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(54) **A DISCUS**

WURFSCHEIBE

DISQUE

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Description

The present invention relates to a discus according to the preamble of claim 1.

A discus of this type is known under the name "Frisbee". It is a playing device usually made of plastic material that can be set rotating about its central axis by hand and thereby thrown stably over relatively far distances.

A disadvantage, however, is that the flight of such discuses can often be followed only with difficulty by the eye. This holds in particular at dusk or under poor visibility conditions. Also, the attractiveness of such discuses frequently diminishes for the user after a relatively short playing time.

DE 34 25 037 A1 describes a discus according to the preamble of claim 1. This known discus includes some groups of light-emitting diodes connected in series, the diodes of each group being arranged in the form of a ring. All diodes of a specific ring are controlled simultaneously and in the same fashion by an electromechanical circuit device comprising mercury switches or flip-flops. However, only a limited number of signal patterns can be incorporated in this known construction and there are significant difficulties for the manufacturer to change signal patterns. Further drawbacks are poor efficiency and a relatively heavy weight.

US-A-4,929,212 discloses a discus having a simple luminous and acoustic device which is controlled by switches activated by centrifugal forces during the flight of the discus.

US-A-4,307,538 describes a lighting system for disc toys including a circuit device consisting of a plurality of logic elements, resistors etc. Therefore, this known circuit device is of heavy weight and does not meet the requirements of little dimensions. This known discus may only ensure that a continuous light streak is visible.

Further, US-A-3,720,018 discloses a disc-shaped flight toy which is illuminated for night flying. Rays from the central light object of the toy are deflected outwardly and radially so as to illuminate either the material of the toy itself, internally, or to reflect light from one or both opposite surfaces thereof. Such a flight toy is also described in US-A-3,786,246 showing a disc-shaped body terminating at its periphery in a downwardly pointing rim receiving lighting means in the form of a plurality of regularly spaced lamps.

The invention is based on the problem of providing a discus of the above-mentioned type which provides a significantly increased attractivity and variability the signal patterns as compared with known discuses and which allows to easily change the signal patterns and an increased efficiency insuring a long playtime.

This problem is solved according to the invention by the features of claim 1. Advantageous embodiments of the invention are described in the further claims.

The discus according to the invention is provided with a circuit device including microprocessor control means controlling each luminous body individually and

according to the use to software, and a time function element activating the luminous bodies in pulsed fashion with pulsed duration of at least 30 %.

The discus has a significantly raised attractivity and variability by replacing the known wiring of the individual electric components by a "software solution" using a microprocessor. Each luminous body can be individually and separately controlled by the microprocessor control means. The originally relatively simple toy "Frisbee" is therefore developed further to a "hightech article" incorporating a particular great number of different signal patterns without requiring changing the hardware components. The discus raises therefore the attractivity for the player and allows the manufacturer to change signal patterns without changing the hardware components.

A further advantage results from the time function element activating the luminous bodies in pulsed fashion with a pulsed duration of at least 30 %. If luminous bodies such as LEDs are driven with a pulse width of 30 % (or more), the human eye no longer perceives the LEDs lighting up and going out but sees the LED light as steady light. In other words, the dark phases between the lighting-up phases cannot be perceived any longer. On the other hand, such a pulse duration saves current at the same time since the LEDs are only switched on e.g. 30 % of the total time. This prolongs considerably the working life of normal batteries or that of accumulators between charging times.

The effects generated by the discus can be extremely diverse depending on the design of the luminous device. For example it is possible to make individual, in particular different-colored, luminous bodies of the luminous device light up by turns. These luminous bodies can also be disposed on the discus in such a way that they form a certain motif. The luminous bodies can furthermore be driven in such a way as to light up according to a certain time scheme and/or scheme influencing the intensity of luminous power. The luminous bodies can light up continuously or intermittently, for example flashing like a stroboscope. If a suitable acoustic device is provided on the discus a great variety of acoustic effects can be produced either alternatively or in addition to the above-mentioned optical effects.

The luminous and/or acoustic device permits the discus to be followed much more easily and better during its flight, whereby the colored play of lights, for example, and possible sound effects considerably increase its attractiveness both for the user and for any onlooker. The hardware components necessary for realizing the inventive luminous and/or acoustic device have such low weight and small dimensions that they do not impair the flying qualities of the discus. It has instead turned out that the slight increase in weight often actually improves the flying qualities.

The luminous and/or acoustic device can be disposed on the underside, top or both sides of the discus. If the luminous device is disposed on the underside of

the discus the bent-down edge of the discus already offers a certain protection for the electric device.

It is also possible for the luminous device to be disposed in a depression in the discus, in which case the device can be inserted in the depression from the top side of the discus. This provides excellent mechanical protection for the electric device in a simple way.

Alternatively the luminous device can also be disposed in a raised area on the top side of the discus or on each side, i.e. protruding beyond the top side and underside.

Favorable flying qualities result when the mass center of the luminous device lies in the center of the discus.

The energy source for the luminous device can be one-way or rechargeable batteries to be connected to a charging set via a plug socket provided on the luminous device, or alternative energy sources such as solar cells for example.

Particularly manifold and attractive optical effects can be obtained if the luminous device has a plurality of luminous bodies which are spaced apart. The luminous bodies can realize a great variety of motifs in a simple way.

An easily realized arrangement results if the luminous bodies are disposed in a circle about the central axis of the discus and comprise small incandescent bulbs, light-emitting diodes or flash bulbs.

At least the areas of the discus adjacent the luminous bodies are advantageously made of a transparent material. In this case the luminous effects are visible on both sides of the discus. This is of advantage in particular since the discus frequently flies at a certain inclination to the horizontal so that both the top side and the underside are visible during flight. It is also possible in this case to embed the electric device completely within the plastic material of the discus which permits particularly good protection for the electric device.

Alternatively the luminous bodies can be surrounded at least partly by an opaque material provided with diaphragmlike openings for selective exit of light.

The luminous device advantageously has reflecting elements preferably disposed in adjustable fashion for influencing the angle of radiation.

Very interesting acoustic effects can be obtained if the discus is provided with an electrically operated acoustic device comprising at least one acoustic element connected with the electric or electronic circuit device for activating the acoustic elements according to a predetermined time scheme and/or scheme influencing the volume and/or tone pitch.

If the luminous means include more than four luminous bodies, it is advantageous if the circuit device has a time function element serving as a clock unit and emitting an in particular rectangular current or voltage pulse, said element being connected with a decade counter driving the luminous means.

Further interesting luminous and/or sound effects

can be obtained if the luminous and/or acoustic means are driven by means of a sensor detecting the direction of rotation, rotational speed, ambient light conditions and/or flying speed of the discus.

The invention will be explained in more detail in the following by way of example with reference to the drawing, in which:

Figs. 1 - 6 show partly cross-sectional, schematic side views of six different embodiments of the discus,

Figs. 7A - 7C show schematic representations of various possibilities of disposing luminous bodies on a carrier,

Fig. 8 shows a circuit diagram of a further embodiment of the electric circuit device for driving sixteen LED luminous bodies.

Fig. 1 shows discus 1 known as a "Frisbee" having a bowl or dish shape. Luminous device 2 is fastened to the underside of discus 1 and has carrier 3 for luminous bodies 4 and electric circuit device 5 with a simple rectangular pulse time function element, a decade counter or a suitably programmed microprocessor.

Luminous device 2 is disposed axially to central axis 6 of discus 1 so that the mass center of luminous device 2 lies in central axis 6 or at least as close as possible thereto. Luminous device 2 can be fastened to discus 1 by glue.

Luminous bodies 4 protrude radially outward from carrier 3 and are spaced apart in a circle about central axis 6. Luminous bodies 4 can comprise permanently wired light-emitting diodes, flash bulbs or small incandescent bulbs received in corresponding sockets in carrier 3.

Luminous bodies 4 are supplied with energy by one or more rechargeable, small-sized batteries (not shown) of luminous device 2. For recharging these batteries plug socket 7 is provided on the top side of luminous device 2 into which a corresponding plug of a charging set (not shown) can be inserted. Plug socket 7 can be received within projection 8 of luminous device 2 that extends upward through circular gap 9 within discus 1.

Electric circuit device 5 drives luminous bodies 4 in such a way that they light up according to the predetermined time scheme and/or scheme influencing the intensity of luminous power.

A switch (not shown) is also provided on luminous device 2 for switching the luminous device on and off.

Discus 1 can be made of a plastic material which is transparent at least in the area of luminous bodies 4 so that the lighting up of luminous bodies 4 can be perceived not only from the underside of discus 1 but also through discus 1 from its top side. It is also possible to metalize the underside of discus 1 to increase the lumi-

nous effect of luminous bodies 4 downward.

In the alternative embodiment apparent from Fig. 2 discus 1 has rotationally symmetric, central depression 9 which is open toward the top. Luminous device 2 is inserted into depression 9 from above. The opening of depression 9 is closed by cover plate 10 whose top side is flush with the top side of the bordering areas of discus 1. Plug socket 7 can extend through cover plate 10, as shown, so that the latter need not be removed for charging the batteries. To prevent dirt or moisture from entering plug socket 7 the latter can be closed by suitable stopper 11.

In the embodiment shown in Fig. 2 the electric circuit device is received within carrier 3. In this embodiment at least the area of depression 9 and/or cover plate 10 are also made of a transparent material so that the lighting up of luminous bodies 4 is visible through the material.

In the alternative embodiment shown in Fig. 3 luminous bodies 4 are disposed on the top side of discus 1 while electric circuit device 5 is located on its underside. Luminous bodies 4 and carrier 3 are covered by transparent cap 13 so that luminous bodies 4 shine through to the outside, on the one hand, and are protected, on the other hand.

Cap 14 drawn over electric circuit device 5 ensures protection of the electric or electronic components.

Fig. 4 shows discus 1 wherein luminous bodies 4 are disposed both on the top side and on the underside of discus 1. Electric circuit device 5 is likewise located on the underside of discus 1.

Fig. 5 shows a further embodiment of discus 1 wherein reflecting elements 15 are disposed within bottom cap 14 to influence in a desired way the angle of emission of the light radiated by luminous bodies 4.

To permit variation of the angle of emission, reflecting elements 15 are expediently disposed in adjustable fashion.

Fig. 6 shows a further embodiment of discus 1 wherein upper cap 13 and lower cap 14 are shown, not in cross section as in Figs. 3 to 5, but in a side view. In this embodiment cap 14 is made of an opaque material. However, to permit a selective exit of light from luminous bodies 4 disposed within cap 14 and shown by broken lines, cap 14 has slotlike light exit openings 16 that have the effect of a diaphragm and limit the angle of emission. Instead of slot-like light exit openings one can also provide ones with other cross-sectional shapes, for example circular light exit openings.

Figs. 7A to 7C show various possibilities for disposing luminous bodies 4 on carrier 3.

In the embodiment shown in Fig. 7A luminous bodies 4 are disposed with their feet parallel to carrier 3, for example a printed board, and fastened thereto.

In the embodiment shown in Fig. 7B luminous bodies 4 are disposed perpendicular to carrier 3, the feet of luminous body 4 piercing carrier 3 and being fastened thereto.

In the embodiment shown in Fig. 7C luminous bodies 4 are disposed at certain angle α to carrier 3. In the embodiment example shown, angle α is 45° but it can also be different depending on the desired angle of radiation of luminous bodies 4.

To ensure simple assembly and firm holding of luminous bodies 4 at the given angle, carrier 3 has holding plate 17 which is beveled at angle α and serves as a support for the feet of luminous bodies 4.

Discuses 1 shown in Figs. 1 to 6 can be provided with acoustic device 12 (shown for clarity's sake only in Fig. 1) having one or more acoustic elements, for example small loudspeakers, which are driven in the desired way by electric circuit device 5.

With reference to Fig. 8 three alternative embodiment examples for electric circuit device 5 will be explained in more detail in the following.

In Fig. 8 the abbreviations have the following meanings:

GND: Ground
VCC: Supply voltage

Fig. 8 shows an electric circuit device wherein the switching functions are realized by means of microprocessor IC 5. The clock frequency of microprocessor IC 5 is given by reference counter 18, for example a quartz crystal. The supply voltage is 4.8 volts and is delivered by battery BT 1 which can likewise be charged via socket 19.

Microprocessor IC 5 is used to drive altogether sixteen different light-emitting diodes D2 to D17 via lines L1 to L16, resistors R3 to R18 and transistors T1 to T16. Lines L1 to L16 are shown in Fig. 8 partly in the form of bus 18.

The microprocessor requires software involving about 4 KB. Ports P 0.0 to P 0.7 and P 2.0 to P 2.7 serve to drive the light-emitting diodes. Port P 1.0 to P 1.7 is utilized as a control and start strip. Pin 1 starts the program selected in pins 3 to 7 which lasts about 2 minutes. Before this time has lapsed the program can be canceled by the key button on pin 1. The direction of the light-emitting diodes is controlled via pin 3 and their speed via pin 4. Eight basic programs can be called via pins 5 to 7.

Claims

1. A discus having a bowl or dish shape, which discus is provided with an electrically operated luminous device (2) including a plurality of luminous bodies (4), which luminous device (2) having an electric or electronic circuit device for activating the luminous bodies (4) according to a predetermined time scheme and/or scheme influencing the intensity of luminous power, characterized in that the circuit device includes microprocessor control

means controlling each luminous body (4) individually and according to the used software, and a time function element (IC 1, IC 2) activating the luminous bodies (4) in pulsed fashion with a pulse duration of at least 30 %.

2. The discus of claim 1, characterized in that the device (2) is disposed on the lower and/or top side of the discus (1).

3. The discus of claim 2, characterized in that the device (2) is disposed in a depression (9) in the discus (1).

4. The discus of claim 2, characterized in that the device (2) is disposed in a raised area on the top side of the discus (1).

5. The discus of claim 1, characterized in that the mass center of the device (2) lies in the center of the discus (1).

6. The discus of claim 1, characterized in that the mass center (2) is supplied with electricity by rechargeable batteries.

7. The discus of claim 6, characterized in that the batteries are adapted to be connected to a charging set via a plug socket (7) provided on the device (2).

8. The discus of claim 1, characterized in that the device (2) is adapted to be operated by solar energy.

9. The discus of claim 1, characterized in that the luminous bodies (4) are spaced apart.

10. The discus of claim 9, characterized in that the luminous bodies (4) are disposed in a circle about the central axis (6) of the discus (1).

11. The discus of claim 1, characterized in that the luminous bodies (4) comprise small incandescent bulbs and/or light-emitting diodes and/or flash bulbs.

12. The discus of claim 9, characterized in that at least the areas of the discus (1) adjacent the luminous bodies (4) are made of a transparent material.

13. The discus of claim 9, characterized in that the luminous bodies (4) are surrounded at least partly by an opaque material provided with diaphragm-like openings for selective exit of light.

14. The discus of claim 1, characterized in that the luminous device (2) has reflecting elements (15) disposed in adjustable fashion for influencing the

angle of radiation.

15. The discus of claim 1, characterized in that the discus (1) is provided with an electrically operated acoustic device (12) comprising at least one acoustic element connected with the electric or electronic circuit device for activating the acoustic elements according to a predetermined time scheme and/or scheme influencing the volume and/or tone pitch.

16. The discus of any of claims 1 to 15, characterized in that the time function element (IC 1, IC 2) activates the luminous bodies (4) with a pulse duration of 30 to 50 %.

17. The discus of any of claims 1 to 16, characterized in that the time function element (IC 2) serves as a clock unit and emits an in particular rectangular current or voltage pulse, said element being connected with a decade counter (IC 3) driving the luminous means.

18. The discus of any of claims 1 to 17, characterized in that the luminous bodies (4) and/or acoustic elements are driven by means of a sensor detecting the direction of rotation and/or rotational speed and/or ambient light conditions and/or flying speed of the discus (1).

Patentansprüche

1. Diskus mit einer schalen- oder schüsselförmigen Gestalt, der mit einer elektrisch betriebenen Leuchteinrichtung (2) versehen ist, einschließlich einer Mehrzahl von Leuchtkörpern (4), die mit einer elektrisch oder elektronischen Schalteinrichtung zur Aktivierung der Leuchtkörper (4) ausgerichtet sind, entsprechend einem vorgegebenen Zeitschema und/oder einem Schema, welches die Intensität der Leuchtkraft beeinflusst,

dadurch gekennzeichnet, daß

die Schalteinrichtung eine Mikroprozessorsteuereinrichtung umfaßt, zur Steuerung eines jeden Leuchtkörpers (4) individuell und entsprechend der eingesetzten Software sowie ein Zeitfunktionselement (IC1, IC2), welches die Leuchtkörper (4) aktiviert in einer gepulsten Weise mit einer Impulsdauer von mindestens 30 %.

2. Diskus nach Anspruch 1, dadurch gekennzeichnet, daß sich die Einrichtung (2) auf der unteren und/oder der oberen Seite des Diskus (1) befindet.

3. Diskus nach Anspruch 2, dadurch gekennzeichnet, daß sich die Einrichtung (2) in einer Vertiefung (9) des Diskus (1) befindet.

4. Diskus nach Anspruch 2, dadurch gekennzeichnet,

daß die Einrichtung sich in einem angehobenen Bereich auf der Oberseite des Diskus (1) befindet.

5. Diskus nach Anspruch 1, dadurch gekennzeichnet, daß das Massenzentrum der Einrichtung (2) im Zentrum des Diskus (1) angeordnet ist. 5
6. Diskus nach Anspruch 1, dadurch gekennzeichnet, daß das Massenzentrum (2) mit Elektrizität durch wiederaufladbare Batterien versorgt ist. 10
7. Diskus nach Anspruch 6, dadurch gekennzeichnet, daß die Batterien an eine Aufladeinrichtung über einen Stecksockel (7) anschließbar sind, mit welchem die Einrichtung (2) ausgerüstet ist. 15
8. Diskus nach Anspruch 1, dadurch gekennzeichnet, daß die Einrichtung (2) durch Solarenergie betreibbar ist. 20
9. Diskus nach Anspruch 1, dadurch gekennzeichnet, daß die Leuchtkörper (4) in einem Abstand voneinander angeordnet sind.
10. Diskus nach Anspruch 9, dadurch gekennzeichnet, daß die Leuchtkörper (4) in einem Kreisbogen um die Mittelachse (6) des Diskus (1) angeordnet sind. 25
11. Diskus nach Anspruch 1, dadurch gekennzeichnet, daß die Leuchtkörper (4) kleine Glühbirnen und/oder lichtemittierende Dioden und/oder Blitzlichtbirnen umfassen. 30
12. Diskus nach Anspruch 9, dadurch gekennzeichnet, daß die Bereiche des Diskus (1), angrenzend an die Leuchtkörper (4) aus einem transparenten Material bestehen. 35
13. Diskus nach Anspruch 9, dadurch gekennzeichnet, daß die Leuchtkörper (4) zumindest teilweise umgeben sind von einem undurchsichtigen Material, welches mit membranähnlichen Öffnungen versehen ist, zum selektiven Lichtaustritt. 40
14. Diskus nach Anspruch 1, dadurch gekennzeichnet, daß die Leuchteinrichtung (2) reflektierende Elemente (15) besitzt, die in einer einstellbaren Weise angeordnet sind zur Beeinflussung des Abstrahlungswinkels. 45
15. Diskus nach Anspruch 1, dadurch gekennzeichnet, daß der Diskus (1) mit einer elektrisch betriebenen akustischen Einrichtung (12) versehen ist, mit mindestens einem akustischen Element, welches an eine elektrische oder elektronische Schalteinrichtung angeschlossen ist, zur Aktivierung der akustischen Elemente, entsprechend einem vorbestimmten Zeitschema und/oder einem 50

Schema zur Beeinflussung der Lautstärke und/oder der Tonhöhe.

16. Diskus nach einem der Ansprüche 1 bis 15, dadurch gekennzeichnet, daß das Zeitfunktionselement (IC1, IC2) die Leuchtkörper (4) aktiviert mit einer Impulsdauer von 30 bis 50 %.
17. Diskus nach einem der Ansprüche 1 bis 16, dadurch gekennzeichnet, daß das Zeitfunktionselement (IC2) als Zeitgebereinheit wirkt und einen im wesentlichen rechteckförmigen Strom- oder Spannungsimpuls emittiert, wobei das Element an einen Zehnergruppenszähler (IC3) angeschlossen ist, der die Leuchteinrichtung aktiviert.
18. Diskus nach einem der Ansprüche 1 bis 17, dadurch gekennzeichnet, daß die Leuchtkörper (4) und/oder die akustischen Elemente durch einen Sensor aktivierbar sind, der die Rotationsrichtung und/oder die Rotationsgeschwindigkeit und/oder die Umgebungslichtbedingungen und/oder die Fluggeschwindigkeit des Diskus (1) erfaßt.

Revendications

1. Disque ayant la forme d'un bol ou d'une coupelle, ledit disque étant pourvu d'un dispositif lumineux à alimentation électrique (2) qui inclut une pluralité de corps lumineux (4), ledit dispositif lumineux (2) ayant un circuit électrique ou électronique pour activer les corps lumineux (4) selon un schéma temporel prédéterminé et/ou selon un schéma qui influence l'intensité de puissance lumineuse, caractérisé en ce que le circuit inclut des moyens de commande à microprocesseur qui commandent chaque corps lumineux (4) individuellement et selon le logiciel utilisé, et un élément à fonction temporelle (IC1, IC2) qui active les corps lumineux (4) de manière pulsée avec une durée d'impulsion d'au moins 30%.
2. Disque selon la revendication 1, caractérisé en ce que le dispositif lumineux (2) est disposé sur le côté inférieur et/ou le côté supérieur du disque (1).
3. Disque selon la revendication 2, caractérisé en ce que le dispositif lumineux (2) est disposé dans une dépression (9) dans le disque (1).
4. Disque selon la revendication 2, caractérisé en ce que le dispositif lumineux (2) est disposé dans une zone relevée sur le côté supérieur du disque (1).
5. Disque selon la revendication 1, caractérisé en ce que le centre de masse du dispositif lumineux (2) est situé au centre du disque (1).

6. Disque selon la revendication 1, caractérisé en ce que le centre de masse (2) est alimenté en électricité par des batteries rechargeables.
7. Disque selon la revendication 6, caractérisé en ce que les batteries sont adaptées à être connectées à un groupe de charge via une prise enfichable (7) prévue sur le dispositif lumineux (2). 5
8. Disque selon la revendication 1, caractérisé en ce que le dispositif lumineux (2) est adapté à être alimenté en énergie solaire. 10
9. Disque selon la revendication 1, caractérisé en ce que les corps lumineux (4) sont écartés les uns des autres. 15
10. Disque selon la revendication 9, caractérisé en ce que les corps lumineux (4) sont disposés sur un cercle autour de l'axe central (6) du disque (1). 20
11. Disque selon la revendication 1, caractérisé en ce que les corps lumineux (4) comprennent des petites ampoules à incandescence et/ou des diodes électroluminescentes et/ou des ampoules flash. 25
12. Disque selon la revendication 9, caractérisé en ce que, au moins les zones du disque (1) adjacentes aux corps lumineux (4) sont réalisées en matériau transparent. 30
13. Disque selon la revendication 9, caractérisé en ce que les corps lumineux (4) sont entourés au moins partiellement par un matériau opaque pourvu d'ouvertures analogues à des diaphragmes pour une sortie sélective de la lumière. 35
14. Disque selon la revendication 1, caractérisé en ce que le dispositif lumineux (2) comporte des éléments réflecteurs (15) disposés d'une manière réglable pour influencer l'angle de rayonnement. 40
15. Disque selon la revendication 1, caractérisé en ce que le disque (1) est pourvu d'un dispositif acoustique à alimentation électrique (12) comprenant au moins un élément acoustique connecté au circuit électrique ou électronique pour activer les éléments acoustiques selon un schéma temporel prédéterminé et/ou selon un schéma qui influence le volume et/ou la hauteur du son. 45 50
16. Disque selon l'une quelconque des revendications 1 à 15, caractérisé en ce que l'élément à fonction temporelle (IC1, IC2) active les corps lumineux (4) avec une durée d'impulsion de 30 à 50%. 55
17. Disque selon l'une quelconque des revendications 1 à 16, caractérisé en ce que l'élément à fonction temporelle (IC2) sert d'unité d'horloge et émet un courant ou une impulsion de tension en particulier rectangulaire, ledit élément étant connecté à un compteur à décade (IC3) qui pilote les moyens lumineux.
18. Disque selon l'une quelconque des revendications 1 à 17, caractérisé en ce que les corps lumineux (4) et/ou les éléments acoustiques sont pilotés au moyen d'un capteur qui détecte la direction de rotation et/ou la vitesse de rotation et/ou les conditions de lumière ambiante et/ou la vitesse de vol du disque (1).

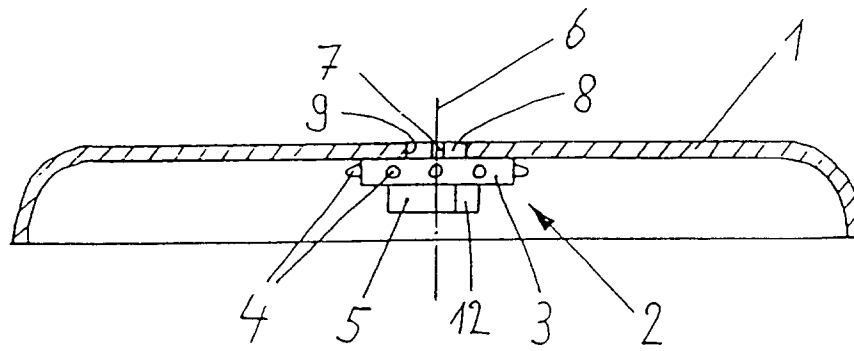


Fig. 1

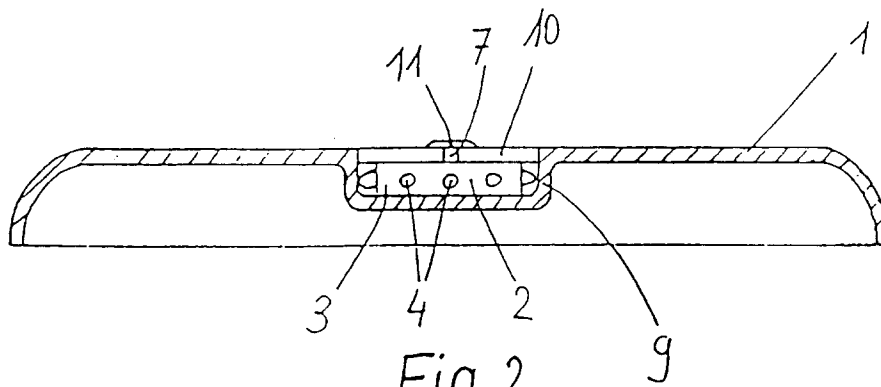


Fig. 2

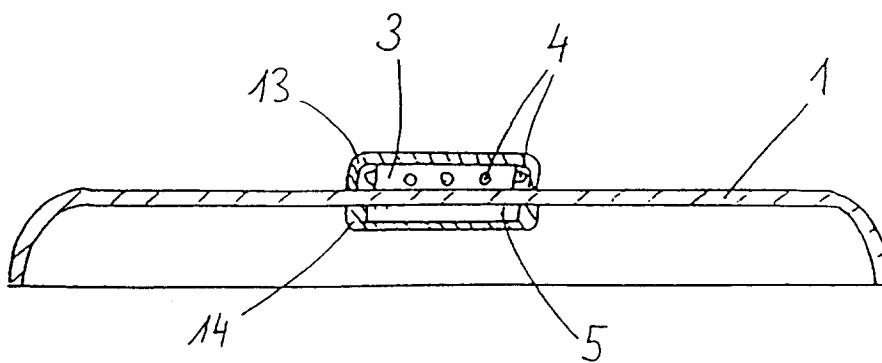


Fig. 3

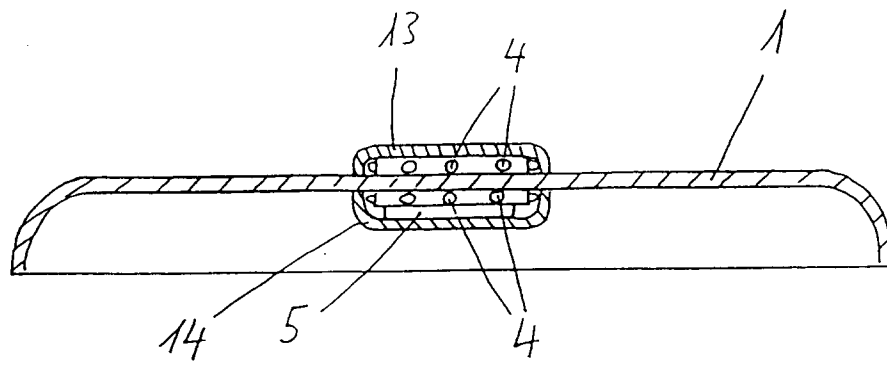


Fig. 4

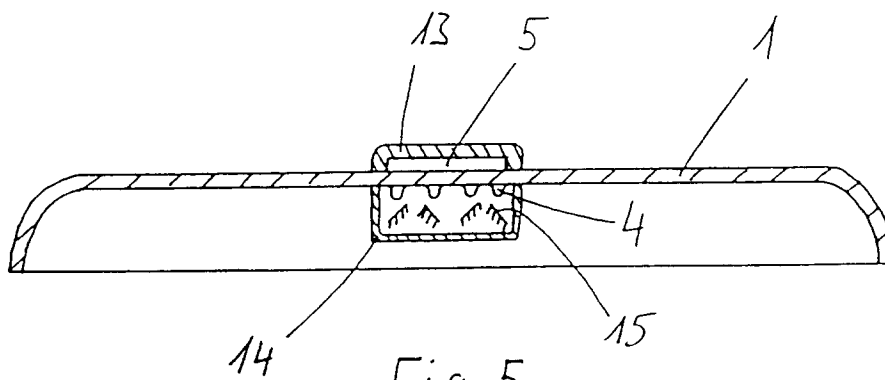


Fig. 5

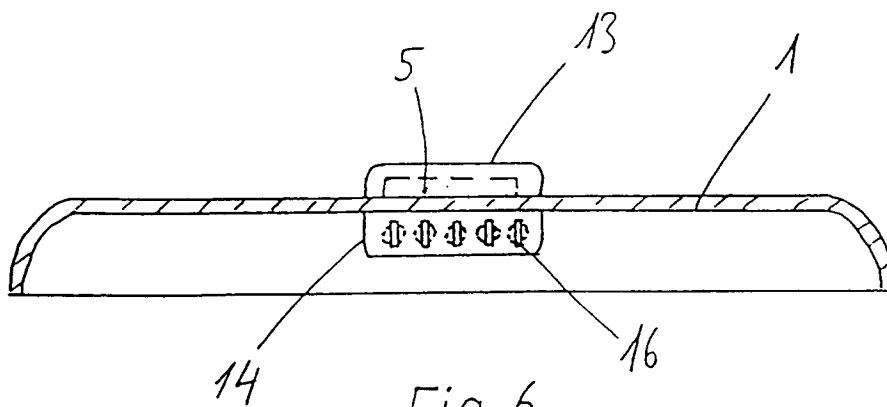


Fig. 6

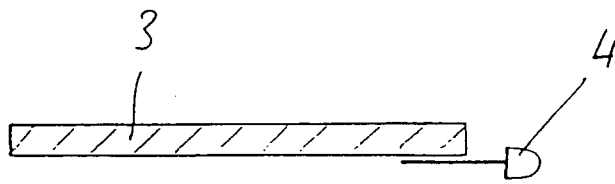


Fig. 7A

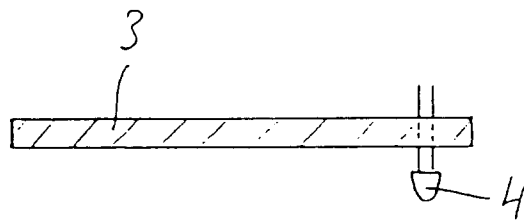


Fig. 7B

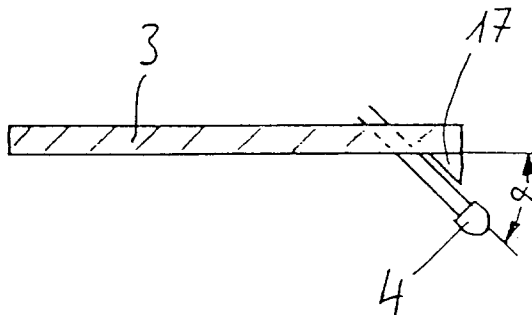


Fig. 7C

