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(54) **DISPLAY CONTROL FOR SCORE AND IMPACT POSITION IN TARGET DEVICE**

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(57) **ABSTRACT**

A target device is used in gun shooting, Japanese archery, archery, etc. The target device has a light-emitting element group of LEDs, for example, disposed around a target plate. The target device also has an impact position detector, a score calculator, and a light-emitting element energizing unit. When an impact position on the target plate is detected by the impact position detector, the score calculator calculates a score based on the detected impact position. The light-emitting element energizing unit selectively energizes the LEDs of the light-emitting element group depending on the calculated score and/or the detected impact position.

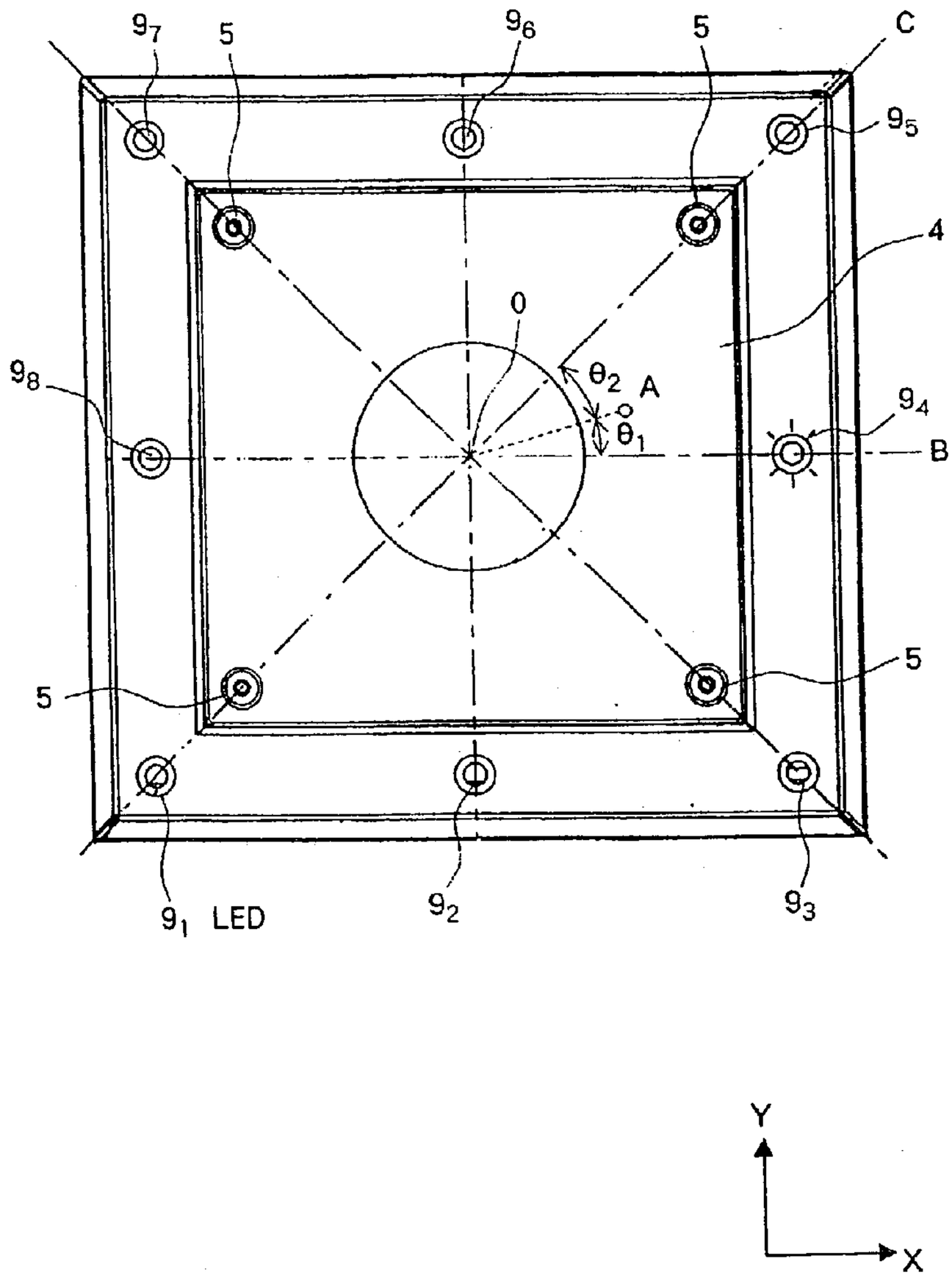


Fig. 1 (Prior Art)

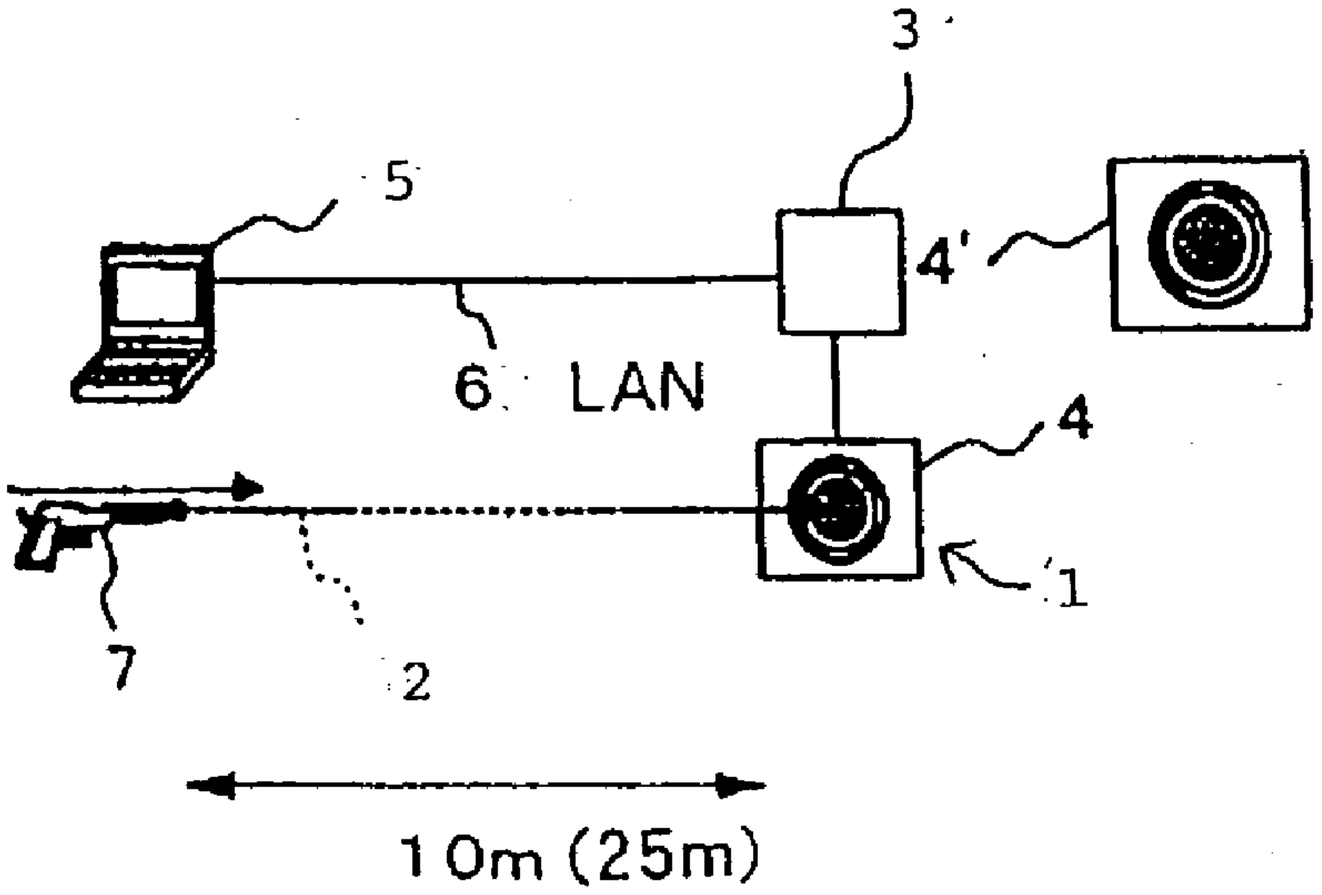


Fig. 2 (Prior Art)

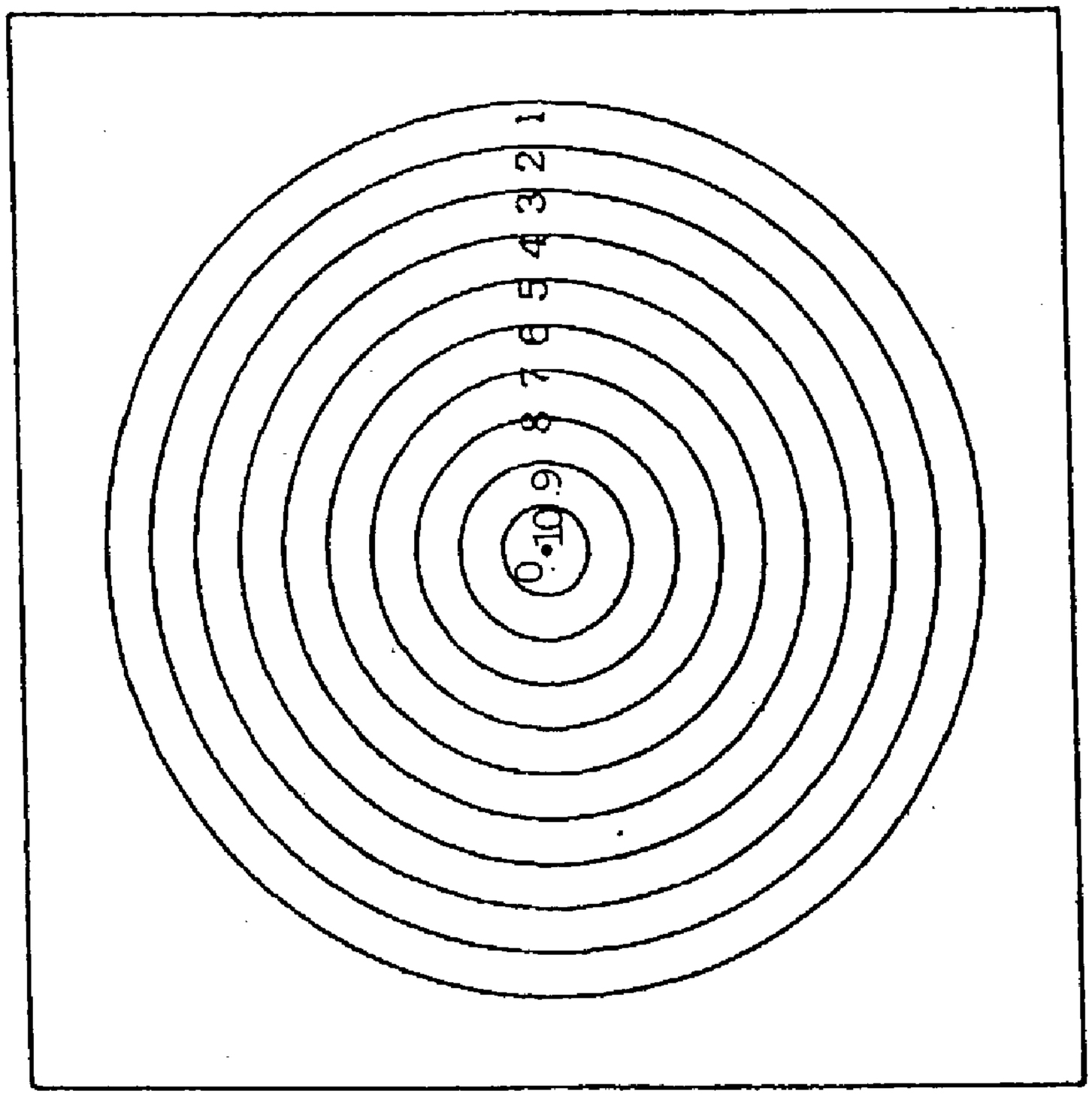


Fig. 3A

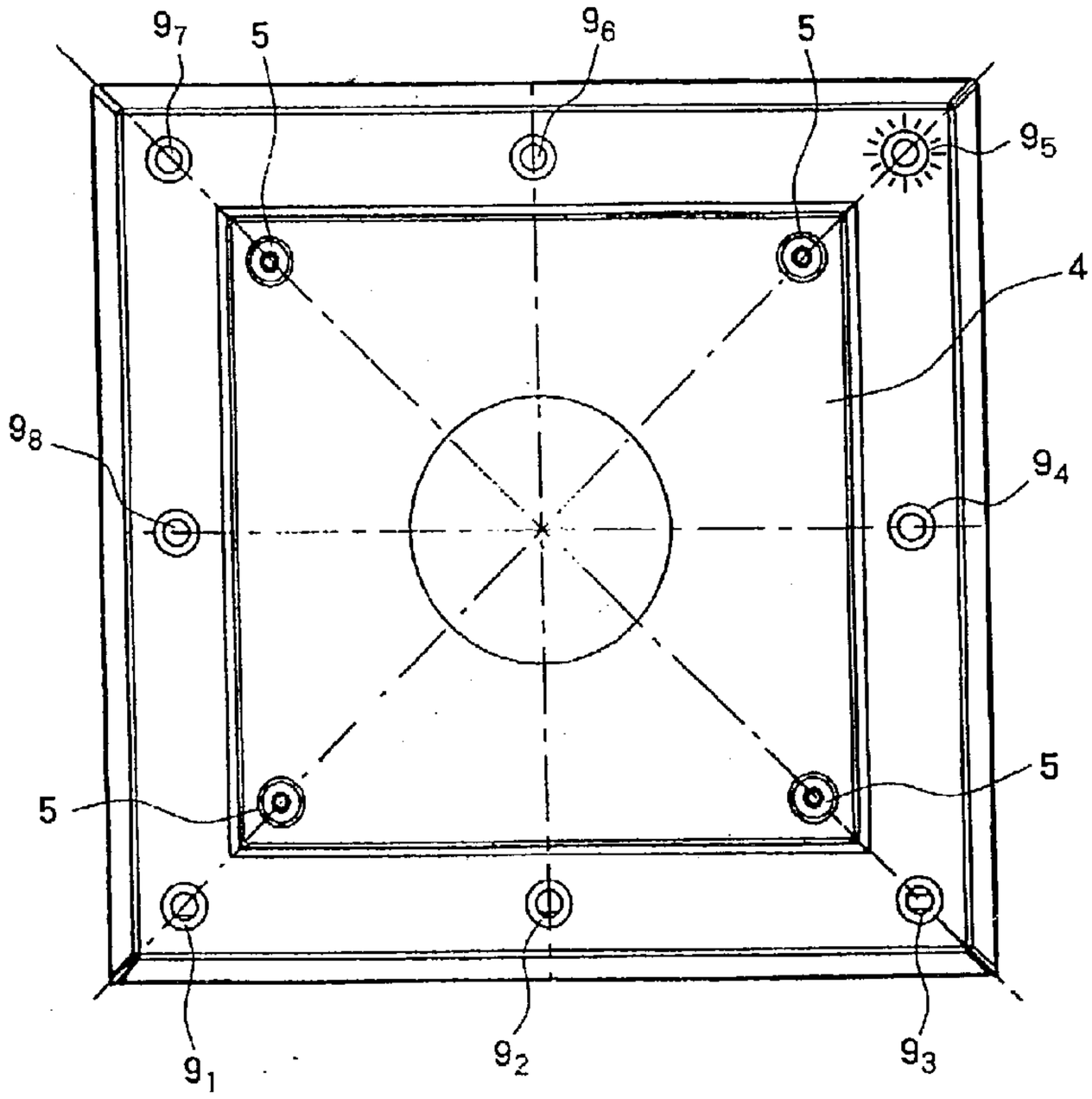

9_7
5
9_6
5
9_5
4
9_8
9_4
5
5
9_1
9_2
9_3

Fig. 3B

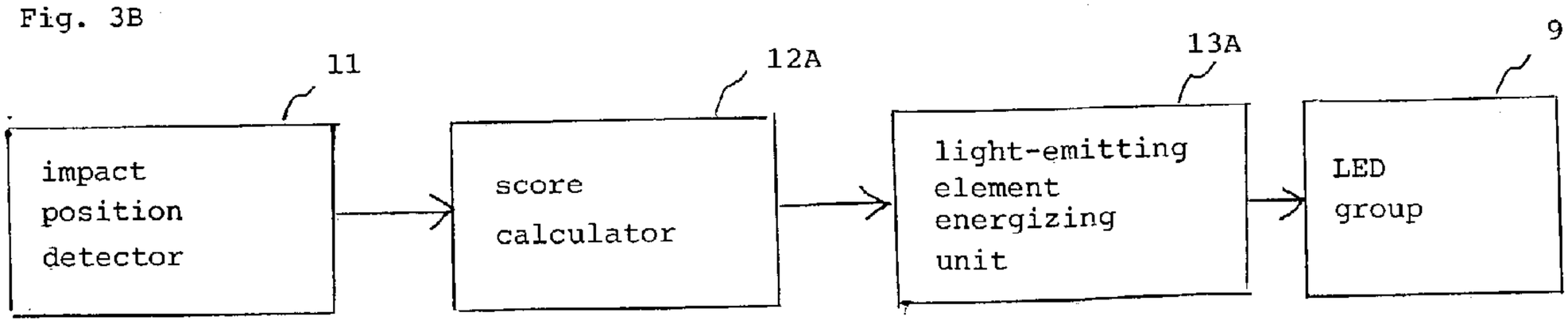
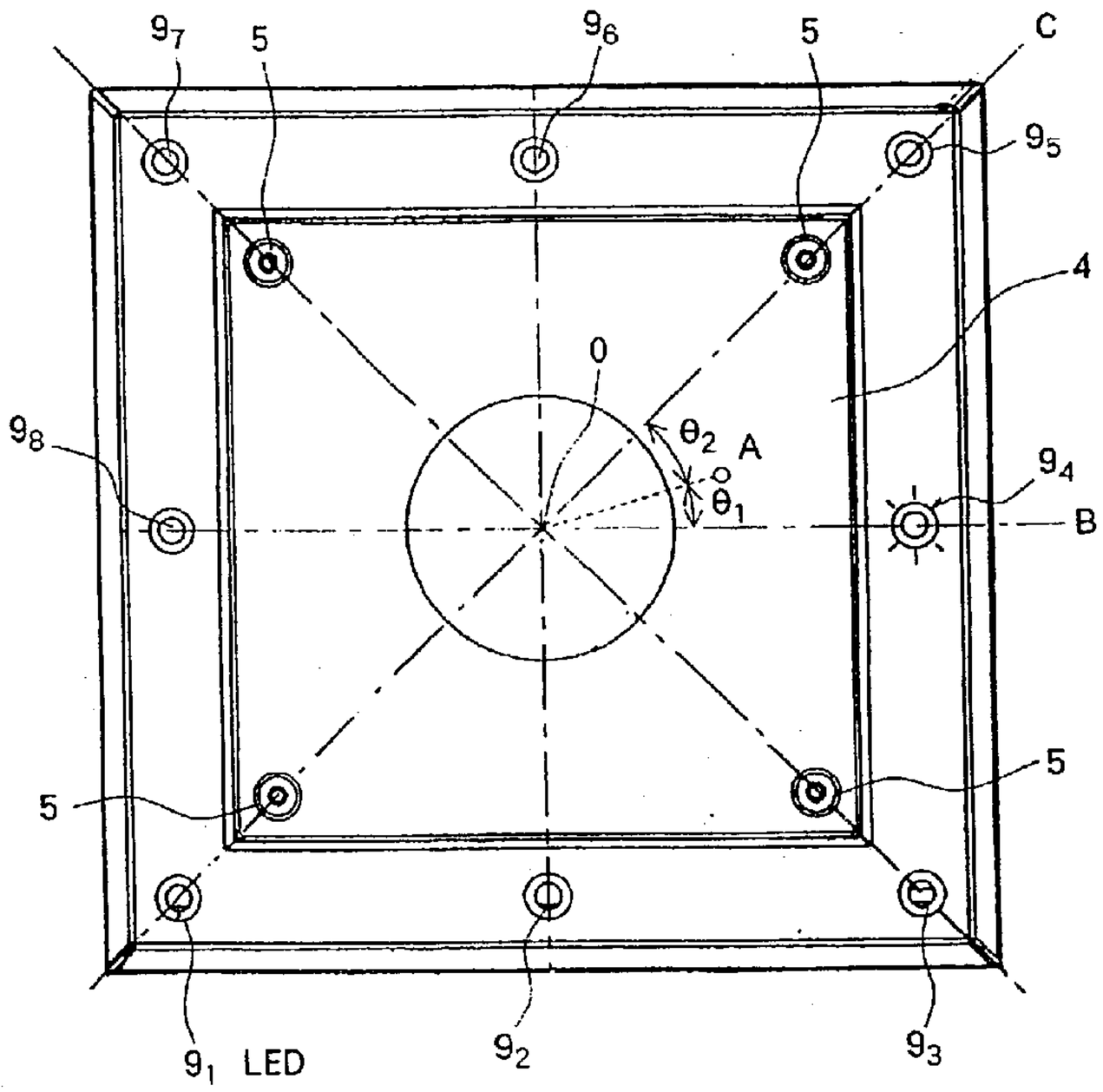

11
impact position detector
12A
score calculator
13A
light-emitting element energizing unit
9
LED group

Fig. 4A


9_7
5
9_6
5
C
9_5
4
0
θ_2
A
θ_1
9_8
9_4
B
5
5
9_1 LED
9_2
9_3

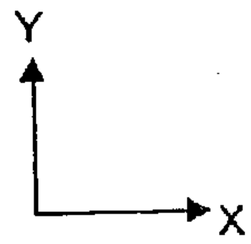

Y
X

Fig. 4B

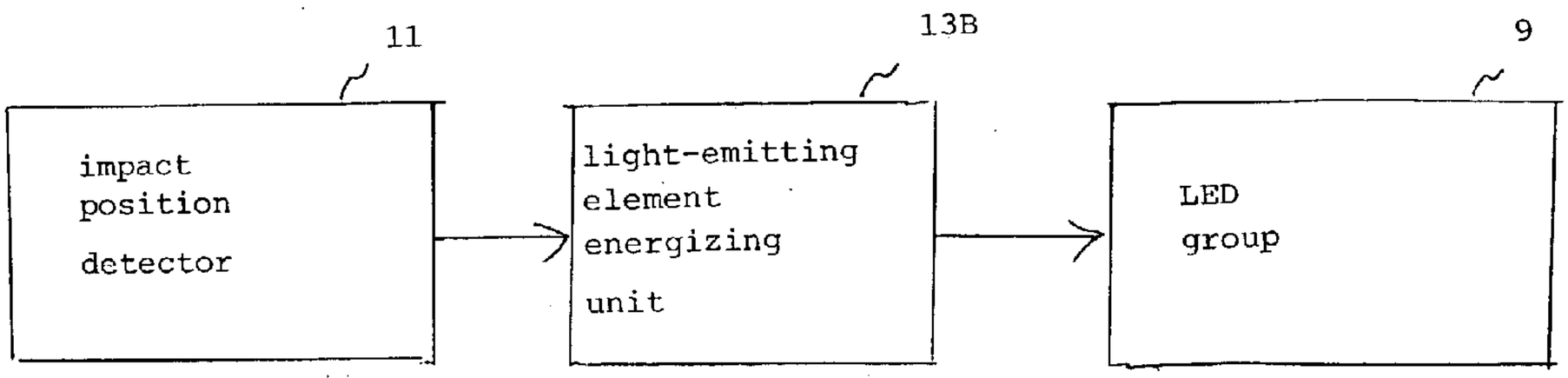

11
13B
9
impact position detector
light-emitting element energizing unit
LED group

Fig. 5A

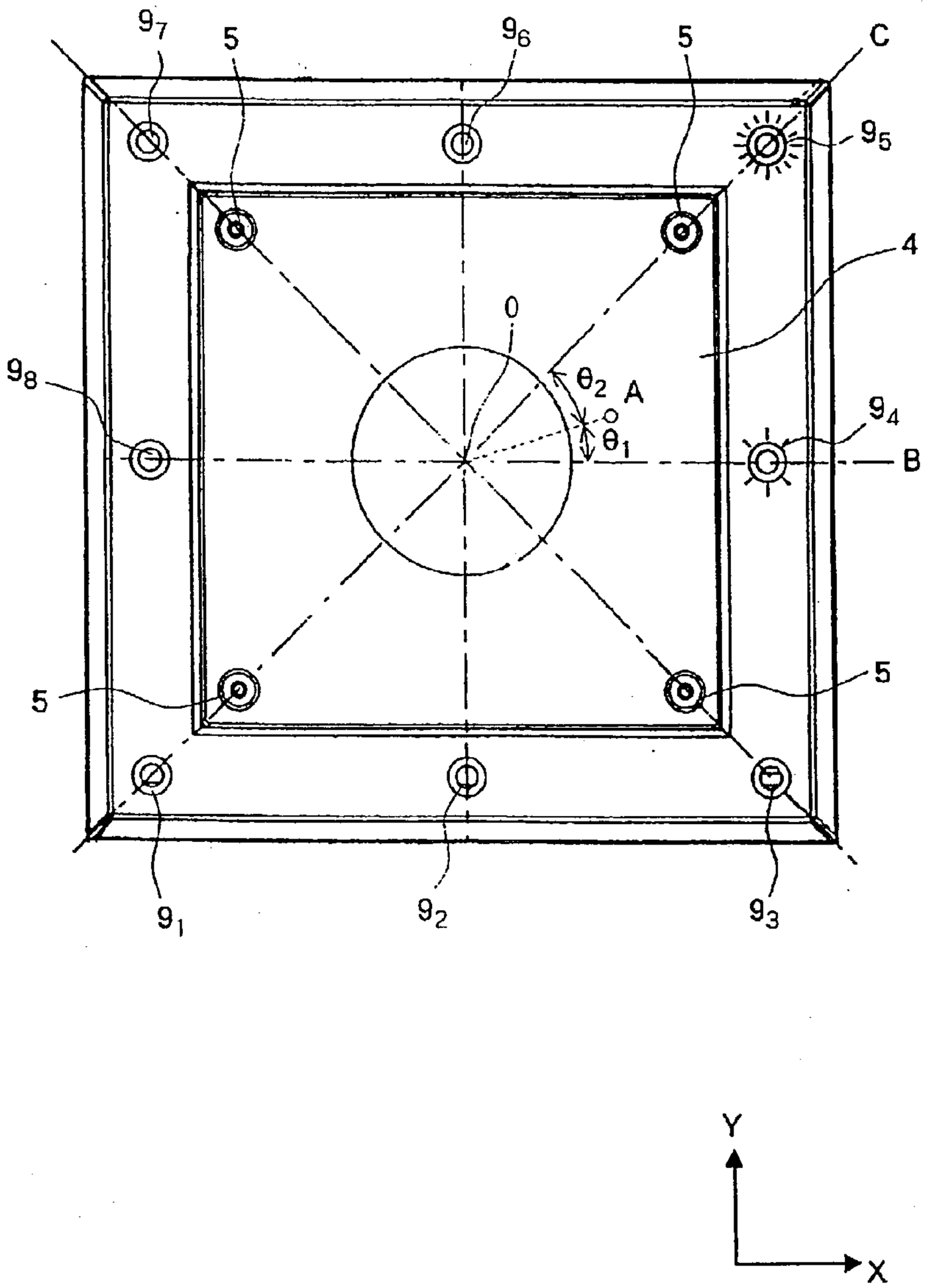

9_7
5
9_6
5
C
9_5
4
0
θ_2
A
θ_1
9_8
9_4
B
5
5
9_1
9_2
9_3
Y
X

Fig. 5B

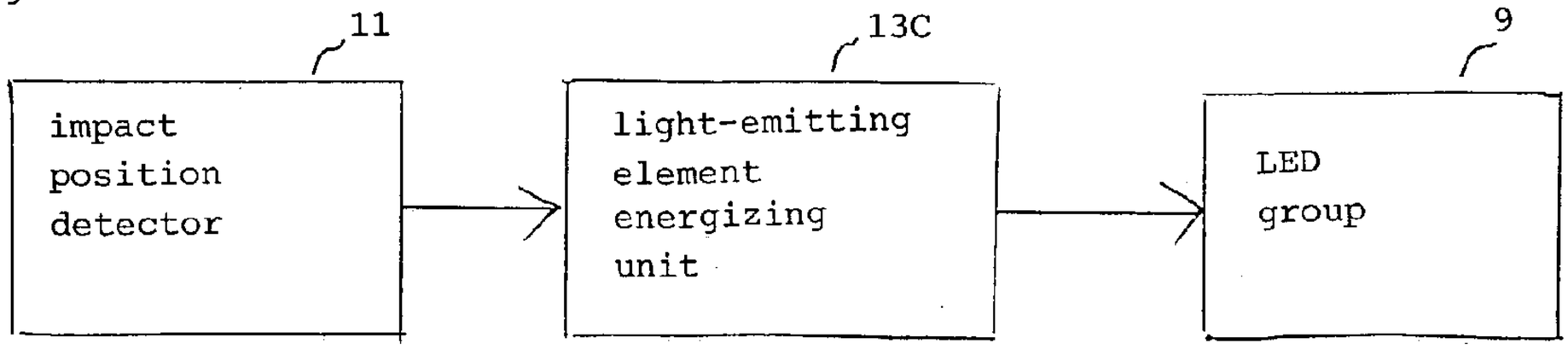

11
impact position detector
13C
light-emitting element energizing unit
9
LED group

Fig. 6A

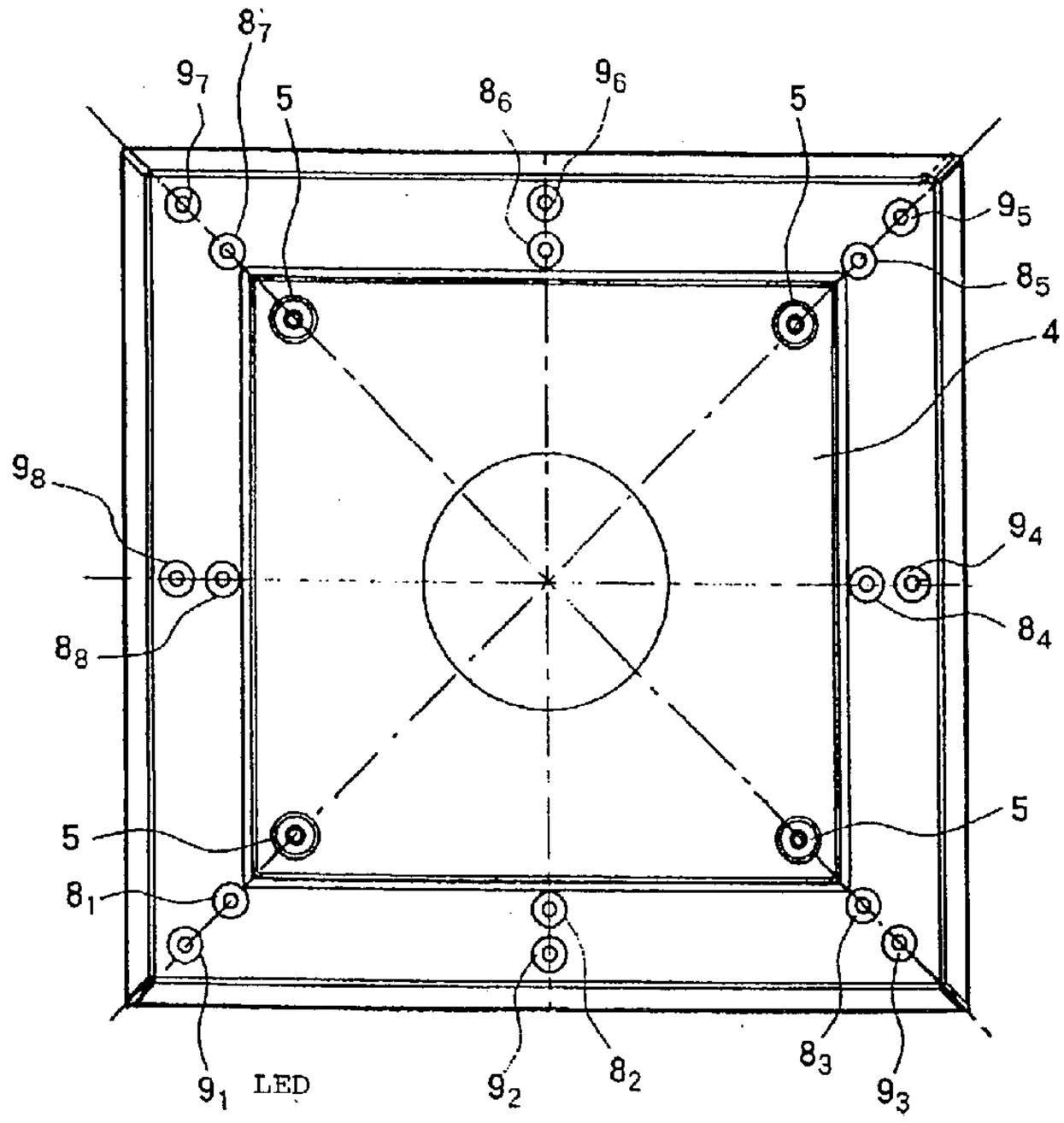

8_7
9_7
5
8_6
9_6
5
9_5
8_5
4
9_8
9_4
8_8
8_4
5
5
8_1
9_1
LED
9_2
8_2
8_3
9_3

Fig. 6B

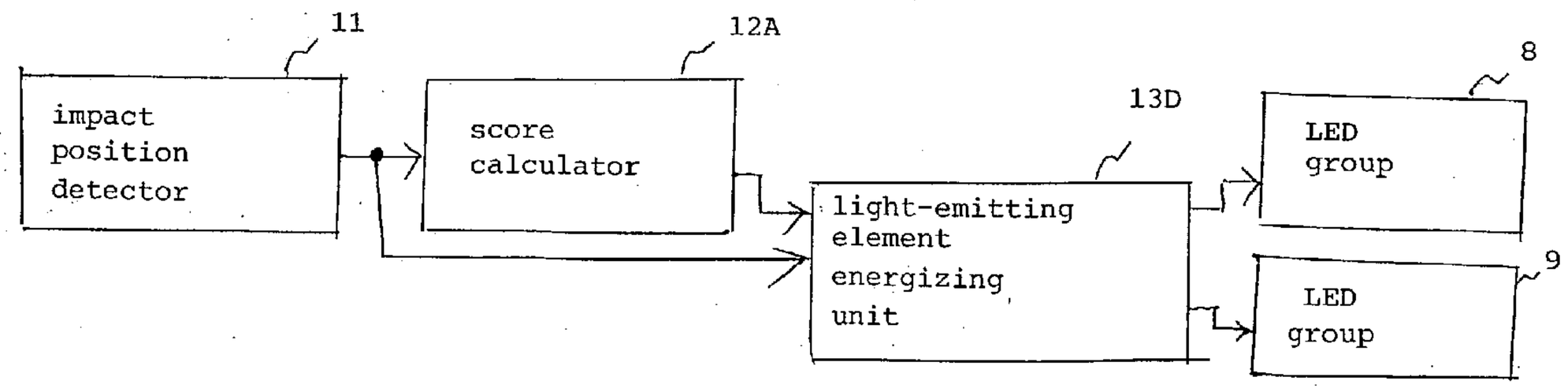

11
impact position detector
12A
score calculator
13D
light-emitting element energizing unit
8
LED group
9
LED group

Fig. 7A

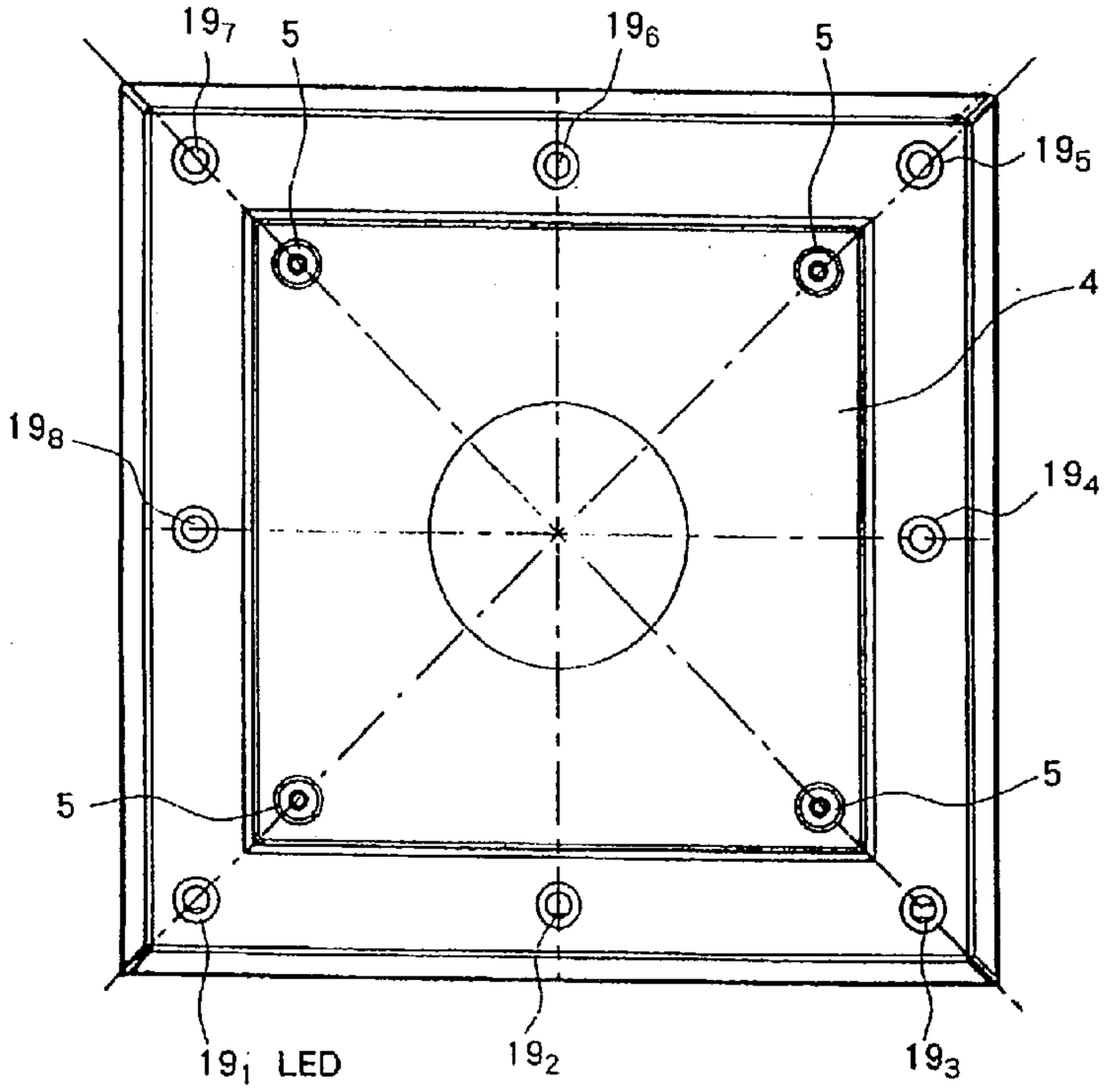

19_7
5
19_6
5
19_5
4
19_8
19_4
5
5
19_1 LED
19_2
19_3

Fig. 7B

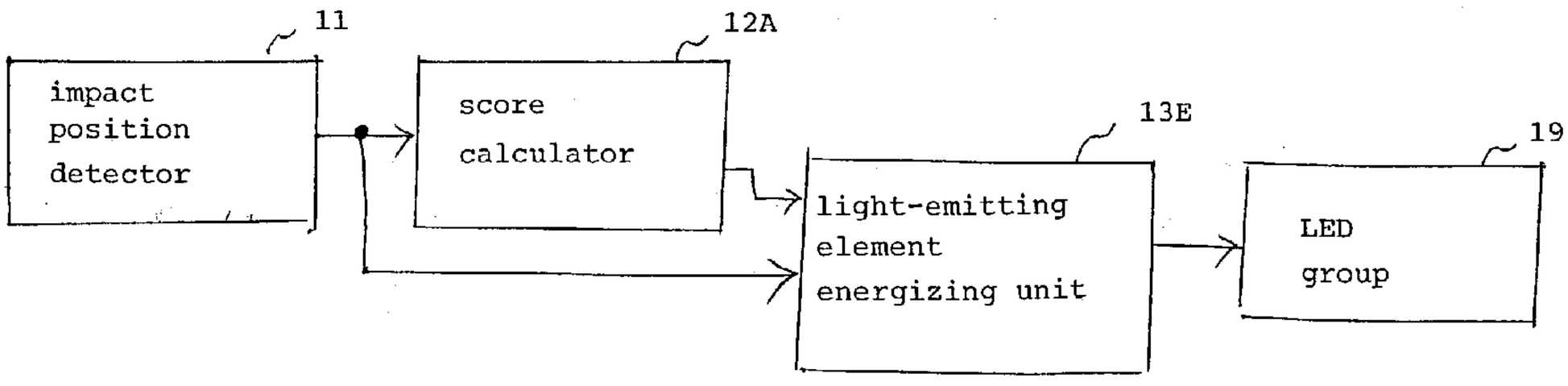

11
impact position detector
12A
score calculator
13E
light-emitting element energizing unit
19
LED group

Fig. 8A

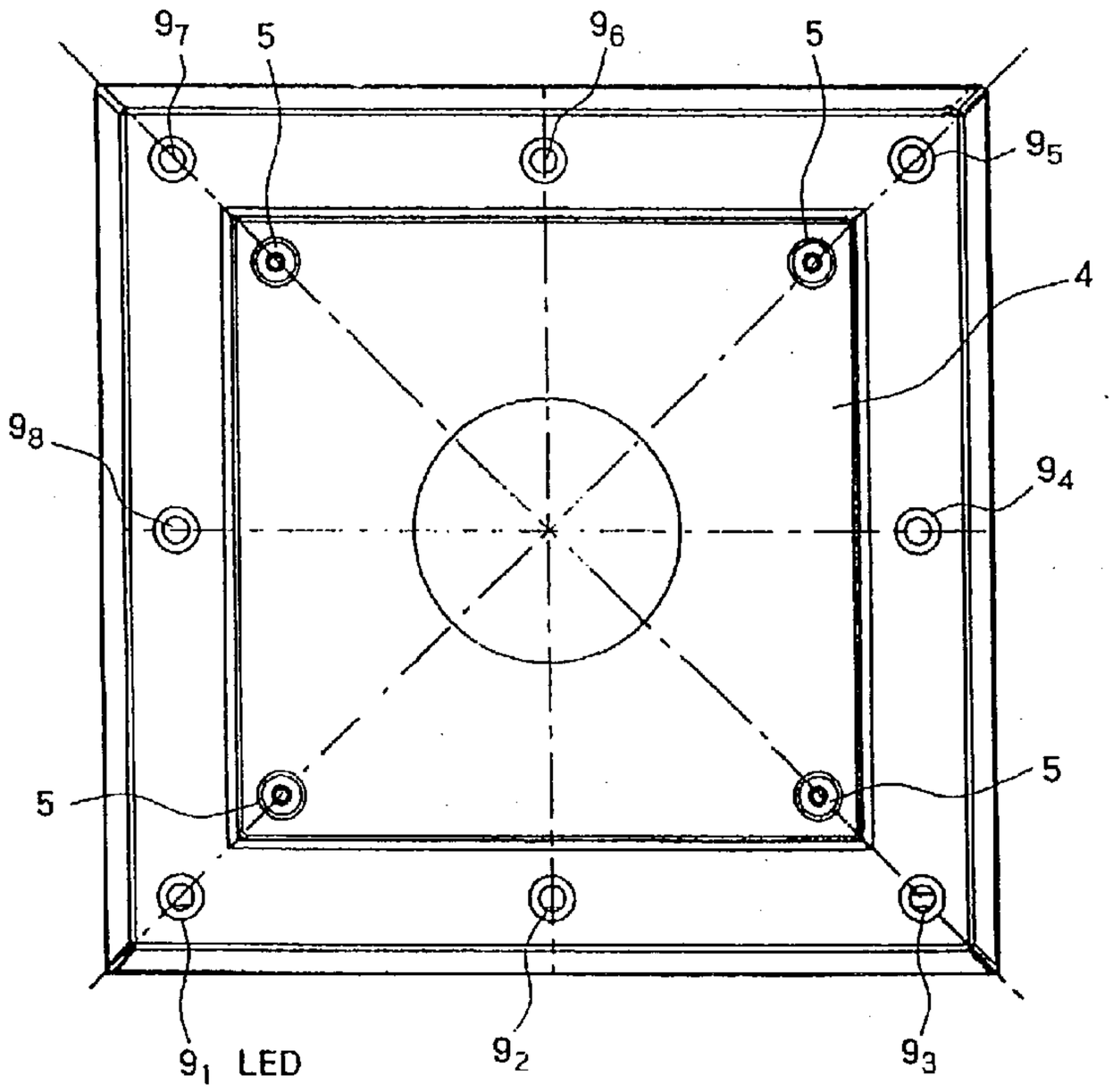

9_7
5
9_6
5
9_5
4
9_8
9_4
5
5
9_1 LED
9_2
9_3

Fig. 8B

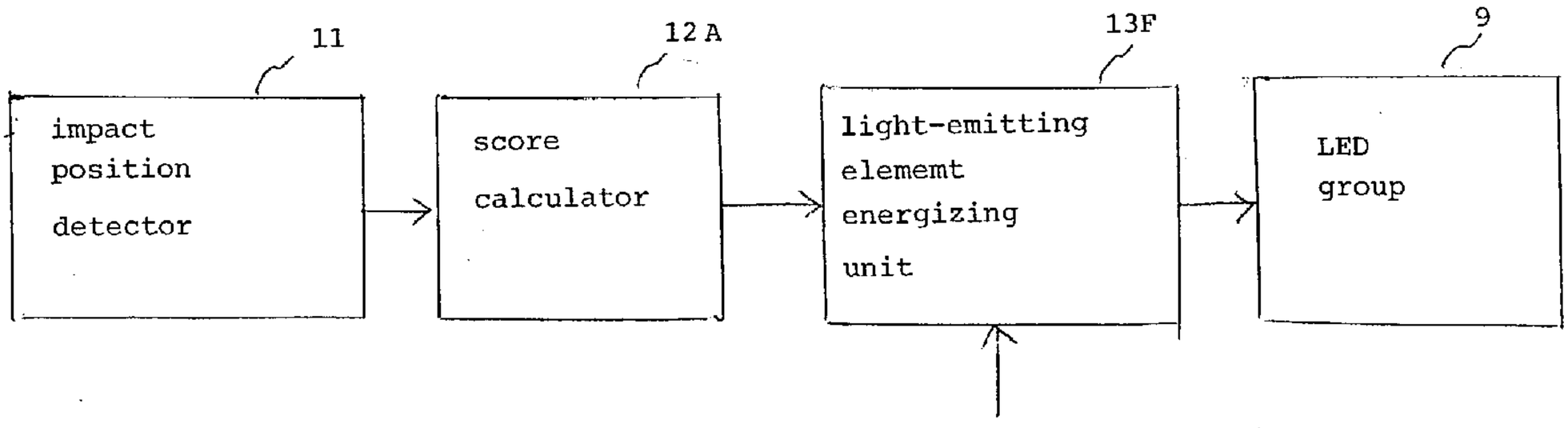

11
impact position detector
12A
score calculator
13F
light-emitting elememt energizing unit
9
LED group

Fig. 9A

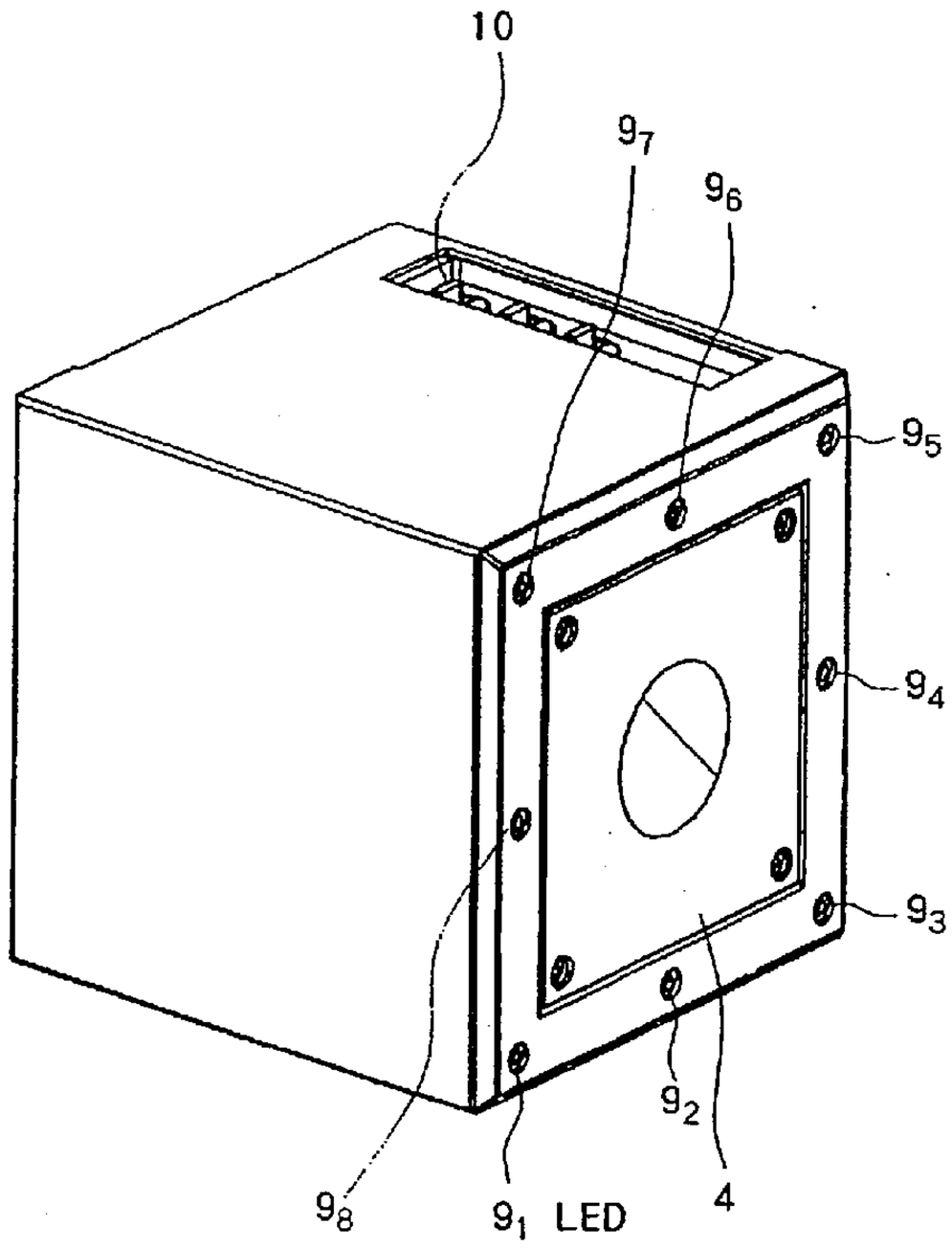

10
9_7
9_6
9_5
9_4
9_3
9_2
9_8
9_1 LED
4

Fig. 9B

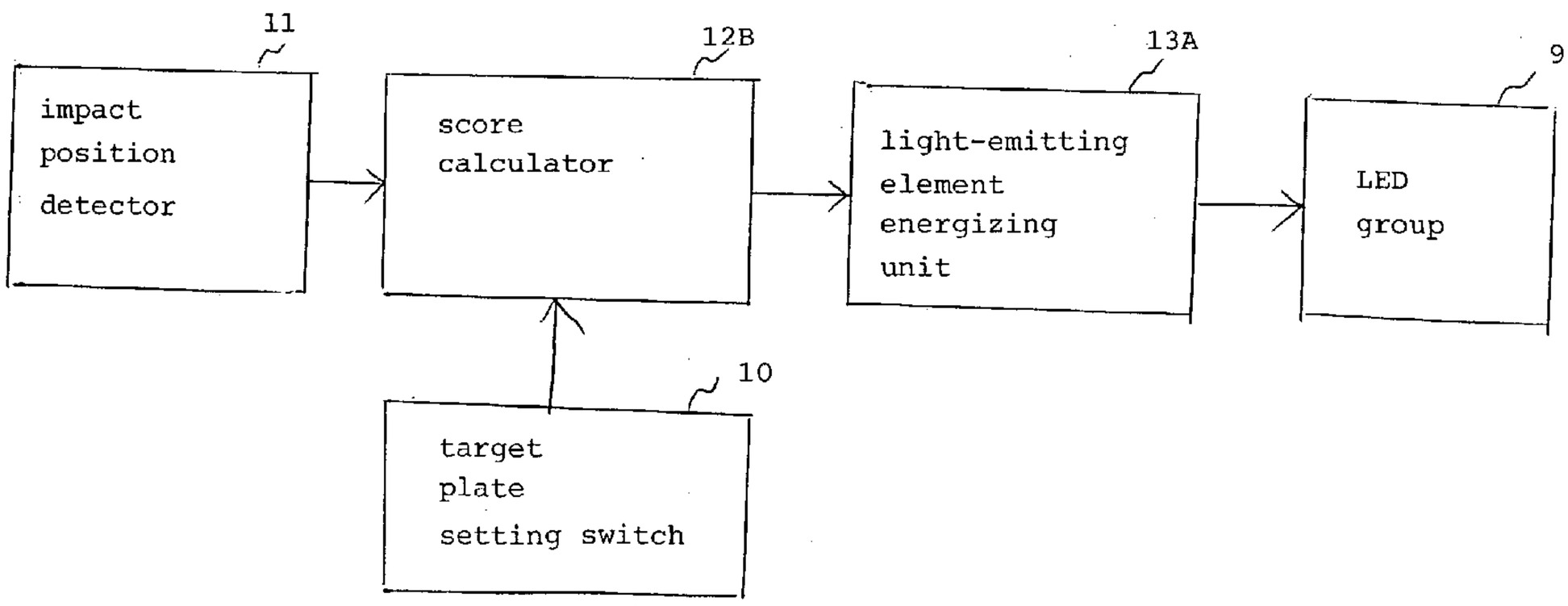

11
impact position detector
12B
score calculator
13A
light-emitting element energizing unit
9
LED group
10
target plate setting switch

Fig. 10

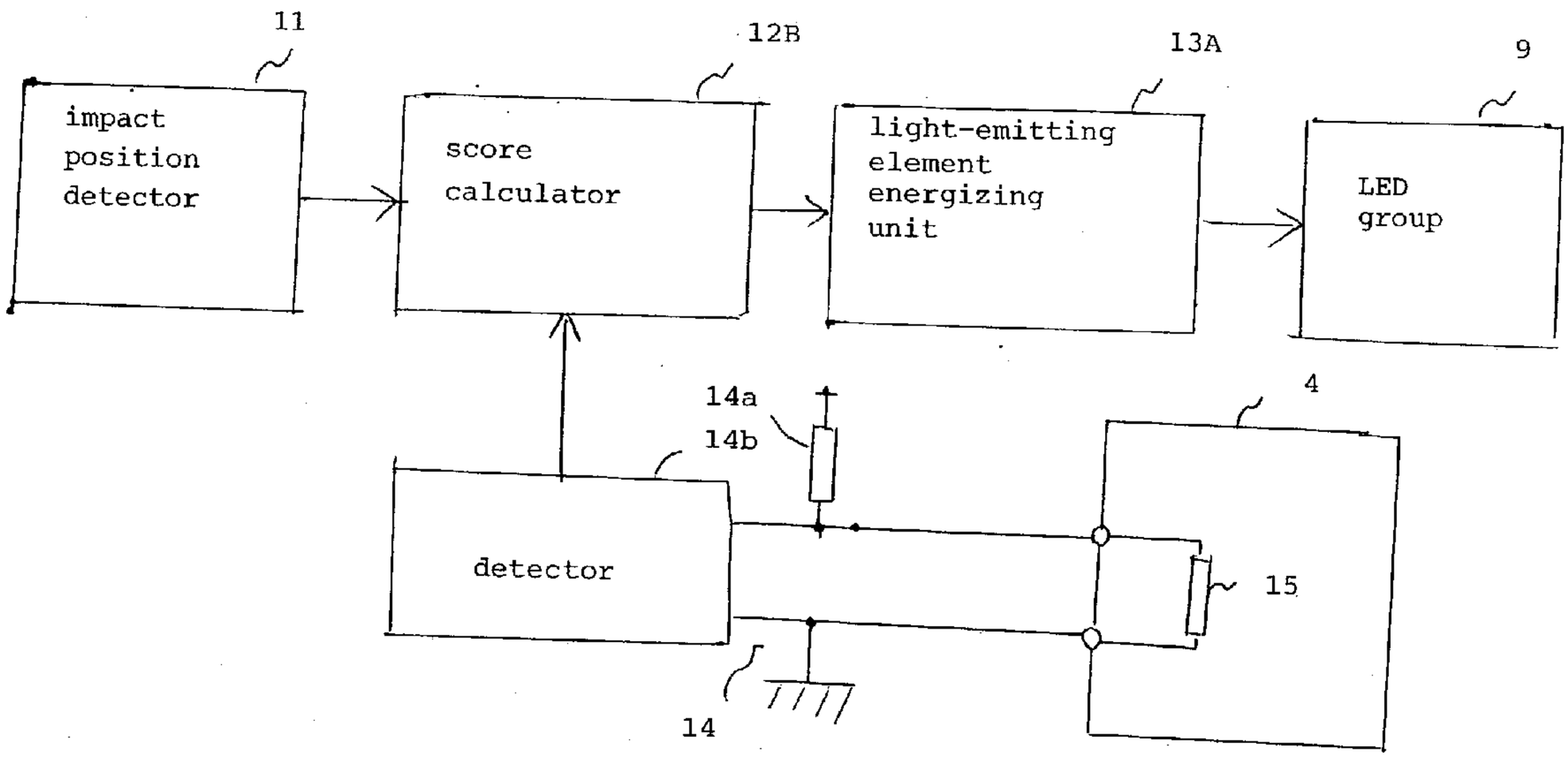

11
12B
13A
9
impact position detector
score calculator
light-emitting element energizing unit
LED group
4
14a
14b
detector
15
14

Fig. 11A

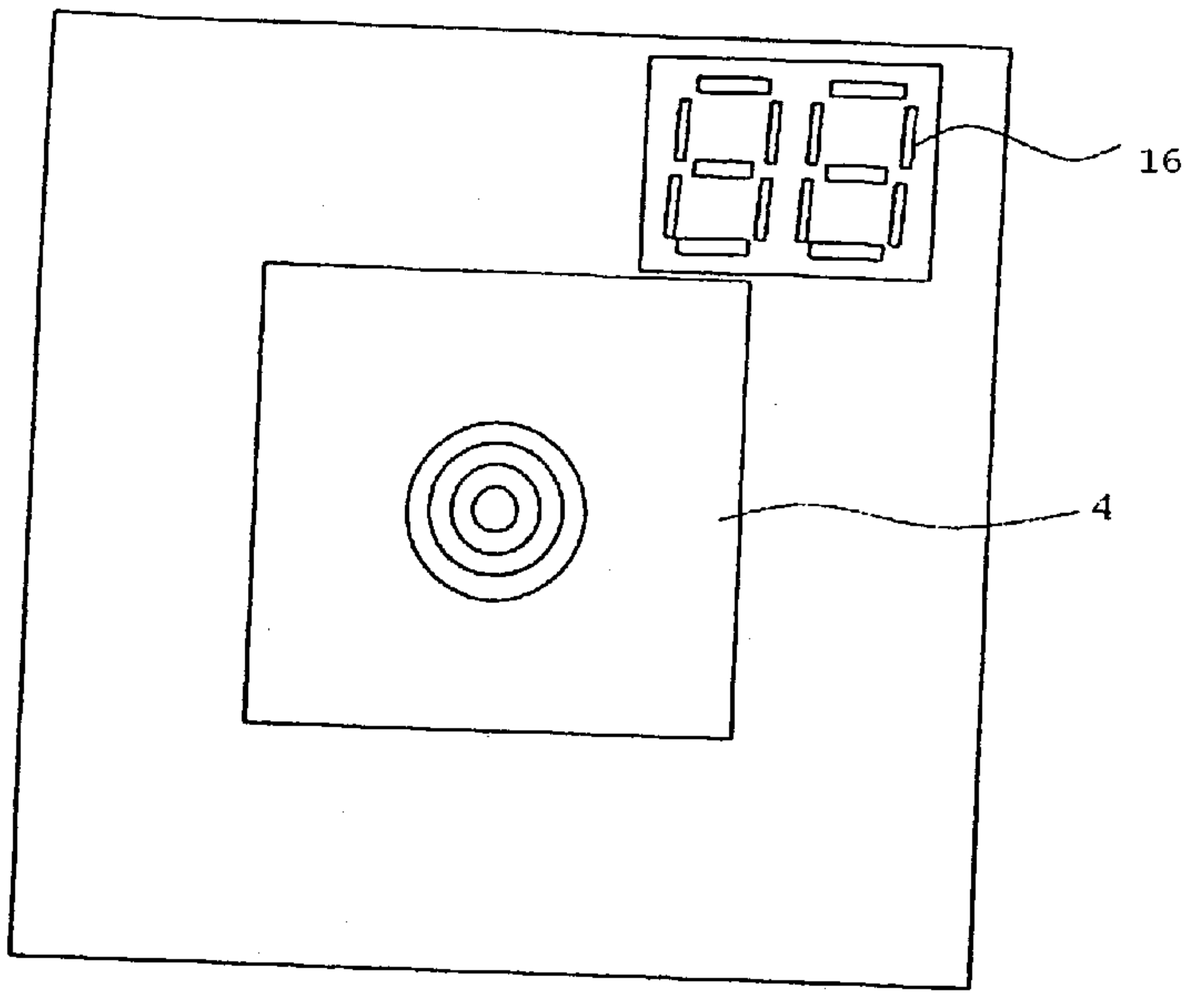


Fig. 11B

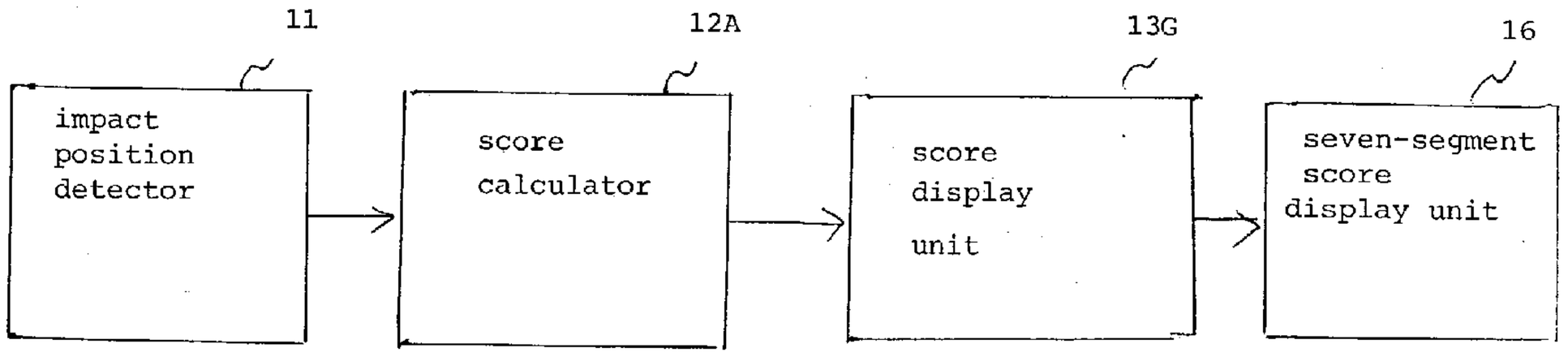


Fig. 12A

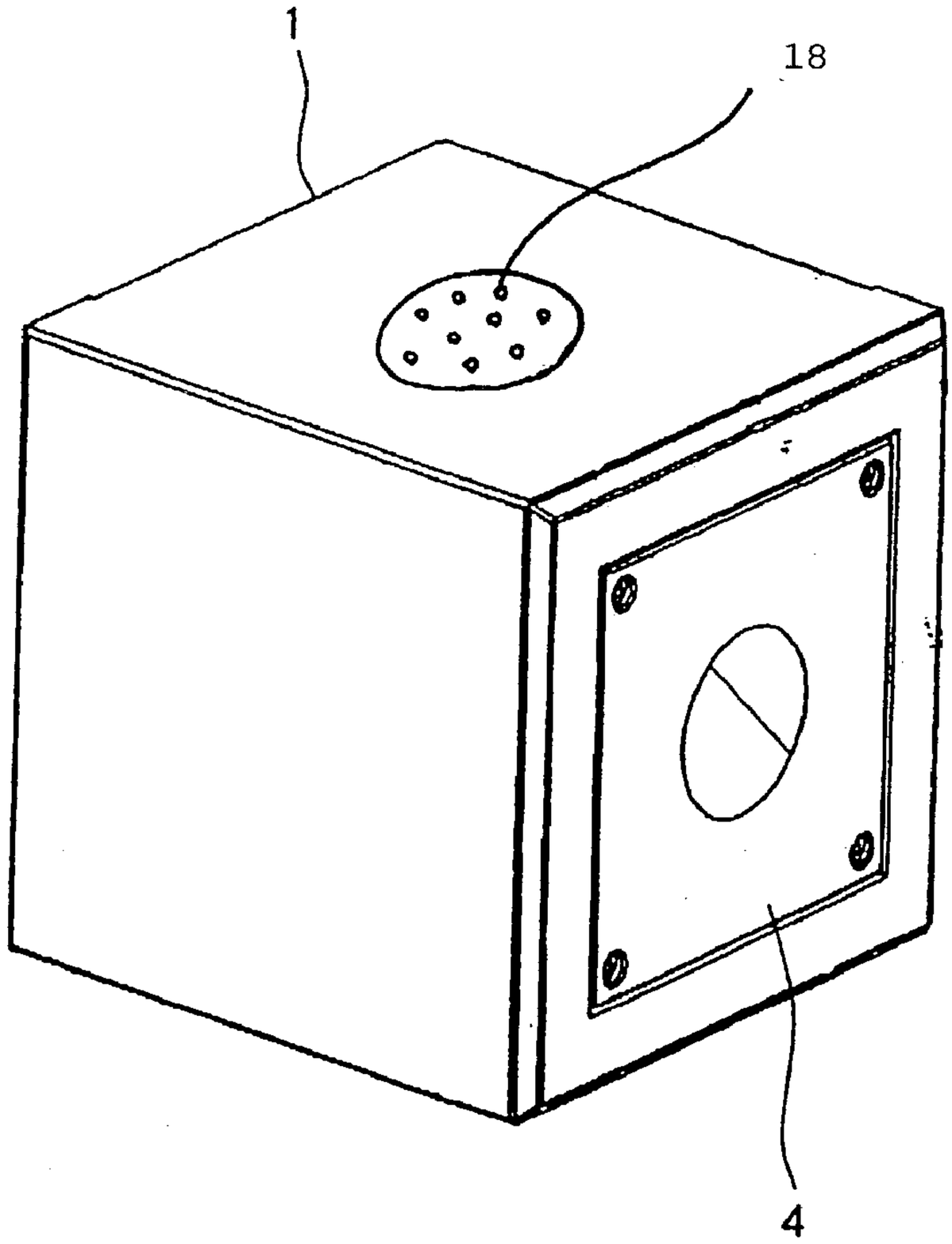
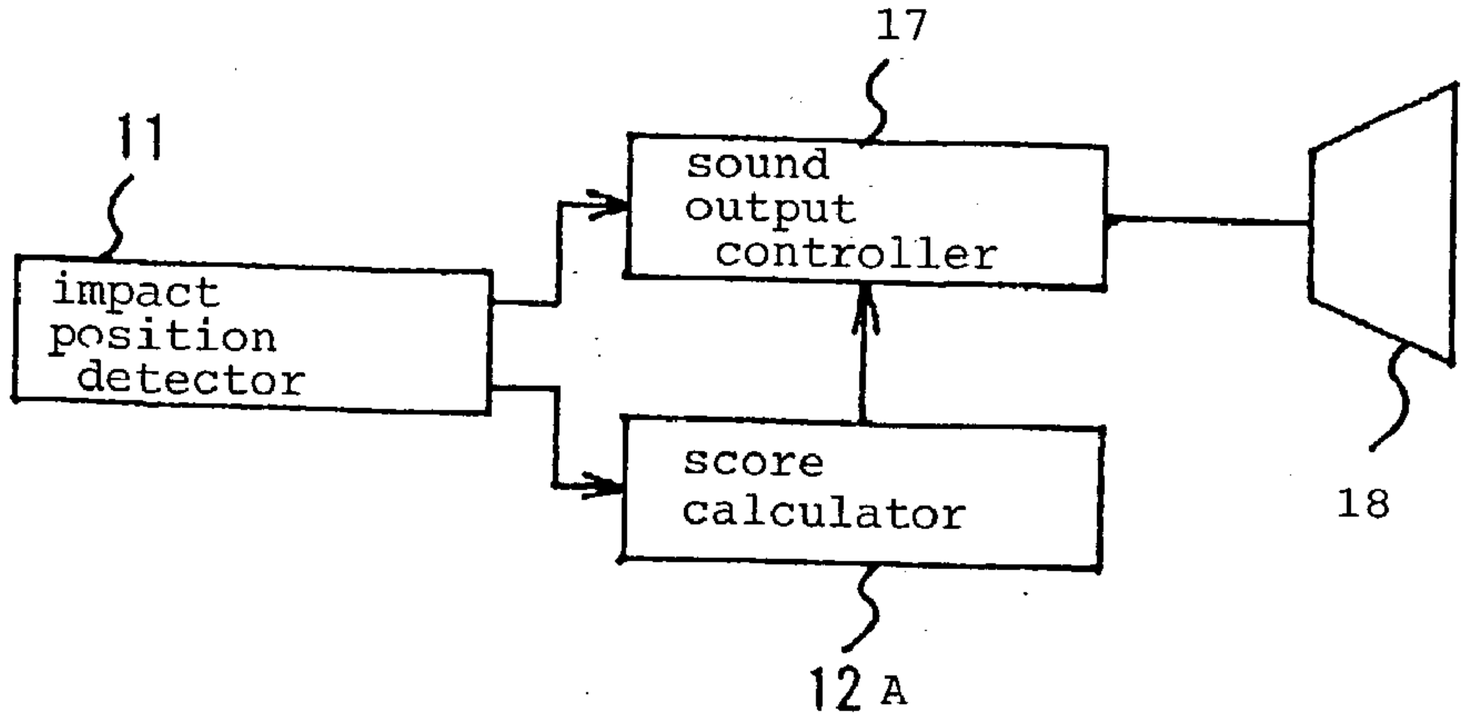


Fig. 12B



DISPLAY CONTROL FOR SCORE AND IMPACT POSITION IN TARGET DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a target device for use in either a competition or a game, such as gun shooting, Japanese archery, archery, etc., for competing for a higher score based on the accuracy with which a bullet, an arrow, or the like hits a target plate, or exercises for practicing such a competition or a game.

[0003] 2. Description of the Related Art

[0004] Target shooting sports including gun shooting, Japanese archery, archery, etc., have heretofore gained popularity among many people. At present, not only Japanese archery and archery, but also gun shooting are played in competitions. According to a typical gun shooting competition, a player shoots a bullet from an air rifle or a laser beam from a laser gun toward a target, and competes for a higher score based on the accuracy with which the bullet or the laser beam hits the target.

[0005] **FIG. 1** of the accompanying drawings shows partly in block form a conventional gun shooting competition system for shooting a target with a laser beam emitted from a laser gun. As shown in **FIG. 1**, the conventional gun shooting competition system has target device **1**, laser gun **7** operated by a shooter, i.e., a player, target plates **4**, **4'**, display unit **5**, and switching unit **3**. Target plates **4**, **4'** are used when target device **1** is spaced from laser gun **7** by distances of 10 m and 25 m, respectively. Target plates **4**, **4'** are selectively mounted removably on target device **1**. In **FIG. 1**, target plate **4** is shown as being mounted on target device **1**. If the distance from laser gun **7** to laser gun **7** is changed to 25 m, then target plate **4** mounted on target device **1** is replaced with target plate **4'**. Switching unit **3** comprises a switching hub of 10BASE-T LAN (Local Area Network) **6**. Display unit **5** is electrically connected through switching unit **3** to target device **1**. Display unit **5** is positioned near the shooter.

[0006] Each player operates laser gun **7** to shoot light beam **2**, i.e., a laser beam, toward target plate **4**, and competes with other players based on a score that is added depending on the position where light beam **2** hits target plate **4**. Light beam **2** shot from laser gun **7** is typically emitted from a semiconductor laser oscillation device mounted in laser gun **7**. As with a real bullet shot from a real gun, light beam **2** is shot from the muzzle of laser gun **7** and travels straight.

[0007] Target device **1** detects the position where light beam **2** hits target plate **4**, i.e., an impact position, and transmits information representing the detected impact position to display unit **5**. Display unit **5** also displays the identification number of the player, the light beam number, the score corresponding to the light beam number, the total score gained thus far, and the impact position, either simultaneously or at spaced time intervals.

[0008] The electronic gun shooting competition system uses a personal computer as display unit **5** which has a score calculating means for automatically carrying out a shooting competition score calculating process. Since the scores of the players can be calculated accurately at a high speed, the electronic gun shooting competition system can manage shooting competitions smoothly.

[0009] **FIG. 2** of the accompanying drawings shows the surface of target plate **4**. As shown in **FIG. 2**, target plate **4** has on its surface ten annular areas, including a central circular area just around center O, divided by ten concentric circles around center O. These areas are also referred to as score areas. Target plate **4** also has an outside area around the annular areas. The player gets no score when light beam **2** hits the outside area. A score for the outermost annular area, i.e., the annular area marked with "1", is 1. Scores for the other annular areas are progressively incremented by 1 toward center O, and the score for the central circular area is 10. A score which the player obtains when shooting target plate **4** is determined based on the distance from center O of target plate **4** to the impact position on target plate **4**.

[0010] Target device **1** has a position-detecting optical device (not shown) for detecting the impact position. The position-detecting optical device comprises a condenser lens and a position-detecting semiconductor device. The position-detecting semiconductor device comprises a CCD (Charge Coupled Device) or a PSD (Position Sensitive Device) which is known in the art. The PSD is preferable to the CCD for its cost and detecting speed.

[0011] When the light beam **2** shot from laser gun **7** hits target plate **4**, the PSD of target device **1** detects the impact position (x, y) of light beam **2** on target plate **4**. The impact position (x, y) is equal to a coordinate position (x, y) in an orthogonal coordinate system on target plate **4**.

[0012] On target device **1**, the origin of the orthogonal coordinate system is aligned with center O of target plate **4**. Target device **1** calculates the distance from the origin to the coordinate position (x, y), and calculates a score for light beam **2** by determining which score area the coordinate position (x, y) belongs to.

[0013] The PSD has a two-dimensional current generating membrane. If a laser beam is focused by the condenser lens and applied as a beam spot to the two-dimensional current generating membrane at a coordinate position (x, y), then the two-dimensional current generating membrane generates therein currents which are two-dimensionally linearly commensurate with the coordinate position (x, y). Specifically, the two-dimensional current generating membrane generates two currents Ix**1**, Ix**2** flowing in two opposite directions along the x-axis and two currents Iy**1**, Iy**2** flowing in two opposite directions along the y-axis. The coordinates x, y of the coordinate position (x, y) are calculated from the currents Ix**1**, Ix**2**, Iy**1**, Iy**2** according to the following equations:

$$x=k(Ix2-Ix1)/(Ix2+Ix1) \quad (1)$$

$$y=k(Iy2-Iy1)/(Iy2+Iy1) \quad (2)$$

[0014] The beam spot position where both (Ix**2**–Ix**1**), (Iy**2**–Iy**1**) are zero is defined as the electrical and mechanical coordinate origin (0, 0) of the PSD. Target plate **4** needs to be positioned two-dimensionally with respect to the PSD within an allowable accuracy range.

[0015] In the conventional electronic gun shooting competition system, display device **5** for displaying scores and impact positions is required to be positioned near the player's shooting spot. Therefore, the conventional electronic

gun shooting competition system is not suitable for use in shooting exercises in limited spaces. The conventional electronic gun shooting competition system is also disadvantageous in that its cost is high. Therefore, there has been a demand in the art for an electronic gun shooting competition system which does not need a display unit such as display unit **5**.

[**0016**] Gun shooting exercises or competitions which use real bullets allow the player to visually recognize an impact position on the target as a bullet mark is left on the target. However, a gun shooting system using a light beam such as a laser beam does not leave any bullet marks on the target. It has been customary for such a gun shooting system to incorporate a separate device for indicating impact positions on the target. According to another proposal, an indicator for indicating an impact position of a light beam is placed on the target. One problem with the proposed system is that it is unable to detect an impact position of the light beam which has hit the indicator.

SUMMARY OF THE INVENTION

[**0017**] It is an object of the present invention to provide a target device which allows a shooter that is located far from the target to easily recognize a shooting result without the need for a display device which would be located near the shooter's position for displaying an image of the target.

[**0018**] According to an aspect of the present invention, a target device has a light-emitting element group disposed near a target plate, and changes energizing patterns of the light-emitting element group depending on a calculated score and/or a detected impact position.

[**0019**] The target device displays scores and impact positions with simple energizing patterns of the light-emitting element group. Since simple energizing patterns can visually be perceived from a distant location, the shooter positioned far from the target device is able to easily recognize the score and the impact position without the need for a display device for displaying an image of the target in the vicinity of the shooting spot where the shooter is positioned.

[**0020**] According to an embodiment of the present invention, the light-emitting element group comprises a plurality of light-emitting elements disposed at substantially equally spaced intervals around the target plate. Preferably, the light-emitting elements are positioned such that angles formed between straight lines extending from a center of the target plate to the light-emitting elements, respectively, are predetermined angles. Because the light-emitting elements are positioned at substantially equally spaced intervals, the impact position can be displayed on the target plate without unwanted localized display irregularities.

[**0021**] According to another embodiment of the present invention, one of the light-emitting elements which is closest to the impact position on the target plate is energized. Alternatively, one of the light-emitting elements is energized such that an angle formed between a straight line extending from a center of the target plate to the one of the light-emitting elements and a straight line extending from the center of the target plate to the impact position on the target plate is minimum. With this arrangement, a direction in which the impact position deviates from the center of the target plate can be displayed.

[**0022**] According to still another embodiment of the present invention, a first light-emitting element, of the light-emitting elements, is determined such that an angle formed between a straight line extending from a center of the target plate to the first light-emitting element and a straight line extending from the center of the target plate to the impact position on the target plate is a smallest first angle, and a second light-emitting element, of the light-emitting elements, is selected such that an angle formed between a straight line extending from the center of the target plate to the second light-emitting element and the straight line extending from the center of the target plate to the impact position on the target plate is a next smallest second angle. The first light-emitting element is energized, and the second light-emitting element is energized if the difference between the second angle and the first angle is at most a predetermined angle. With this arrangement, the resolution with which to indicate the direction of the impact position with respect to the center of target plate can be twice the resolution of a target device having the same number of light-emitting elements.

[**0023**] According to still another embodiment of the present invention, light-emitting elements to be energized are changed depending on the score calculated by a score calculating means. Alternatively, combinations of light-emitting elements to be energized are changed depending on the score calculated by the score calculating means. If some scores are expressed by changing combinations of light-emitting elements, then the number of light-emitting elements for expressing a full score may be small.

[**0024**] According to yet another embodiment of the present invention, the light-emitting element group comprises a first light-emitting element group energizable in energizing patterns which vary depending on the score calculated by the score calculating means, and a second light-emitting element group energizable in energizing patterns which vary depending on the detected impact position. The first light-emitting element group and the second light-emitting element group should preferably be energizable to emit light in different colors, respectively. Inasmuch as the first light-emitting element group and the second light-emitting element group emit light in different colors, the shooter located far from the target device can easily distinguish the score and the impact position from each other.

[**0025**] According to yet another embodiment of the present invention, the light-emitting element group is energized to display the score and the impact position in a time-division manner. Alternatively, the light-emitting element group is energized to display the score and the impact position alternately in an intermittent fashion. Furthermore, each of the light-emitting elements comprises a bicolor light-emitting diode for emitting light in two colors, and should preferably be energized to emit light to display the score and the impact position in different colors for better visibility. Because one light-emitting element group is capable of displaying both scores and impact positions, the number of light-emitting elements used may be reduced, and the target device is relatively low in cost and small in size.

[**0026**] According to yet still another embodiment of the present invention, at least one of the light-emitting elements is operable as a ready lamp for indicating that a shooter can shoot at the target plate. Preferably, at least one of the

light-emitting elements which is operable as the ready lamp is positioned below the target plate. Since at least one of the light-emitting elements doubles as a ready lamp, no additional ready lamp needs to be newly provided. Therefore, the number of light-emitting elements may be small. Since at least one of the light-emitting elements which is operable as the ready lamp is positioned below the target plate, when the shooter holds a laser gun and aims at the target plate, the light-emitting element as the ready lamp is concealed from the vision of the shooter by the gunbarrel, and hence the ready lamp does not obstruct the shooting action of the shooter.

[**0027**] According to yet still another embodiment of the present invention, at least one of the light-emitting elements is operable as a busy lamp for indicating that a shooter cannot shoot at the target plate. Preferably, at least one of the light-emitting elements which is operable as the busy lamp is positioned above the target plate. Since at least one of the light-emitting elements doubles as a busy lamp, no additional busy lamp needs to be newly provided. Therefore, the number of light-emitting elements may be small. Since at least one of the light-emitting elements which is operable as the busy lamp is positioned above the target plate, when the shooter holds the laser gun and aims at the target plate, the light-emitting element as the busy lamp is present in the vision of the shooter, allowing the shooter to easily recognize that the shooter cannot shoot at the target plate.

[**0028**] According to another embodiment of the present invention, the target device further comprises a switch for setting a type of the target plate which is mounted in place, and an equation for calculating the score from the impact position is changed depending on the type of the target plate which is set by the switch. By operating the switch, it is possible to accurately calculate and display a score depending on the type of the target plate which is mounted in place.

[**0029**] According to a yet further embodiment of the present invention, the target device further comprises a detecting means for automatically detecting a type of the target plate which is mounted in place, and an equation for calculating the score from the impact position is changed depending on the type of the target plate which is automatically detected by the detecting means. Since the equation for calculating scores is automatically changed depending on the type of the target plate used, the user finds it less burdensome to change the target plate than with the target device with the switch, and scores are prevented from being calculated according to a wrong equation.

[**0030**] According to a still further embodiment of the present invention, the detecting means detects the type of the target plate which is mounted in place by reading either the resistance of a resistor embedded in the target plate which is mounted in place, information stored in an IC chip embedded in the target plate which is mounted in place, magnetic information embedded in the target plate which is mounted in place, or a pattern of slits disposed in the target plate which is mounted in place.

[**0031**] According to a still further embodiment of the present invention, the light-emitting element group is energizable in energizing patterns which are visually recognizable as a character and/or a numeral representing the score and/or the impact position.

[**0032**] According to yet another embodiment of the present invention, the target device further comprises a sound output means for providing sound information depending on a shot on the target plate.

[**0033**] The sound output means provides predetermined sound information when a shot is detected on the target plate by the impact position detecting means. The shooter is thus given a feel similar to an actual gun shooting activity.

[**0034**] According to yet another embodiment of the present invention, the sound output means provides sound information depending on the score calculated by the score calculating means. The shooter can thus obtain an auditory recognition of the score of the shot.

[**0035**] The above and other objects, features, and advantages of the present invention will become apparent from the following description with reference to the accompanying drawings which illustrate examples of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[**0036**] **FIG. 1** is a view, partly in block form, of a conventional gun shooting competition system which employs a laser gun for shooting a laser beam;

[**0037**] **FIG. 2** is a view of a target plate used in the conventional gun shooting competition system;

[**0038**] **FIG. 3A** is a front elevational view of a target device according to a first embodiment of the present invention;

[**0039**] **FIG. 3B** is a block diagram of a circuit arrangement of the target device according to the first embodiment;

[**0040**] **FIG. 4A** is a front elevational view of a target device according to a second embodiment of the present invention;

[**0041**] **FIG. 4B** is a block diagram of a circuit arrangement of the target device according to the second embodiment;

[**0042**] **FIG. 5A** is a front elevational view of a target device according to a third embodiment of the present invention;

[**0043**] **FIG. 5B** is a block diagram of a circuit arrangement of the target device according to the third embodiment;

[**0044**] **FIG. 6A** is a front elevational view of a target device according to a fourth embodiment of the present invention;

[**0045**] **FIG. 6B** is a block diagram of a circuit arrangement of the target device according to the fourth embodiment;

[**0046**] **FIG. 7A** is a front elevational view of a target device according to a fifth embodiment of the present invention;

[**0047**] **FIG. 7B** is a block diagram of a circuit arrangement of the target device according to the fifth embodiment;

[**0048**] **FIG. 8A** is a front elevational view of a target device according to a sixth embodiment of the present invention;

[**0049**] **FIG. 8B** is a block diagram of a circuit arrangement of the target device according to the sixth embodiment;

[0050] **FIG. 9A** is a perspective view of a target device according to a seventh embodiment of the present invention;

[0051] **FIG. 9B** is a block diagram of a circuit arrangement of the target device according to the seventh embodiment;

[0052] **FIG. 10** is a block diagram of a circuit arrangement of a target device according to an eighth embodiment of the present invention;

[0053] **FIG. 11A** is a front elevational view of a target device according to a ninth embodiment of the present invention;

[0054] **FIG. 11B** is a block diagram of a circuit arrangement of the target device according to the ninth embodiment;

[0055] **FIG. 12A** is a perspective view of a target device according to a tenth embodiment of the present invention; and

[0056] **FIG. 12B** is a block diagram of a circuit arrangement of the target device according to the tenth embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0057] 1st Embodiment:

[0058] **FIG. 3A** shows in front elevation a target device according to a first embodiment of the present invention, and **FIG. 3B** shows in block form a circuit arrangement of the target device according to the first embodiment. The target device has a front surface on which target plate **4** is mounted, the front surface facing a shooting spot where a shooter is positioned.

[0059] The front surface of the target device shown in **FIG. 3A** is of a square shape having a vertical dimension of 10 cm and a horizontal dimension of 10 cm. Target plate **4** which is also of a square shape is mounted on a central area of the front surface of the target device. Target plate **4** comprises a solid panel and has a plurality of circular score areas as shown in **FIG. 2** around its center. Target plate **4** is fastened to a casing of the target device by four screws **5** at its corners.

[0060] The target device has LED group **9** comprising eight light-emitting elements, i.e., light-emitting diodes (LEDs) $\mathbf{9}_1$ through $\mathbf{9}_8$, disposed around target plate **4**. LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ are spaced at substantially equal intervals around target plate **4**. Specifically, LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ are positioned such that each of straight lines (indicated by the dot-and-dash lines in **FIG. 3A**) extending from the center of target plate **4** to respective LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ is angularly spaced 45° from other adjacent straight lines.

[0061] The target device also has impact position detector **11**, score calculator **12**A, and light-emitting element energizing unit **13**A. The target device displays a score with LED group **9**. Impact position detector **11** detects impact position (x, y) on target plate **4** according to the equations (1), (2) described above. Score calculator **12**A calculates the distance from center O of target plate **4** to impact position (x, y) based on detected impact position (x, y), and compares the calculated distance with the ranges (radii) of the score areas to calculate a score for detected impact position (x, y). It is necessary that center O of target plate **4** and the detecting origin of impact position detector **11** be in complete alignment with each other.

[0062] Light-emitting element energizing unit **13**A determines an energizing pattern of LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ of LED group **9** depending on the score which has been calculated by score calculator **12**A. For example, if the score calculated by score calculator **12**A is "1", then light-emitting element energizing unit **13**A energizes only LED $\mathbf{9}_1$. If score calculator **12**A has calculated scores "2" through "8", then light-emitting element energizing unit **13**A energizes only LEDs $\mathbf{9}_2$ through $\mathbf{9}_8$, respectively. Thus, an LED or LEDs corresponding to a score calculated by score calculator **12**A are energized. Consequently, when only LED $\mathbf{9}_5$ is energized as a result of a shot, the shooter can immediately recognize that the shot has won a score "5". If score calculator **12** has calculated a score "9", then light-emitting element energizing unit **13**A energizes LED $\mathbf{9}_2$ and LED $\mathbf{9}_7$. If score calculator **12** has calculated a score "10", then light-emitting element energizing unit **13**A energizes all LED $\mathbf{9}_1$ through LED $\mathbf{9}_8$. Stated otherwise, the target device changes combinations of LEDs to be energized depending on the score which has been calculated by score calculator **12**A. Usually, at least 10 LEDs would be required to display scores "0" through "10". According to the present embodiment, however, since some scores are expressed by changing combinations of LEDs to be energized, the number of LEDs that are required may be reduced from 10 to 8.

[0063] In the present embodiment, the LEDs are energized progressively counterclockwise from the left lowermost one below target plate **4** in **FIG. 3A** as the score increases. However, the LEDs may be energized progressively clockwise. The number of LEDs that are used may further be reduced by using a binary representation of scores. According to the present invention, the LEDs may be energized in any energizing patterns insofar as they allow the shooter to read scores which it has won. While target plate **4** comprises a solid panel in the present embodiment, it may comprise a sheet of film or paper.

[0064] 2nd Embodiment:

[0065] **FIG. 4A** shows in front elevation a target device according to a second embodiment of the present invention, and **FIG. 4B** shows in block form a circuit arrangement of the target device according to the second embodiment.

[0066] As shown in **FIG. 4**A, the target device according to the second embodiment has LED group **9** comprising eight LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ disposed around target plate **4**. According to the second embodiment, eight LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ of LED group **9** are used to give an approximate indication of an impact position on target plate **4**, rather than to indicate a score. As shown in **FIG. 4**B, the target device also has impact position detector **11** and light-emitting element energizing unit **13**B. Light-emitting element energizing unit **13**B energizes LED group **9** depending on an impact position on target plate **4**. It is now assumed that the impact position on target plate **4** is represented by point A in **FIG. 4A**. Position (x, y) of point A is calculated according to the equations (1), (2) described above. Line segment OA extends from center O of target plate **4** to point A. Point A is positioned between line segment OB extending from center O to LED $\mathbf{9}_4$ and line segment OC extending from center O to LED $\mathbf{9}_5$. Angle θ_1 formed between line segments OA, OB is smaller than angle θ_2 formed between line

segments OA, OC. Light-emitting element energizing unit **13**B energizes LED $\mathbf{9}_4$ on line segment OB. Consequently, when the shooter hits target plate **4** at a certain impact position, light-emitting element energizing unit **13**B energizes an LED, all LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ of LED group **9**, such that the angle formed between a line segment extending from center O to that LED and a line segment extending from center O to the impact position is minimum. Stated otherwise, the score areas on target plate **4** are divided into eight angular zones having equal angles (45°) around center O by eight LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ disposed at equal angles around target plate **4**, and light-emitting element energizing unit **13**B determines which one of the divided angular zones the impact position is located in, and energizes an LED belonging to the determined angular zone. The shooter can confirm from the shooting spot in which direction the impact position deviates from center O. Generally, in gun shooting competitions, most impact positions concentrate on score areas representing scores "7" through "10", i.e., score areas near center O. Therefore, the direction in which the impact position deviates from center O presents more important information than the distance by which the impact position deviates from center O for the shooter to correct its shooting action. The target device according to the second information displays that deviating direction to give the shooter an indication of the deviating direction of the impact position. The shooter confirms the displayed deviating direction, and corrects its shooting action based on the confirmed deviating direction.

[**0067**] Alternatively, an LED, of all LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ of LED group **9**, which is linearly closest to point A of the impact position may be energized to present an approximate indication of the impact position to the shooter.

[**0068**] 3rd Embodiment:

[**0069**] **FIG. 5A** shows in front elevation a target device according to a third embodiment of the present invention, and **FIG. 5B** shows in block form a circuit arrangement of the target device according to the third embodiment. The target device according to the third embodiment has LED group **9** of eight LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ disposed around target plate **4** as with the second embodiment. As shown in **FIG. 5**B, the target device according to the third embodiment also has impact position detector **11** and light-emitting element energizing unit **13**C.

[**0070**] It is now assumed that the impact position on target plate **4** is represented by point A in **FIG. 5A**. Point A is positioned between line segment OB extending from center O to LED $\mathbf{9}_4$ and line segment OC extending from center O to LED $\mathbf{9}_5$. Angle θ_1 formed between line segments OA, OB is smaller than angle θ_2 formed between line segments OA, OC. According to the third embodiment, light-emitting element energizing unit **13**C also energizes LED $\mathbf{9}_4$ on line segment OB as with the target device according to the second embodiment.

[**0071**] If the difference between angle θ_1 and angle θ_2 is at most a predetermined angle of 11.25°, then light-emitting element energizing unit **13**C energizes not only LED $\mathbf{9}_4$, but also LED $\mathbf{9}_5$. When the shooter sees the energization of both LEDs $\mathbf{9}_4$, $\mathbf{9}_5$, the shooter becomes aware of the fact that the impact position deviates from center O in an intermediate direction between LEDs $\mathbf{9}_4$, $\mathbf{9}_5$. With the target device according to the third embodiment, therefore, light-emitting element energizing unit **13**C determines an LED (first light-emitting element, i.e., LED $\mathbf{9}_4$ in **FIG. 5A**), of all LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ of LED group **9**, such that the angle formed between a line segment extending from center O to that LED and line segment OA extending from center O to the impact position (point A) is smallest (first angle, i.e., θ_1 in **FIG. 5A**), and an LED (second light-emitting element, i.e., LED $\mathbf{9}_5$ in **FIG. 5A**) such that the angle formed between a line segment extending from center O to that LED and line segment OA is next smallest (second angle, i.e., θ_2 in **FIG. 5A**). Then, light-emitting element energizing unit **13**C energizes the first light-emitting element (LED $\mathbf{9}_4$), and also energizes the second light-emitting element (LED $\mathbf{9}_5$) if the difference between the first angle and the second angle is at most a predetermined angle.

[**0072**] If the predetermined angle is 11.25°, then the score areas on target plate **4** can be divided into 16 angular zones having equal angles (22.5°) around center O. With this arrangement, although the number of LEDs used in the target device according to the third embodiment is the same as the number of LEDs used in the target device according to the second embodiment, the resolution with which to indicate the direction of the impact position with respect to the center of target plate **4** can be twice the resolution of the target device according to the second embodiment, i.e., can be represented by the 16 angular zones.

[**0073**] The target device according to the third embodiment can display impact positions with simple energizing patterns of LED group **9**. Since such simple energizing patterns of LED group **9** can visually be perceived from a distant location, the shooter positioned far from the target is able to easily recognize the impact position without the need for a display device for displaying an image of the target in the vicinity of the shooting spot where the shooter is positioned.

[**0074**] 4th Embodiment:

[**0075**] **FIG. 6A** shows in front elevation a target device according to a fourth embodiment of the present invention, and **FIG. 6B** shows in block form a circuit arrangement of the target device according to the fourth embodiment. The target device according to the fourth embodiment has LED group **8** (first light-emitting element group) of eight LEDs $\mathbf{8}_1$ through $\mathbf{8}_8$ and LED group **9** (second light-emitting element group) of eight LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ which are disposed around target plate **4**.

[**0076**] As shown in **FIG. 6**B, the target device according to the fourth embodiment also has impact position detector **11**, score calculator **12**A, and light-emitting element energizing unit **13**D.

[**0077**] LED group **8** serves to display a score calculated by score calculator **12**A, and LED group **9** serves to display an impact position detected by impact position detector **11**. Both LED groups **8**, **9** are energized by light-emitting element energizing unit **13***d*. As with the first and second embodiments, LEDs $\mathbf{8}_1$ through $\mathbf{8}_8$ and LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ are positioned such that each of straight lines (indicated by the dot-and-dash lines in **FIG. 6A**) extending from the center of target plate **4** to respective LEDs $\mathbf{8}_1$ through $\mathbf{8}_8$ and respective LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ is angularly spaced 45° from other adjacent straight lines. In the fourth embodiment, LED group **9** is disposed outwardly of LED group **8**. However,

LED groups **8**, **9** are not limited to the layout shown in **FIG. 6**A, but LED group **8** may be disposed outwardly of LED group **9**.

[**0078**] With the target device according to the fourth embodiment, LED group **8** and LED group **9** emit light in different colors. For example, LEDs $\mathbf{8}_1$ through $\mathbf{8}_8$ of LED group **8** comprise red light-emitting diodes, and LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ of LED group **9** comprise green light-emitting diodes. These differently colored light emission from LED group **8** and LED group **9** is effective to prevent the shooter from mixing up score displays and impact position displays.

[**0079**] According to the fourth embodiment, LED group **8** for displaying scores are energized in the same energizing patterns as with the first embodiment, and LED group **9** for displaying impact positions are energized in the same energizing patterns as with the second and third embodiments.

[**0080**] 5th Embodiment:

[**0081**] **FIG. 7A** shows in front elevation a target device according to a fifth embodiment of the present invention, and **FIG. 7B** shows in block form a circuit arrangement of the target device according to the fifth embodiment. The target device according to the fifth embodiment has LED group **19** of eight LEDs $\mathbf{19}_1$ through $\mathbf{19}_8$ which can be energized in energizing patterns that are changed depending on a score calculated by score calculator **12**A and can also be energized in energizing patterns that are changed depending on an impact position detected by impact position detector **11**.

[**0082**] As shown in **FIG. 7**B, the target device according to the fifth embodiment also has impact position detector **11**, score calculator **12**A, and light-emitting element energizing unit **13**E. Light-emitting element energizing unit **13**E energizes LED group **19** to display a score and an impact position in a time-division manner, or preferably alternately in an intermittent fashion.

[**0083**] Each of LEDs $\mathbf{19}_1$ through $\mathbf{19}_8$ of LED group **19** comprises a bicolor LED for emitting color selectively in two colors. If each of LEDs $\mathbf{19}_1$ through $\mathbf{19}_8$ is a bicolor LED for emitting color selectively in red and green, then light-emitting element energizing unit **13**E controls LEDs $\mathbf{19}_1$ through $\mathbf{19}_8$ to emit light in red for displaying scores and to emit light in green for displaying impact positions. Since LED group **19** emits light in different colors for displaying scores and impact positions, the shooter can easily distinguish score displays and impact position displays from each other.

[**0084**] According to the fifth embodiment, LED group **19** are energized in the same energizing patterns as with the first embodiment for displaying scores, and LED group **19** are energized in the same energizing patterns as with the second and third embodiments for displaying impact positions.

[**0085**] Inasmuch as one LED group **19** is capable of displaying both scores and impact positions with bicolor LEDs, the number of LEDs used may be smaller than the number of LEDs used in the fourth embodiment. Therefore, the target device according to the fifth embodiment is relatively low in cost and small in size.

[**0086**] 6th Embodiment:

[**0087**] **FIG. 8A** shows in front elevation a target device according to a sixth embodiment of the present invention, and **FIG. 8B** shows in block form a circuit arrangement of the target device according to the sixth embodiment. The target device according to the sixth embodiment has LED group **9** of eight LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ as with the target device according to the first embodiment. According to the sixth embodiment, at least one of LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$, e.g., LEDs $\mathbf{9}_1$ through $\mathbf{9}_3$, is used as a ready lamp for indicating that the shooter can shoot a light beam, and at least one of LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$, e.g., LEDs $\mathbf{9}_5$ through $\mathbf{9}_7$, is used as a busy lamp for indicating that the shooter cannot shoot a light beam. LEDs $\mathbf{9}_1$ through $\mathbf{9}_3$, which double as the ready lamp, are positioned below target plate **4**. Therefore, when the shooter holds the laser gun and aims at target plate **4**, LEDs $\mathbf{9}_1$ through $\mathbf{9}_3$ are concealed from the vision of the shooter by the gunbarrel, and hence the ready lamp does not obstruct the shooting action of the shooter. LEDs $\mathbf{9}_5$ through $\mathbf{9}_7$, which double as the busy lamp, are positioned above target plate **4**. Therefore, when the shooter holds the laser gun and aims at target plate **4**, LEDs $\mathbf{9}_5$ through $\mathbf{9}_7$ are present in the vision of the shooter, allowing the shooter to easily recognize that the shooter cannot shoot a light beam.

[**0088**] As shown in **FIG. 8**B, the target device according to the sixth embodiment also has impact position detector **11**, score calculator **12**, and light-emitting element energizing unit **13**F. Light-emitting element energizing unit **13**F operates LED group **9** selectively as the ready lamp or the busy lamp in response to a signal from an external source.

[**0089**] According to the sixth embodiment, since LEDs $\mathbf{9}_1$ through $\mathbf{9}_8$ of LED group **9** double as the ready lamp and the busy lamp, no separate ready lamp and busy lamp need to be provided, and hence the number of LEDs used may be reduced.

[**0090**] In the target devices according to the second through fifth embodiments, the LED group or groups may be operated as a ready lamp and a busy lamp.

[**0091**] 7th Embodiment:

[**0092**] **FIG. 9A** shows in perspective a target device according to a seventh embodiment of the present invention, and **FIG. 9B** shown in block form a circuit arrangement of the target device according to the seventh embodiment. Target plates which are spaced at different distances from laser gun (not shown in **FIG. 9A**), e.g., target plate **4** (spaced 10 m from laser gun) and target plate **4'** (spaced 25 m from laser gun) shown in **FIG. 1**, have differently sized score areas. Even when an impact position remains the same on the different target plates, it is necessary for a score calculator to use a score calculating equation depending on the score areas of the target plate that is actually mounted on the target device. As shown in **FIG. 9**A, the target device according to the seventh embodiment has target plate setting switch **10** which can be operated by the user for setting the type of the target plate that is actually mounted on the target device.

[**0093**] As shown in **FIG. 9**B, the target device according to the seventh embodiment also has target plate setting switch **10**, impact position detector **11**, score calculator **12**B, and light-emitting element energizing unit **13**A. Depending on the type of the target plate which has been set by the user using target plate setting switch **10**, light-emitting element energizing unit **13**A determines a score calculating equation for determining a score from an impact position on the target

plate, and calculates a score according to the determined equation. Therefore, the target device can display an accurate score depending on the type of the target plate that is actually mounted on the target device.

[**0094**] Target plate setting switch **10** may be incorporated in the target devices according to the fourth through sixth embodiments.

[**0095**] 8th Embodiment:

[**0096**] **FIG. 10** shows in block form a circuit arrangement of a target device according to an eighth embodiment of the present invention. The target device according to the eighth embodiment has target plate detector **14** for automatically detecting the type of the target plate that is actually mounted on the target device, in addition to impact position detector **11**, score calculator **12**B, and light-emitting element energizing unit **13**A. Target plate detector **14** comprises pull-up resistor **14***a* and detector **14***b*. Resistor **15** which is embedded in the target plate is electrically connected to detector **14***b*. Detector **14***b* has its one terminal connected to pull-up resistor **14***a* and its other terminal connected to ground. Resistor **15** has a resistance which varies depending on the type of the target plate used, e.g., target plate **4** or target plate **4**'. When target plate **4** is mounted on the target device, resistor **15** embedded in target plate **4** has its ends electrically connected to detector **14***b*, which reads the resistance of resistor **15**, detects the type of mounted target plate **4**, and provides outputs the detected type to score calculator **12**B.

[**0097**] After being supplied with the detected type from detector **14***b*, score calculator **12**B applies an impact position on target plate **4** as detected by impact position detector **11** to the score calculating equation depending on the detected type, calculates a score according to the score calculating equation, and supplies the calculated score to light-emitting element energizing unit **13**A. The score is displayed in the manner described above in the first embodiment.

[**0098**] According to the eighth embodiment, since the score calculating equation used in score calculator **12**B is automatically changed depending on the type of the target plate used, the user finds it less burdensome to change the target plate than with the seventh embodiment, and any errors involved in setting the type of the target plate used are eliminated.

[**0099**] According to the eighth embodiment, the type of the target plate used is detected based on the resistance of resistor **15** embedded in the target plate. However, the type of the target plate used may be detected by reading information stored in an IC chip embedded in the target plate, magnetic information embedded in the target plate, or a pattern of slits disposed in the target plate.

[**0100**] Target plate detector **14** may be incorporated in the target devices according to the fourth through sixth embodiments.

[**0101**] 9th Embodiment:

[**0102**] **FIG. 11A** shows in front elevation a target device according to a ninth embodiment of the present invention, and **FIG. 11B** shows in block form a circuit arrangement of the target device according to the ninth embodiment. As shown in **FIG. 11**A, the target device according to the ninth embodiment has seven-segment score display panel **16** for displaying a score, disposed in an upper right region of the surface of the target device on which target plate **4** is mounted. Seven-segment score display panel **16** has two sets of seven LEDs arranged in the shape of "8", the LEDs being selectively energizable to display numerals representing a score.

[**0103**] As shown in **FIG. 11**B, the target device according to the ninth embodiment also has impact position detector **11**, score calculator **12**A, and score display unit **13**G.

[**0104**] When a light beam shot from laser gun hits target plate **4**, impact position (x, y) on target plate **4** is detected by impact position detector **11** using equation (1) and (2) described above, and score calculator **12**A calculates a score based on detected impact position (x, y). The calculated score, which is either one of "0" through "10", is displayed on seven-segment score display panel **16** by score display unit **13**G.

[**0105**] The target device according to the ninth embodiment dispenses with a score display unit such as display unit **5** of the electronic gun shooting competition system shown in **FIG. 1**, and allows the user to practice shooting in a relatively small space.

[**0106**] The target device may have not only the score display panels for displaying scores, but also an impact position display panel for displaying impact positions with characters.

[**0107**] In shooting competitions, the distance between the shooting spot where the shooter is positioned and target plate **5** is required to be 5 m at minimum, and the target device needs to have a surface area having vertical and horizontal dimensions of 10 cm for installing target plate **4** thereon. Consequently, the size of seven-segment score display panel **16** mounted on the target device is limited, making it difficult for the shooter in the shooting spot to visually recognize clearly the numerals displayed on seven-segment score display panel **16**. For this reason, it is preferable to display scores and impact positions in simple energizing patterns as with the target devices according to the first through eighth embodiments, rather than displaying scores and impact positions in numerals and characters with the score display panel.

[**0108**] 10th Embodiment:

[**0109**] **FIG. 12A** shows in perspective a target device according to a tenth embodiment of the present invention, and **FIG. 12B** shows in block form a circuit arrangement of the target device according to the tenth embodiment.

[**0110**] As shown in **FIG. 12A**, the target device supports square target plate **4** centrally on its front surface, target plate **4** having circular score areas as shown in **FIG. 2** around its center. Target plate **4** is fastened to a casing of the target device by four screws **5** at its corners.

[**0111**] Target device has speaker **18** mounted on a side wall of a casing thereof for producing speech or an electronic sound representative of an impact position and a score based on the impact position when a light beam shot from the laser gun (not shown in **FIG. 12A**) hits target plate **4**. Speaker **18** may be mounted on any regions of target device where target plate **4** is not mounted, rather than a side wall of the casing thereof.

[0112] As shown in FIG. 12B, the target device according to the tenth embodiment also has impact position detector **11**, score calculator **12**A, and sound output controller **17**. When impact position detector **11** detects an impact position on target plate **4** at the time a light beam shot from the laser gun hits target plate **4**, sound output controller **17** controls speaker **18** to output an electronic sound indicating that the light beam shot from the laser gun hits target plate **4**. In gun shooting activities that use actual bullets, the sound that is produced when a bullet is shot from the gun is much louder than the sound that is produced when the bullet actually hits the target. To give the shooter a feel analogous to an actual shooting action using a real bullet with the target device according to the tenth embodiment, it is preferable to output the electronic sound from speaker **18** at the time the light beam is emitted from the laser gun. However, irrespective of whether a real bullet is shot from the real gun or a light beam is emitted from the laser gun, since the period of time that elapses after the shooter pulls the trigger until the real bullet or the light beam hits the target plate is considerably short, the shooter the target plate is considerably short, the shooter can have a feel similar to a gun shooting action using a real bullet if an electronic sound simulating a real bullet shot is output from speaker **18** at the time the light beam emitted from the laser gun hits target plate **4**.

[0113] Impact position detector **11** detects an impact position of the light beam emitted from the laser gun as with the above embodiments. Score calculator **12**A also calculates a score based on the impact position detected by impact position detector **11** as with the above embodiments. Information representing the score calculated by score calculator **12**A is sent to sound output controller **17**, which controls speaker **18** to output a sound representing the score based on the score calculated by score calculator **12**A. For example, the calculated score may be output as speech information from speaker **18**. If the score is equal to or higher than a predetermined score, then speech information or a melody indicating that the score is equal to or higher than the predetermined score may be from speaker **18**. Upon hearing such a sound, the shooter can obtain an auditory recognition of the score of the shot.

[0114] In the tenth embodiment, sound information is output from speaker **4** based on impact positions on target plate **4** and scores depending on the impact positions. The visual display system for displaying impact positions and scores with LEDs according to any of the above embodiments may be combined with the system according to the tenth embodiment for producing an auditory presentation of impact positions and scores.

[0115] While preferred embodiments of the present invention have been described in specific terms, such description is for illustrative purposes only, and it is to be understood that changes and variations may be made without departing from the spirit or scope of the following claims.

What is claimed is:

1. A target device comprising:

a target plate;

a light-emitting element group disposed near said target plate;

impact position detecting means for detecting an impact position on said target plate and/or score calculating means for calculating a score based on the impact position detected by said impact position detecting means; and

light-emitting element group energizing means for changing energizing patterns of said light-emitting element group depending on the calculated score and/or the detected impact position.

2. A target device according to claim 1, wherein said light-emitting element group comprises a plurality of light-emitting elements disposed at substantially equally spaced intervals around said target plate.

3. A target device according to claim 2, wherein said light-emitting elements are positioned such that angles formed between straight lines extending from a center of said target plate to said light-emitting elements, respectively, are predetermined angles.

4. A target device according to claim 1, wherein said light-emitting element group comprises a plurality of light-emitting elements, said light-emitting element group energizing means energizing one of said light-emitting elements which is closest to the impact position on said target plate.

5. A target device according to claim 1, wherein said light-emitting element group comprises a plurality of light-emitting elements, said light-emitting element group energizing means comprising means for energizing one of said light-emitting elements such that an angle formed between a straight line extending from a center of said target plate to said one of the light-emitting elements and a straight line extending from said center of said target plate to said impact position on said target plate is minimum.

6. A target device according to claim 1, wherein said light-emitting element group comprises a plurality of light-emitting elements, said light-emitting element group energizing means comprising means for determining a first light-emitting element, of said light-emitting elements, such that an angle formed between a straight line extending from a center of said target plate to said first light-emitting element and a straight line extending from the center of said target plate to said impact position on said target plate is a smallest first angle, and a second light-emitting element, of said light-emitting elements, such that an angle formed between a straight line extending from the center of said target plate to said second light-emitting element and the straight line extending from the center of said target plate to said impact position on said target plate is a next smallest second angle, energizing said first light-emitting element, and energizing said second light-emitting element if the difference between said second angle and said first angle is at most a predetermined angle.

7. A target device according to claim 1, wherein said light-emitting element group comprises a plurality of light-emitting elements, said light-emitting element group energizing means comprising means for changing light-emitting elements to be energized depending on the score calculated by said score calculating means.

8. A target device according to claim 7, wherein said light-emitting element group comprises a plurality of light-emitting elements, said light-emitting element group energizing means comprising means for changing combinations of light-emitting elements to be energized depending on the score calculated by said score calculating means.

9. A target device according to claim 1, wherein said light-emitting element group comprises a first light-emitting element group energizable in energizing patterns which vary

depending on the score calculated by said score calculating means, and a second light-emitting element group energizable in energizing patterns which vary depending on the impact position detected by said impact position detecting means.

10. A target device according to claim 9, wherein said first light-emitting element group and said second light-emitting element group are energizable to emit light in different colors, respectively.

11. A target device according to claim 1, wherein said light-emitting element group energizing means comprises means for energizing said light-emitting element group to display the score and the impact position in a time-division manner.

12. A target device according to claim 11, wherein said light-emitting element group energizing means comprises means for energizing said light-emitting element group to display the score and the impact position alternately in an intermittent fashion.

13. A target device according to claim 1, wherein said light-emitting element group comprises a plurality of light-emitting elements, each of said light-emitting elements comprising a bicolor light-emitting diode for emitting light in two colors.

14. A target device according to claim 13, wherein said light-emitting element group energizing means comprises means for energizing said light-emitting elements display the score and the impact position in different colors.

15. A target device according to claim 1, wherein said light-emitting element group comprises a plurality of light-emitting elements, at least one of said light-emitting elements being operable as a ready lamp for indicating that a shooter can shoot at the target plate.

16. A target device according to claim 15, wherein said at least one of said light-emitting elements which is operable as the ready lamp is positioned below said target plate.

17. A target device according to claim 1, wherein said light-emitting element group comprises a plurality of light-emitting elements, at least one of said light-emitting elements being operable as a busy lamp for indicating that a shooter cannot shoot at the target plate.

18. A target device according to claim 17, wherein said at least one of said light-emitting elements which is operable as the busy lamp is positioned above said target plate.

19. A target device according to claim 1, further comprising:

a switch for setting a type of the target plate which is mounted in place.

20. A target device according to claim 19, wherein said score calculating means comprises means for changing an equation for calculating the score from said impact position, depending on the type of the target plate which is set by said switch.

21. A target device according to claim 1, further comprising:

detecting means for automatically detecting a type of the target plate which is mounted in place.

22. A target device according to claim 21, wherein said score calculating means comprises means for changing an equation for calculating the score from said impact position, depending on the type of the target plate which is automatically detected by said detecting means.

23. A target device according to claim 21, wherein said detecting means comprises means for detecting the type of the target plate which is mounted in place by reading the resistance of a resistor embedded in the target plate which is mounted in place.

24. A target device according to claim 21, wherein said detecting means comprises means for detecting the type of the target plate which is mounted in place by reading information stored in an IC chip embedded in the target plate which is mounted in place.

25. A target device according to claim 21, wherein said detecting means comprises means for detecting the type of the target plate which is mounted in place by reading magnetic information embedded in the target plate which is mounted in place.

26. A target device according to claim 21, wherein said detecting means comprises means for detecting the type of the target plate which is mounted in place by reading a pattern of slits disposed in the target plate which is mounted in place.

27. A target device according to claim 1, wherein said light-emitting element group is energizable in energizing patterns which are visually recognizable as a character and/or a numeral representing said score and/or said impact position.

28. A target device according to claim 1, further comprising:

sound output means for outputting sound information depending on a shot on said target plate and/or said score and/or said impact position.

29. A target device comprising:

a target plate;

impact position detecting means for detecting an impact position on said target plate;

score calculating means for calculating a score based on the impact position detected by said impact position detecting means; and

sound output means for outputting sound information depending on a shot on said target plate and/or said score and/or said impact position.

30. A target device according to claim 29, further comprising:

a switch for setting a type of the target plate which is mounted in place.

31. A target device according to claim 29, further comprising:

detecting means for automatically detecting a type of the target plate which is mounted in place.

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