 12-18 of the portable scoreboard may be "overenergized" safely and extremely efficiently in the following manner. The entire lamp load, e.g., 83 lamps for a scoreboard of the type illustrated, is divided into two approximately equal loads, "load segment I" and "load segment II", and each of which is alternately "overenergized" with pulses from a 24 volt DC source. Current in the "worst case" (all lamps of a "load segment" on) reaches approximately 3.6 amps. Thus, one portion or "half" of the entire scoreboard display will always be energized while the other "half" is cooling down and vice versa. It has been determined that by applying "overenergizing" pulses to the lamps at approximately 60 Hz (the lamps in each "load segment" of the scoreboard will be cooled for approximately one one hundred twentieth of a second after the termination of each applied energizing pulse of approximately one one hundred twentieth of a second) in accordance with the principles of the in-

vention, the complete face of the whole board will always appear to be lighted in the eyes of a viewer (although only a portion of the board is actually energized at any instant) due to the optical illusory effects. It is physically impossible for the eyes to notice the extinguishing and relighting of the lamps in each portion of the scoreboard when the lamps in the other portion are also alternating from "off" to "on" at approximately 60 Hz.

Appropriate circuitry for operating a portable scoreboard in accordance with the principles of the invention is shown in FIG. 2. As indicated and in accordance with the invention, the entire scoreboard load is divided and includes load segment I comprising, for example, the lamps used for indicating the guest score and the inning, and into load segment II which comprises the lamps used for indicating home team score, balls, strikes, out, and at bat. Individual ones of the plural lamps 12-18 are controlled (on-off) by switches from the control console, to form lighted numerals for inning and score and to indicate balls, strikes, etc., as should be understood. In accordance with the principles of the invention, the loads I, II are alternately energized with DC pulses at a rate of approximately 60 Hz, although frequencies ranging from as low as 50 Hz to as high as 70 Hz may be employed.

The new and improved "scintillating" circuitry for efficiently operating a portable scoreboard in accordance with the inventive principles generally includes a 24 volt DC battery source 26; the load segment I (comprising lamps 12, 13); and the load segment II (comprising lamps 14-18) connected to the battery through relay contacts 80a, 80b, respectively; power switching circuitry including a pair of silicon controlled rectifiers (SCR's) 51, 52 for delivering pulses alternately to the two loads I, II; timing circuitry of the relaxation oscillator type including unijunction transistor (UJT) 53 for generating timing trigger pulses for operating the power SCR's 51, 52; and guard circuitry for disconnecting the lamps from the power source in the event the oscillator fails to deliver trigger pulses to the gates of the power SCR's or in the event the power source 26 is reduced to an unsatisfactory level, e.g., 22 volts.

In accordance with the principles of the invention, the timing circuit for the generation of lamp energizing pulses at the desired rate of approximately 60 Hz is a relaxation oscillator comprising the unijunction transistor 53 in association with resistors 55, 56 and 57 and a capacitor 58. The bases B1 and B2 of the UJT 53 are connected across the 24 volt battery source through the resistors 56 and 57, while its emitter is connected between the resistor 55 and capacitor 58, as shown. The parameters of resistor 55 and capacitor 58 are appropriately selected for the specific pulse width desired. For example, with a 0.12 microfarad capacitor 58 and a 58 kilohm resistor 56, the positive trigger pulses generated at the base B1 will be approximately 7 milliseconds, thereby providing a scintillating pulse rate of approximately 70 Hz; while if the resistor 56 is increased to approximately 100 kilohms, the pulse duration will be 12 milliseconds, thereby providing a pulse rate of approximately 50 Hz. For a scintillating rate of approximately 60 Hz requiring a pulse duration of approximately 8 milliseconds, the resistance of resistor 56 is 68 kilohms.

The generated pulsing output of the timing circuit is applied to the gates of the SCR's through diodes 61 and 62 which function to block the passage of positive signals from the gate of one SCR to the gate of the other SCR, as will be understood. Thus, the time base for the scintillating circuit is established by the combination of UJT, resistors 55-57, and capacitor 58 which form a conventional relaxation oscillator.

The generated positive pulses are used in accordance with the invention to trigger alternately the firing of the pair of SCR's 51, 52 in order to switch the overenergization of the scoreboard lamps alternately between load I and load II. More specifically, a resistor 63 is included to provide blocking diode 61 with back bias when the SCR 51 is not fired, thus removing the trigger pulse from the gate of the SCR 52 and forcing the SCR 51 to fire first. Thus, when the SCR 51 fires, its anode is at minus potential, therefore removing the back bias on the blocking diode 61. The next pulse generated by the relaxation oscillator will therefore fire the SCR 52. As will be understood, the SCR 52 commutates the SCR 51 by grounding the capacitors 74a and 74b to complete one switching cycle. The capacitors 74a and 74b are wired back-to-back to form a non-polarized capacitor of one-half the rated value of the capacitors. The resistors 70 and 71 are included in parallel with loads I, II to provide loads to the SCR's 51 and 52 during switching of the lamp patterns and therefore ensure that the SCR's will not be artificially unlatched at any time (such as, for example, when "guest score" and "inning" are being changed).

As an important aspect of the present invention, guard circuitry is associated with the scintillating circuitry to remove the power source from the lamps and thereby prevent the burning out of the lamps if the timing circuit should fail to generate a train of pulses for any reason. Additionally, the guard circuitry provides for the removal of the source from the lamp load when the battery has substantially run down to a predetermined weakened level, e.g., 22 volts. The guard circuit includes the operating coil of a safety relay 80 which is controlled by an SCR 81. The latching of the relay 80 through the energization of its coil will open contacts 80a, 80b to remove the power from the lamps 12-18. The SCR 81 is, itself, controlled by a unijunction transistor 82, which in turn is controlled by a guard capacitor 83, which in turn is controlled by a guard transistor 85. The guard circuitry ensures longer battery life, as should be understood.

As long as the SCR's 51 and 52 are firing properly, the transistor 85 will saturate with every other pulse generated by the UJT 53 and will discharge the guard capacitor 83 through the resistor 89 as well as its own collector-emitter junction. However, should SCR 52 for any reason cease to fire in its order and at the predetermined rate, in this example 60 Hz, the guard transistor 85 will not fire and will, therefore, allow the capacitor 83 to charge to the peak voltage of the UJT 82. When this point is reached, the UJT 82 itself will fire and will cause the SCR 81 to fire, thereby energizing the coil 80 and causing it to open its associated contacts 80a, 80b, thereby removing both the loads I and II from the voltage source. As an important aspect of the invention, resistors 88 and 89 as well as the capacitor 82 cooperate to form a time constant of approximately four seconds, which will provide a safety factor to allow

occasional short term (less than 4 seconds) failures of the generation of a pulse train to be non-effective in initiating the firing of the SCR 81.

The back-to-back wiring of the capacitors 74a and 74b provides a point 74c (the junction of the two capacitors) which can be employed to drive the guard transistor 85, when desired or found necessary. In this case, the conditions of both SCR 51 and SCR 52 will be sensed rather than the condition of just SCR 52, as in the circuit arrangement illustrated in FIG. 2. Thus, with this modification of the circuit, there will be a signal at every timing pulse instead of every other timing pulse, as with the FIG. 2 circuit. Accordingly, when the guard transistor 85 is driven from point 74c, it would be switching at twice the rate at which it switches in the FIG. 2 circuit, and this arrangement would reduce the size requirement of the guard capacitor 83 from that of the FIG. 2 circuit.

A zener diode 90 is included in the guard circuit, as shown, and it functions to sense constantly the battery voltage. Should the battery voltage drop below a predetermined value, i.e., 22 volts, the zener diode 90 will block the transistor from firing, a condition which will therefore permit the capacitor 83 to accumulate sufficient charge to fire the UJT 82 which in turn will fire the SCR 81 and thereby energize the safety relay coil 80.

By way of an example, the parameters for the circuit of FIG. 2 for operating a scoreboard having 83 lamps (14 volts DC) from a 24 volt storage battery source are tabulated hereinbelow.

Circuit Element	Reference Numeral	Specification
Resistors	55	68 Kohms .5 watt
	56	220 ohms .5 watt
	57, 86	47 ohms .5 watt
	63, 87	4.7 Kohms .5 watt
	64	2.2 Kohms .5 watt
	65	470 ohms .5 watt
	66	15 ohms .5 watt
	70, 71	125 ohms 10 watt
	84	390 ohms .5 watt
	88	6.8 Kohms .5 watt
	89	1.5 Kohms .5 watt
	91	3.3 Kohms .5 watt
	92	15 Kohms .5 watt
	93	100 ohms .5 watt
Capacitors	58	.12 MFD-75VDC
	67	.22 MFD-75VDC
	74a, 74b	50 MFD-50VDC
	83	500 MFD-25VDC
	93	.68 MFD-75VDC
	95	.056 MFD-100VDC
Silicon Controlled Rectifiers	51, 52	MCR 2818R-1
	81	MOT 430 or MOT 2N5060
Transistor	85	2N3705
Unijunction Transistors	53, 82	2N2646 or 2N4871
Relay	80	Guardian 9152 C-24v
Reset Switch	49	Guardian 9152 C-24 v
DC Source	26	Two 12 volt batteries

As should be appreciated, the new and improved portable scoreboard of the present invention may be easily carried from playing field to playing field and quickly placed into reliable operation from a readily portable DC source, such as a pair of 12 volt storage

batteries. The alternate energization of each half of the display board by a square wave of DC power pulses, of course, reduces the power requirement for operating the entire board, thereby contributing to the reduction in size of the power source and contributing to the ease with which the power source may be moved from site to site. Moreover, the alternate energization of the halves of the display board at 50-70 Hz provides intermittent cooling periods, and thereby enables the display lamps to be overenergized for enhanced visibility, while not distracting from the overall scoreboard display, which appears to be constantly lighted (without "flicker" or "dimming") due to the advantageous use of optical illusory effects on the unaided eye.

As the most important advantage of the invention, a portable scoreboard can be successfully and reliably operated from a readily available rechargeable battery source for extended periods, i.e., several hours without recharging. Absent the new circuitry, operation of a battery powered conventional scoreboard would cause the battery to run down in an unacceptably short period of time. Thus, it should be appreciated that the new and improved guard circuitry, which ensures the conservation of battery energy, and the new and improved scintillating circuitry, which reduces the battery load, effectively extend battery life from the unacceptably short period of time obtained with a conventional board directly powered by a battery to the acceptable and comparatively long life of many, many hours.

It should be understood that the new and improved circuitry and the scoreboard operated thereby have been disclosed herein by way of example and not limitation of the present invention. Those skilled in the art will appreciate that many other practical uses of the inventive principles are apparent, including, for example, "standby" or "emergency" power source applications. Accordingly, reference should be made to the appended claims in ascertaining the scope of the invention.

We claim:

1. A portable scoreboard comprising
 - a. a display panel including a plurality of selectively lightable incandescent lamps divided into first and second lamp loads;
 - b. a portable battery providing a DC voltage source of predetermined value;
 - c. scintillating circuit means for alternately applying said DC voltage to each of said lamp loads for durations of approximately 5-12 milliseconds;
 - d. said lamps are of predetermined voltage rating substantially less than the DC voltage source;
 - e. whereby the lamps of the first load are non-energized and free to cool down during the energization of the second load and vice versa, whereby the lamps of the entire display panel provide an appearance of constantly being lighted, and whereby said lamps are overenergized when said voltage is

applied.

2. The scoreboard of claim 1, in which
 - a. said scintillating circuit means include a generator of timing pulses and means switching the delivery of DC voltage from said first load to said second load at a rate determined by the frequency of said timing pulses.
3. The scoreboard of claim 2, which further includes
 - a. guard circuit means in association with said scintillating circuit means to prevent the energization of said lamps by said DC source in the absence of timing pulses for a predetermined limited duration.
4. The scoreboard of claim 3, in which
 - a. said guard circuit means includes means to prevent the energization of said lamps upon the predetermined diminution of voltage of said DC source.
5. A circuit for energizing a plurality of display lamps from a DC voltage source, including
 - a. means dividing said plurality of lamps into two groups;
 - b. means generating a train of timing pulses;
 - c. switching means alternately and mutually exclusively applying the voltage from said DC source to said two groups of lamps at a frequency and for durations determined by said timing pulses;
 - d. the frequency of the application of said voltage to said lamps being high enough to provide the optical illusion that both groups of lamps are lighted at the same time and said frequency being low enough to provide each group of lamps sufficient time for cooling of its filaments while the other group of lamps is being energized; and
 - d. said lamps being overenergized by said DC source to provide extra light and a more readily visible appearance.
6. The circuit of claim 5, which includes
 - a. guard circuit elements for opening the lamp energizing circuit upon the failure of said means generating a train of timing pulses or upon the reduction of the voltage source to a predetermined level.
7. The circuit of claim 6, in which
 - a. the timing pulses are generated by a UJT relaxation oscillator means;
 - b. said switching means includes a commutated pair of silicon controlled rectifiers;
 - c. said guard circuit includes relay means having switch contacts in series with said DC source and said lamp groups and a latching coil in series with a guard silicon controlled rectifier;
 - d. sampling means for detecting the voltage at the gates of the commutated pair of silicon controlled rectifiers;
 - e. said guard silicon controlled rectifiers being fired in the absence of the detection of a pulsating voltage by the voltage sampling means.

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