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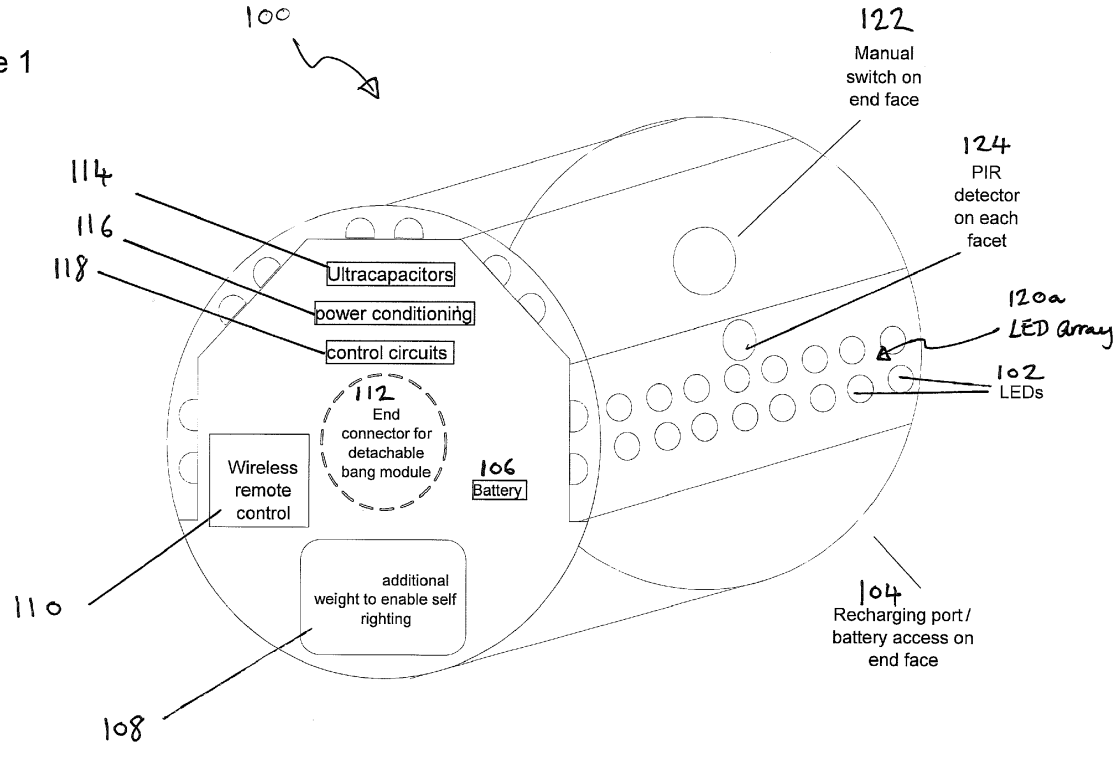
(54) **FLASH GRENADE AND ACOUSTIC MODULE THEREFOR**

(57) There is disclosed a flash grenade for selective activation where upon activation the grenade may emit at least 100,000 lumens, the flash grenade comprising: an operator interface; a power source; a plurality of light emission units each connected to the power source independently and comprising: an array of light emitting elements; a power converter unit for driving the array; a control unit independently connected to each light emission unit, the control unit comprising a processor and being operably connected to the operator interface.

Figure 1



EP 3 348 954 A1

Description

[0001] The present invention relates to a flash grenade and an acoustic module therefor.

[0002] It is known from US8113689 to provide a non-pyrotechnic projectile capable of emitting 100,000 candelas per square metre and which may be selectively activated to disorientate nearby personnel. US8113689 discloses a power source interfaced with a centralised control electronics unit. The control electronics connect to various light generators.

[0003] According to a first aspect of present invention there is provided a flash grenade for selective activation where upon activation the grenade may emit at least 100,000 lumens, the flash grenade comprising, an operator interface a power source, a plurality of light emission units each connected to the power source independently and comprising: an array of light emitting elements; a power converter unit for driving the array, and a control unit independently connected to each light emission unit, the control unit comprising a processor and being operably connected to the operator interface.

[0004] As such a handheld flash grenade is provided which supplies energy to in an efficient manner and thereby tends to make good use of the available energy, e.g. as stored in the power source, such that a smaller power source may be used.

[0005] Further, the independent coupling of the control unit to each light emission unit, and the provision of a power converter at each light emission unit, tends to provide the grenade with redundancy in case a part fails in service.

[0006] Each light emission unit may comprise a capacitive energy store and/or and inductive energy store.

[0007] Such an energy store can be tuned to deliver power in a particularly responsive manner and so can therefore permit higher switching frequencies of the light emitting element arrays.

[0008] There may be provided a capacitor charging means electrically interposed between the power source and each capacitive energy store. The capacitor charging means may be connected to the control unit.

[0009] The control unit may be configured for driving at least one of the arrays of light emitting elements in a pulse mode when the grenade is activated such that in operation the array of light emitting elements may switch between a high power output condition and a low power output condition repeatedly. The pulse mode may be such that the array of light emitting elements may switch between conditions at a frequency predetermined to disorientate nearby personnel.

[0010] The low power output mode is substantially zero watts.

[0011] Each array of light emitting elements may be an array of light emitting diodes (LEDs). Further the array of LEDs may comprise at least 20 LEDs.

[0012] The power source may be a lithium ion battery.

[0013] The power source may be operable to deliver output power of at least 5 kW to the light emission units.

[0014] The operator interface may be configured to enable selection between initiation modes. The initiation modes may comprise any combination of: an instant initiation, a delayed initiation, a wirelessly controlled initiation, or, a passive infra-red detection initiation.

[0015] The operator interface may be configured to enable selection between activation modes. The activation modes may comprise: a pulse mode where the light emitting elements may switch between a high power output condition and a low power output condition repeatedly, or a continuous power output mode where the power output is substantially constant.

[0016] According to a second aspect of the invention there is provided an acoustic module for a flash grenade comprising: a connector for attachment to a flash grenade; an acoustic signal generator for generating at least one predetermined acoustic signal at or around a predetermined frequency.

[0017] The acoustic module may further comprise an acoustic cavity configured to substantially resonate at the predetermined frequency.

[0018] The connector may be for detachable attachment.

[0019] The connector may be for conveying electrical signals when connected to a reciprocally configured connector at a flash grenade.

[0020] The connector may be for conveying electrical power when connected to a reciprocally configured connector at a flash grenade.

[0021] The acoustic module may be configured to produce at least 100 dB.

[0022] The acoustic module may be configured to operate synchronously with a flash grenade to which the module can be connected.

[0023] The acoustic module may be activated and/or pre-programmed by way of a remote operator interface.

[0024] So that the invention may be well understood, embodiments thereof shall now be described with reference to the following figures, of which:

Figure 1 shows a three-dimensional representation of a handheld flash grenade according to the present invention;

Figure 2 shows a schematic diagram of a first embodiment of a flash grenade according to the present invention;

Figure 3 shows a schematic diagram of a second embodiment of a flash grenade according to the present invention; and

Figure 4 shows a schematic diagram of a modular acoustic attachment which may be provided as part of the flash grenade.

[0025] With reference to Figure 1 there is shown gen-

erally at 100 a handheld flash grenade. The grenade 100 comprises a substantially cylindrical housing 130 which accommodates a plurality of LEDs 102 arranged as LED arrays 120a, 120b. The housing 130 further accommodates a power source 106, a means for adjusting its standing position 108, a transceiver 110 for wireless control of the grenade, an array of ultracapacitors 114 (which may be arranged as a plurality of arrays), a power converter unit 116 (which may be arranged as a plurality of converter units) for driving the LEDs, and a control unit 118.

[0026] The housing 130 has a substantially circular front and back face which are substantially parallel and separated by an interconnecting side wall surface. Incorporated into the interconnecting side wall, the housing 130 has facets arranged to extend axially between the substantially circular faces of the cylindrical housing 130. Each of these facets has arranged at it an array of LEDs, such as LED array 120a. Further, each facet is provided with a PIR sensor 124.

[0027] Additionally the housing accommodates an end connector 112 at the front face of the housing for attaching and electrically interfacing an optional noise producing module (as will be later discussed with reference to figure 4.

[0028] A manual switch 122 is provided at the back face of the housing for selectively switching the grenade 100 between and 'on' mode (where the grenade 100 may emit light if so instructed) and an 'off' mode (where the grenade 100 may not emit light).

[0029] Also provided at the back face of the housing 130 is an access panel or port 104 whereby either the power source 106 can be removed (and replaced), or a recharging energy source can be coupled into the source 106 to recharge it.

[0030] In operation, the handheld grenade 100 may be picked up by an operator, switched manually from the 'off' mode to the 'on' mode using switch 122 and subsequently thrown into a hostile environment. A subsequent instruction received from the wireless transceiver 110 (which may be delivered by a remote control retained by the operator) causes the battery 106 to transfer energy, via the power converter units 116 and/or ultracapacitors 114 to the LED arrays 120a and 120b, which then emit intense light and thereby disorientate adversaries proximate to the grenade 100.

[0031] Figure 2 shows schematically a flash grenade 200, similar to grenade 100, where components similar to components in flash grenade 100 are incremented by 100. For instance the LED array 120a of the grenade 100 in Figure 1 is similar to the LED array 220a of grenade 200.

[0032] With reference to Figure 2, there is shown a grenade 200 provided with a plurality of light emission units 201. Each of the light emission units 201 comprises an ultracapacitor array 214, a power converter unit 216 and the LED array 220. The ultracapacitor array 214 is connected to the power converter unit 216 which is in turn connected to the LED array 220.

[0033] For instance, a light emission unit 201 a comprises ultracapacitor array 214a, connected to power converter unit 216a connected to LED array 220a.

[0034] The grenade 200 is further provided with an ultracapacitor charger 215 connected to each of the arrays of ultracapacitors 214a, 214b and 214c. The ultracapacitor charger 215 is connected to a power source 206 such that the ultracapacitor charger 215 can receive and manage power from the source 206. The ultracapacitor charger 215 is further connected to a control unit 218 such that it may send and receive signals from the control unit 218.

[0035] The control unit 218 is additionally connected to each of the power converter units 216a, 216b and 216 c such that it can send and receive signals to and from these units.

[0036] Still further, the control unit 218 is connected to various interface units, such as a PIR sensor unit 224 and a wireless control unit 210 (which may be provided as part of a broader operator interface including also a manual remote control unit) such that the control unit 218 may act in dependence on signals received from these.

[0037] The control unit 218 comprises a signal generator (not shown) and/or clock for generating a periodic signal that varies between an upper value and a lower value at a predetermined frequency.

[0038] In operation, a disorienting light emission may be effected.

[0039] Each ultracapacitor array 214a, 214b, and 214c is driven by the ultracapacitor charger 215, under instruction from the control unit 218 such that the charging of the ultracapacitor array is regulated such that should the LED array need activation at a predetermined time, the ultracapacitor array is able to discharge through the power converter unit 216 into the LED array 220 (and thereby put the grenade 200 is a high power output mode) in a predetermined manner.

[0040] In particular the ultracapacitor arrays may be driven to charge during one phase of a cycle of the periodic signal generated at the control unit 218 and then may be driven to discharge during the second phase of a cycle of the periodic signal.

[0041] Accordingly the LED arrays may be switched between a high power mode (i.e. as the ultracapacitor array 214 discharges into the LED array 220) and a low power mode (i.e. as the ultracapacitor array 214 is charged).

[0042] Figure 3 shows schematically a flash grenade 300, similar to grenade 100, where components similar to components in flash grenade 100 are incremented by 200. For instance the LED array 120a of the grenade 100 in Figure 1 is similar to the LED array 320a of grenade 300.

[0043] As such, with reference Figure 3 there is shown generally at 300 a further schematic embodiment of a flash grenade. As compared with the Figure 2 embodiment, this flash grenade 300 tends to do away with the ultracapacitor arrays 214a, 214b, 214c and the associ-

ated charger 215.

[0044] Thus in this Figure 3 embodiment, the light emission units 301 comprise a power converter unit 316 connected to a LED array 320.

[0045] A power source 306 is connected to each of the power converters 316a, 316b and 316c. A control unit 318 is connected to each of the power converters 316a, 316b and 316c. The control unit 318 is also connected to various interface units, such as a PIR sensor unit 324 and a wireless control unit 310 (which may be provided as part of a broader operator interface including also a manual remote control unit) such that the control unit 318 may act in dependence on signals received from these.

[0046] In operation, the flash grenade 300 activates at least one of the LED arrays 320a, 320b, and 320c when the associated power converter unit 316a, 316b, or 316c is instructed by a signal from the control unit 318 to pass electrical energy from the power source 306 to its associated LED array. With energy being transferred from the power source 306 to an LED array 302, the grenade 300 is placed in a high power mode of operation.

[0047] The instruction to pass energy between the power source 306 and some or all of the LED arrays 320a, 320b, 320c may be in the form of a periodic signal having a first phase of a cycle and a second phase of a cycle such that the first phase of the cycle causes activation of the LED arrays 320a, 320b, 320c (i.e. electrical energy is supplied to the LED arrays 320a, 320b, 320c) and the second portion of the cycle causes deactivation (i.e. not electrical energy supplied to the arrays).

[0048] In general operation any of the grenades 100, 200 or 300 may be used as follows.

[0049] An operator firstly identifies an enclosure, particularly a building, containing targets for disorientation.

[0050] The operator then throws or otherwise deploys the flash grenade into the building (having first set the grenade into the 'on' mode).

[0051] The operator then selects that the flash grenade be activated. This selection may be by means of an instruction to the grenade issued, via an operator-held remote control device, to the wireless transceiver. Alternatively this instruction may have been made prior to deployment of the grenade by setting a countdown timer (using a clock in the control unit) such that at the end of the countdown, the grenade is activated.

[0052] Upon activation the LED arrays are illuminated (the particular mechanism of illumination depending on whether the Figure 2 to Figure 3 arrangement is used). In general this illumination will be a high frequency periodic illumination where the LED arrays activated switch between a high power output mode and a low power output mode.

[0053] The flash grenades contemplated above may be provided with a modular attachment for enhancing the disorientation effect by providing the option of deploying an acoustic disorientation effect.

[0054] As such, the acoustic disorientation device (or module) 400 is provided. With reference to Figure 4, the acoustic disorientation device 400 has the general form of a puck and as such the acoustic disorientation device 400 is generally cylindrical with its diameter greater than its depth.

[0055] The acoustic disorientation device 400 can be attached to the flash grenade system 100. Where the acoustic disorientation device is in the form of a puck as shown in Figure 4, the device 400 may attach to the grenade 100 such that the main cylindrical axis is aligned with the axis of the grenade 100.

[0056] The acoustic disorientation device 400 comprises a main body or housing 440 featuring a mating connector 412, an acoustic signal generator 410 and an acoustic resonator cavity 410. The mating connector 412 is electrically connected to the acoustic signal generator 410.

[0057] The mating connector 412 is suitable for mechanically fastening and unfastening from the end connector 112 on the flash grenade 100. As such the connector 412 provides a detachable fixture.

[0058] Further, the mating connector 412 interfaces with the flash grenade 100 such that when mechanically fastened together, electrical signals and power from the flash grenade 100 may be relayed to the acoustic disorientation device 400.

[0059] In particular, signals may be relayed over the connectors 112, 412 from the control circuits 118 to the acoustic signal generator 410, which signals activate the acoustic signal generator 410 to cause the emission of acoustic waves.

[0060] The acoustic signal generator 410 is arranged to transmit acoustic waves into the resonator cavity 420. The resonator cavity 420 is a hollow chamber within the main body 440 configured to have dimensions suitable for amplifying the acoustic signal by resonance.

[0061] Thus in use the acoustic disorientation device can generate sufficiently powerful acoustic waves to disorient proximate personnel. In particular it is expected that the device can emit 100dB of sound or more.

[0062] The waveforms of the acoustic waves generated by the acoustic wave generator can be predetermined by the user. For instance the waveforms can be pre-programmed into the control circuits 118 and selectively activated via the operator interface.

[0063] The acoustic waves generated by the device 400 may operate synchronously with the flash system. For instance the acoustic disorientation device 400 may periodically alternate between a phase of acoustic wave emission and a phase of general silence. This periodic alternation may be coherent with and have the same period as the high power and low power phases of the pulsed optical disorientation signal.

[0064] In operation the acoustic disorientation device 400 can be fastened to the flash grenade 100. From here, the acoustic disorientation device 400 can be turned on, deployed and activated in an equivalent manner to the LED illumination described above.

[0065] Alternative versions of the acoustic disorienta-

tion device (or module) 400 could comprise an integral power source and signal receiver such that there was no necessity for electrical power and signals to be conveyed across the connector 112.

[0066] Alternative versions of the acoustic disorientation device (or module) 400 could be provided without an acoustic cavity.

Claims

1. A flash grenade for selective activation where upon activation the grenade may emit at least 100,000 lumens, the flash grenade comprising:

    an operator interface;
    a power source;
    a plurality of light emission units each connected to the power source independently and comprising:

        an array of light emitting elements;
        a power converter unit for driving the array;

    a control unit independently connected to each light emission unit, the control unit comprising a processor and being operably connected to the operator interface.

2. A flash grenade according to claim 1, wherein each light emission unit comprises a capacitive energy store.

3. A flash grenade according to claim 1 or claim 2, wherein each light emission unit comprises an inductive energy store.

4. A flash grenade according to claim 2, comprising a capacitor charging means electrically interposed between the power source and each capacitive energy store.

5. A flash grenade according to claim 4, wherein the capacitor charging means is connected to the control unit.

6. A flash grenade according to any one of the preceding claims, wherein the control unit is configured for driving at least one of the arrays of light emitting elements in a pulse mode when the grenade is activated such that in operation the array of light emitting elements may switch between a high power output condition and a low power output condition repeatedly.

7. A flash grenade according to claim 6, wherein the low power output mode is substantially zero watts.

8. A flash grenade according to any one of the preceding claims wherein the power source is operable to deliver output power of at least 5 kW to the light emission units.

9. A flash grenade according to any one of the preceding claims wherein the operator interface is configured to enable selection between activation modes.

10. An acoustic module for a flash grenade comprising:

    a connector for attachment to a flash grenade;
    an acoustic signal generator for generating at least one predetermined acoustic signal at or around a predetermined frequency.

11. An acoustic module according to claim 10, further comprising an acoustic cavity configured to substantially resonate at the predetermined frequency.

12. An acoustic module according to claim 9 or 10, wherein the connector is for detachable attachment.

13. An acoustic module according to claims 10, 11, or 12, wherein the connector is for conveying electrical signals when connected to a reciprocally configured connector at a flash grenade.

14. An acoustic module according to claims 10 to 13, wherein the connector is for conveying electrical power when connected to a reciprocally configured connector at a flash grenade.

15. An acoustic module according to any one of claims 17 to 21 wherein the acoustic module is configured to produce at least 100 dB.

Figure 1

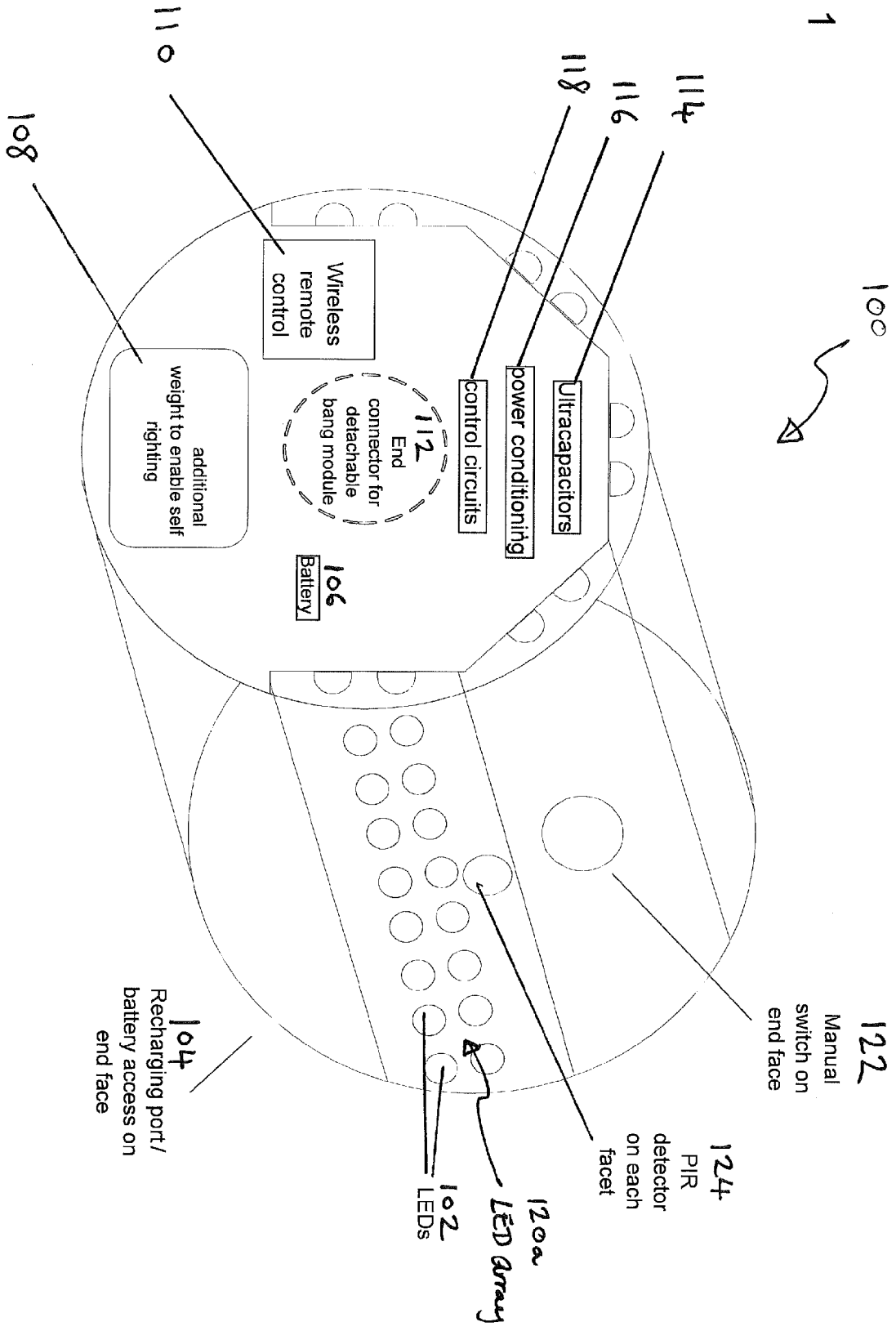

100
122
Manual switch on end face
124
PIR detector on each facet
120a
LED Array
102
LEDs
104
Recharging port/ battery access on end face
108
110
114
116
118
Wireless remote control
additional weight to enable self righting
112
End connector for detachable bang module
106
Battery
Ultracapacitors
power conditioning
control circuits

Figure 2

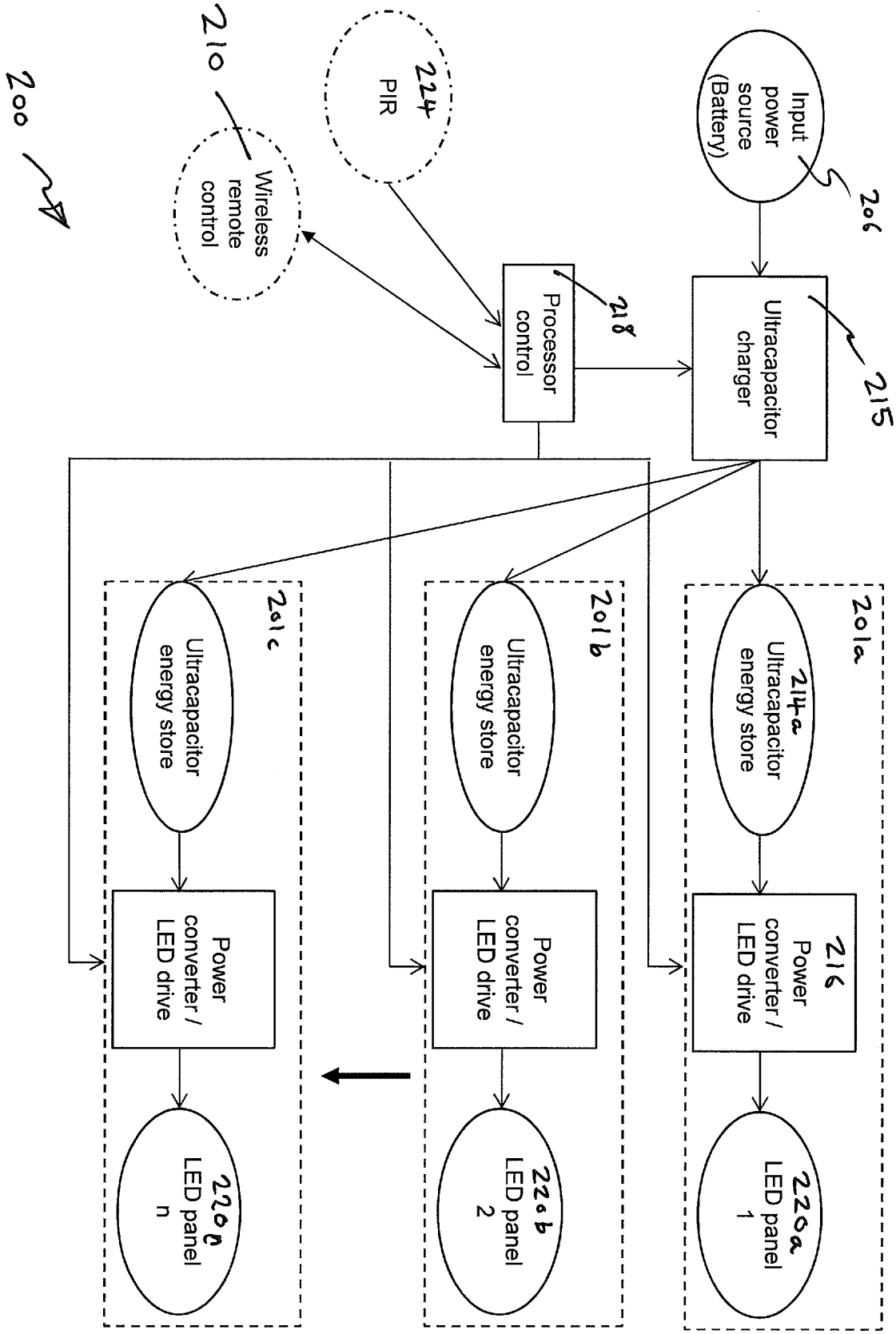
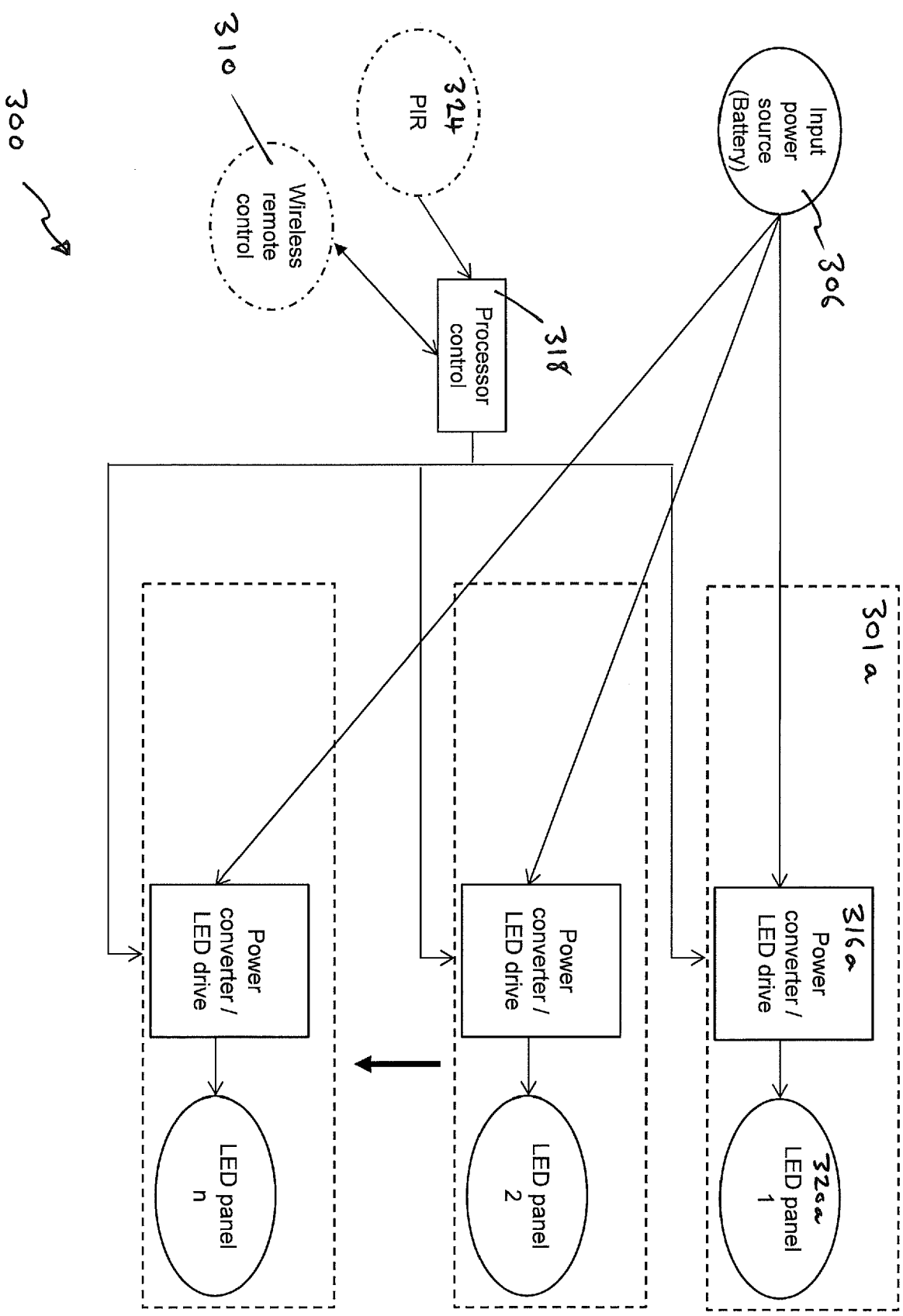

200
Input power source (Battery)
206
Ultracapacitor charger
215
Processor control
218
PIR
224
Wireless remote control
210
201a
214a Ultracapacitor energy store
216 Power converter / LED drive
220a LED panel 1
201b
Ultracapacitor energy store
Power converter / LED drive
220b LED panel 2
201c
Ultracapacitor energy store
Power converter / LED drive
220c LED panel n

Figure 3


300
310
Wireless remote control
324
PIR
Input power source (Battery)
306
Processor control
318
301a
316a
Power converter / LED drive
320a
LED panel 1
Power converter / LED drive
LED panel 2
Power converter / LED drive
LED panel n

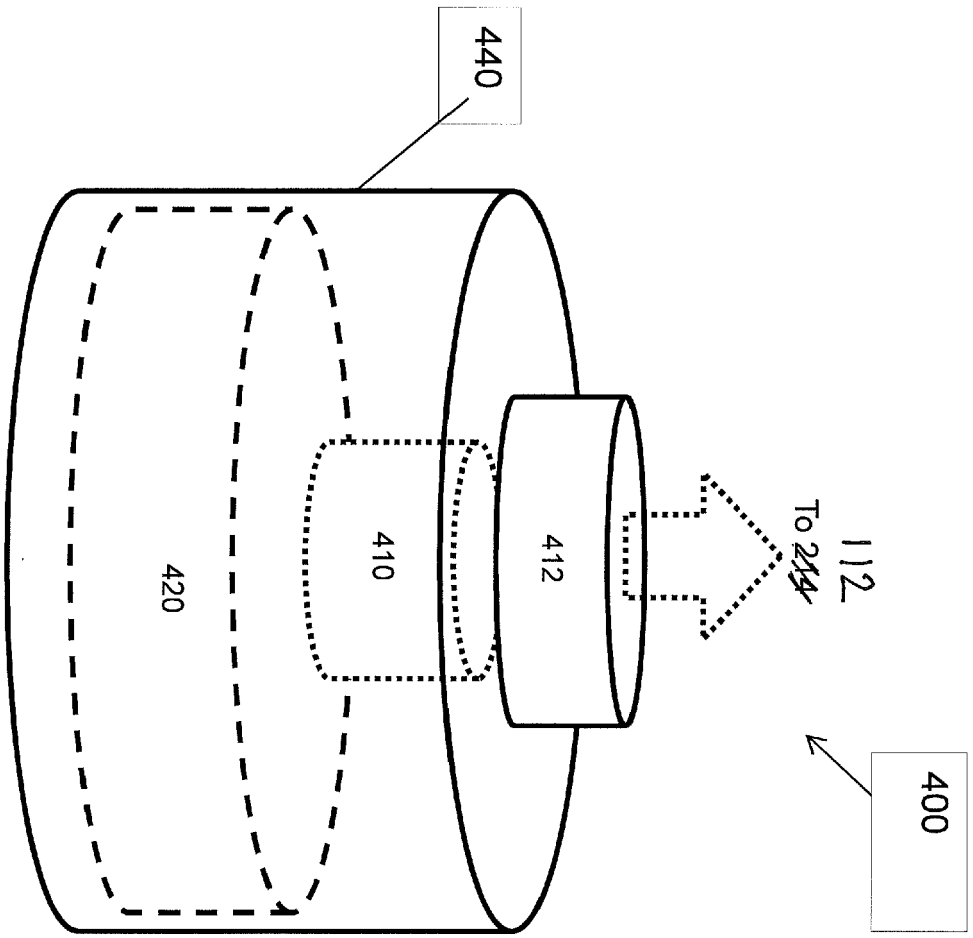


Figure 4

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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 1164

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2008/216699 A1 (MCALEER MICHAEL K [US] ET AL) 11 September 2008 (2008-09-11) * paragraph [0047] * * paragraph [0049] * * paragraph [0051] * * paragraph [0058] - paragraph [0060] * * paragraph [0079] - paragraph [0080] * * paragraph [0064] * * claim 1 * * figures * * paragraph [0021] * * paragraph [0070] * * paragraph [0083] *	1-9	INV. F42B12/42 F42B27/00
X	US 2010/285909 A1 (VOELKER JEFFREY J [US] ET AL) 11 November 2010 (2010-11-11) * paragraph [0014] - paragraph [0015] * * paragraph [0019] * * paragraph [0021] * * figures *	1,2,4-9	
X	EP 3 023 731 A1 (DIEHL BGT DEFENCE GMBH & CO KG [DE]) 25 May 2016 (2016-05-25) * paragraph [0023] - paragraph [0024] * * paragraph [0026] * * paragraph [0028] * * paragraph [0031] * * paragraph [0041] * * paragraph [0020] * * figures *	1,2,4-9	TECHNICAL FIELDS SEARCHED (IPC) F42B F41H

-/--

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	3 July 2017	Gex-Collet, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 1164

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2010/072895 A1 (GLYNN KENNETH P [US] ET AL) 25 March 2010 (2010-03-25) * paragraph [0051] * * paragraph [0049] * * paragraph [0052] * * paragraph [0053] - paragraph [0055] * * paragraph [0058] * * paragraph [0062] * * figures * * paragraph [0010] *	1,6-9	
X	US 2016/231090 A1 (BISHOP LYMAN [US] ET AL) 11 August 2016 (2016-08-11) * paragraph [0017] * * paragraph [0018] * * paragraph [0023] * * paragraph [0026] * * paragraph [0032] * * figures *	1,6-9	
			TECHNICAL FIELDS SEARCHED (IPC)

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	3 July 2017	Gex-Collet, A

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X : particularly relevant if taken alone
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P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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Application Number
EP 17 15 1164

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-9

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 17 15 1164

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-9

A flash grenade for selective activation where upon activation the grenade may emit at least 100,000 lumens, the flash grenade comprising:an operator interface;a power source;a plurality of light emission units each connected to the power source independently and comprising:an array of light emitting elements;a power converter unit for driving the array;a control unit independently connected to each light emission unit, the control unit comprising a processor and being operably connected to the operator interface.

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2. claims: 10-15

An acoustic module for a flash grenade comprising:a connector for attachment to a flash grenade;an acoustic signal generator for generating at least one predetermined acoustic signal at or around a predetermined frequency.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 15 1164

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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03-07-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 8113689 B **[0002]**