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(54) **SYSTEM FOR ATTACHING A DEVICE TO AN OBJECT, AND ASSOCIATED SYSTEM FOR DEPLOYING THE DEVICE**

(57) The present invention relates to a system for attaching a device to an object, comprising: means for attaching the device to an object; a trigger mechanism for triggering activation of the attaching means; and means for releasably coupling the device to a deployment system, comprising: a first configuration in which the device is rigidly coupled to the deployment system; a second configuration in which the device is flexibly coupled to the deployment system; and means for controllably changing the configuration of the coupling means from the first configuration to the second configuration, wherein, the trigger mechanism is activated upon changing the configuration of the coupling means from the first configuration to the second configuration. The invention further relates to a charge deployment system.

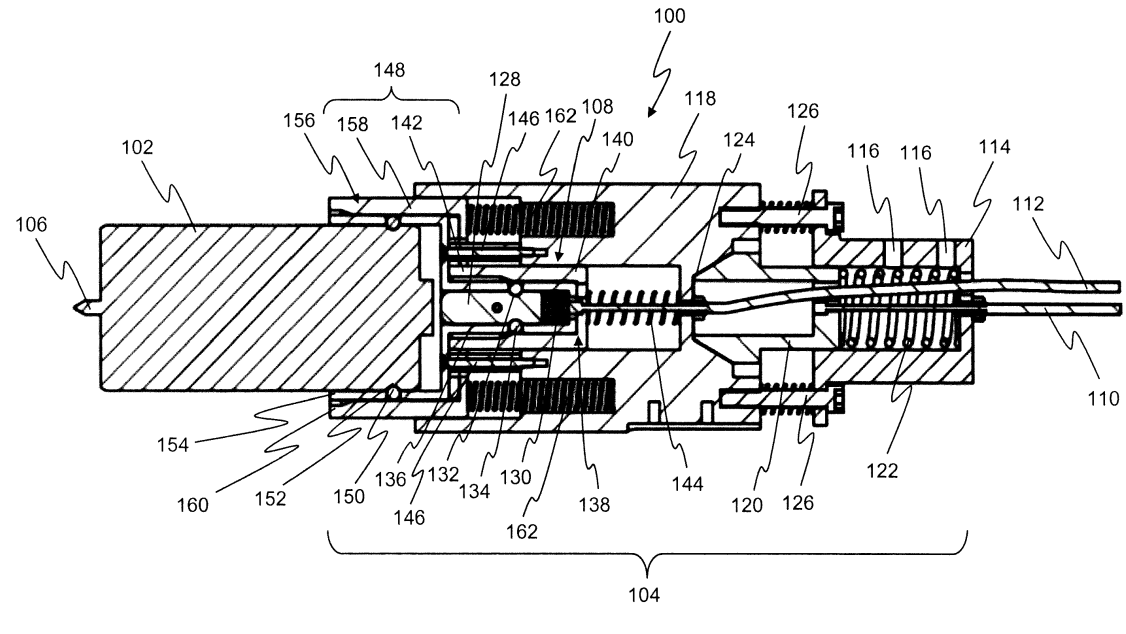

Figure 1

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Description

[0001] The present invention relates to a system for attaching a device to an object. The invention also relates to a deployment system for deploying the device and attaching it to an object. In particular, the invention relates to a disposal charge deployment system for ordnance neutralisation. The system is suited to deploying multiple disposal charges to neutralise multiple items of ordnance in a single sortie. In particular, the invention relates to the neutralisation of underwater ordnance, such as mines.

[0002] Underwater ordnance disposal systems are known. For example, traditional mine sweeping vessels drag either lines to mechanically trigger the ordnance or a decoy to remotely trigger the ordnance for example by simulating the magnetic or acoustic signature of a vessel being targeted by the ordnance. This type of mine sweeping is dangerous as it requires the vessel to enter the area containing the ordnance. In addition, unsweepable ordnance has been developed which prevents the use of such a system.

[0003] Other types of ordnance disposal systems are known, and enable remote, i.e. remote from a vessel such as a mine countermeasures vessel (MCMV), operation. Examples of such known systems are diver placed charges, remotely operated single charge systems, and multiple charge deployment systems.

[0004] The diver placed charges may be attached to the ordnance by a variety of means such as a rope, or mechanical fixings, etc and can be triggered by a variety of means such as a timer, or a flash exploder. Diver placed charges are inherently dangerous for the diver, and time consuming to clear an area containing the ordnance to be disposed.

[0005] Remotely operated single charge systems provide the advantage over diver placed charges that a human is not required to enter the area containing the ordnance A number of remotely operated single charge systems are known. Such systems may have an onboard target identification system, or they may be controlled from a surface vessel. These systems may require an identification vehicle to be used to identify the ordnance before releasing the charge system. Where the system has a target identification system onboard, there may be the need for significant time to be spent to train the system to identify ordnance. As such, the single charge systems are time consuming, and may not correctly identify ordnance. Furthermore, once launched from a vessel in an armed state, the charge can not be recovered safely and so is always triggered, but due to the difficulties associated with identifying ordnance may sometimes neutralise non-ordnance targets. This leads to a high attrition rate of the charges, which leads to operational problems. Due to the complete destruction of the vehicles associated with such systems at neutralisation, the operational costs are high.

[0006] A known remotely operated multiple charge deployment system enables more than one ordnance to be targeted in a single sortie. The known system enables more than one charge to be dropped separately, each charge being dropped in the vicinity of a different ordnance to be neutralised. The known multiple charge deployment systems utilise a blast charge which is operationally limited in its employment. As used herein, the term 'sortie' refers to a single launch of a charge deployment system from a MCMV.

[0007] Other known systems provide a remotely operated vehicle which carries a single charge to be deployed. The system uses simultaneous activation of an attachment device to attach the charge to ordnance, and release of the charge from the underwater vehicle carrying the charge. This can be undesirable since when the attachment device fails to securely attach the charge to the ordnance, the charge is lost and difficult if not impossible to recover.

[0008] It is therefore an object of the present invention to provide a multiple charge deployment system for ordnance neutralisation which reduces the cost, and time, associated with ordnance neutralisation. In particular, it is an object of the present invention to more efficiently enable multiple ordnance to be targeted and neutralised in a single sortie. It is a further object of the present invention to provide a charge system which can be effectively coupled to the ordnance to be neutralised. It is a yet further object of the present invention to provide an effective system for attaching a device, such as a charge device, to an object, such as ordnance.

[0009] According to a first aspect of the present invention, there is provided a system for attaching a device to an object. The system comprises: means for attaching the device to an object; a trigger mechanism for triggering activation of the attaching means; and means for releasably coupling the device to a deployment system. The coupling means comprises: a first configuration in which the device is rigidly coupled to the deployment system; a second configuration in which the device is flexibly coupled to the deployment system; and means for controllably changing the configuration of the coupling means from the first configuration to the second configuration. The trigger mechanism is activated upon changing the configuration of the coupling means from the first configuration to the second configuration.

[0010] By providing an attaching system having a first configuration in which the device is rigidly coupled to a deployment system and a second configuration in which the device is flexibly coupled to the deployment system, advantageously, a device can be attached to an object more effectively. In this way, it is possible to ensure a secure attachment of the device to an object before releasing the device from the deployment system, but without risking dislodging the attachment because the coupling between the device and the deployment system, after attachment is flexible, thereby reducing the transfer of movement of the deployment system to the device.

[0011] The coupling means preferably further comprises a third configuration in which the device is released from the deployment system. By providing such a third configuration, the operator of the attachment system can ensure that the device is attached to the object before releasing the device from the deployment system.

[0012] In a preferred embodiment, the trigger mechanism and the coupling means are provided in a housing, the housing being mountable to the deployment system. The attaching means is preferably provided in a housing coupled to the device, the attaching means housing being releasably coupled to the deployment system by the coupling means. By providing only the attaching means on the object, the remainder of the system may be more easily reusable. Once the device is attached to the object with the attaching means, the remainder of the system can be reloaded with another device having the attaching means to attach the other device to another, or indeed the same, object. Such a system therefore reduces the cost of and complexity of attaching a device to an object.

[0013] The coupling means preferably comprises: a first portion configured to be rigidly mounted to the deployment system; a second portion on which the device is releasably coupled; and an engagement member slidably coupled to the first portion or the second portion. The other of the first portion and the second portion comprises a recess configured to receive the engagement member when the coupling means is in the first configuration to rigidly couple the first portion to the second portion.

[0014] Preferably, the first portion and the second portion are coupled together by at least one resilient mount, each mount preferably comprising a helical spring, wherein the configuration of the coupling means is changed from the first configuration to the second configuration by sliding the engagement member from a position in which it is engaged with the recess, to a position in which it is disengaged from the recess, such that the first portion and the second portion are coupled only by the or each resilient mount.

[0015] The or each resilient mount preferably comprises: a retainer having a shaft and a retaining portion; and a resilient element disposed about the shaft. A first end of the shaft is fixed to the first portion or the second portion of the coupling means, the shaft passing through a hole in the other of the second portion and the first portion, and the second end of the shaft comprises the retaining portion, which prevents the first portion and the second portion from completely separating. A first end of the resilient element acts on the first portion, and a second end of the resilient element acts on the second portion, such that the first portion and the second portion are biased apart.

[0016] Preferably, the resilient element is a spring, such as a helical spring. Preferably, when the coupling means is in the first configuration, the engagement member causes the or each shaft to be in tension. By causing the or each shaft of the resilient mount to be in tension, advantageously, the or each resilient mount is locked in a rigid state.

[0017] Preferably, the coupling means comprises a plurality of resilient members, such as three, four, five, six or more.

[0018] The engagement member preferably comprises a frustoconical end, the recess being correspondingly frustoconical. By providing a frustoconical end, the engagement member may self-align with the recess.

[0019] Preferably, the engagement member is biased towards the recess by a resilient element. The resilient element is preferably a spring, such as a helical spring. The biasing force acting on the engagement member is preferably greater than the biasing force, or forces, acting on the first portion and the second portion by the or each resilient mount. In this way, the coupling means is retained in the first configuration.

[0020] The coupling means preferably further comprises an operating cable attached to the engagement member to slide the engagement member from the engaged position to the disengaged position. The cable is preferably a Bowden cable comprising a cable within a sheath, one end of the sheath being attached to the first portion of the coupling means.

[0021] The trigger mechanism preferably comprises: a pin, preferably being a captive pin, having a first end and a second end; and a store of potential energy, preferably being a compressed spring, adjacent the first end of the pin, configured to convert the stored potential energy to kinetic energy of the pin upon changing the configuration of the coupling means from the first configuration to the second configuration, wherein, the second end of the pin is configured to act on the attaching means to trigger attachment.

[0022] The pin preferably comprises a recess configured to receive a retainer, the retainer configured to retain the pin in an armed position when the coupling means is in the first configuration. The retainer preferably comprises at least one ball bearing, the recess in the pin being configured to partially receive the ball bearing. The trigger mechanism preferably comprises a first hollow tubular member, for receiving the pin, comprising at least one through hole for receiving the at least one ball bearing, the diameter of the or each through hole preferably being less than the diameter of the ball bearing. The trigger mechanism preferably further comprises a second hollow tubular member having a portion with a first inner diameter and a portion with a second inner diameter greater than the first inner diameter. The first diameter being such that the first hollow tubular member is a sliding fit within the second hollow tubular member. The wall thickness of the first hollow tubular member, and the diameter of the at least one ball bearing are configured such that when the first hollow tubular member is within the second hollow tubular member, the inner surface of the portion of the second hollow tubular member having the first diameter acts of the at least one ball bearing to retain it in the recess of the pin, the pin being received in the first hollow tubular member at a position such that potential energy is stored in the potential energy store. That is to say, the spring is compressed, and the trigger is armed.

[0023] When the second hollow tubular member is moved relative to the first hollow tubular member, from a first position in which the at least one ball bearing is retained in the recess of the pin to a position where the portion of the second hollow tubular member having the second inner diameter is adjacent the at least one ball bearing, the at least one ball bearing is released from the recess in the pin, thereby activating the trigger.

[0024] Preferably, the second hollow tubular member comprises a base, the base being coupled to a trigger cable for moving the second hollow tubular member relative to the first hollow tubular member. The trigger cable is preferably a Bowden cable, one end of the sheath of the Bowden cable being coupled to the second portion of the coupling means. The trigger cable and the coupling means cable are preferably coupled together at their distal ends, such that they may be pulled simultaneously.

[0025] The engagement member is preferably a hollow tubular member to enable the trigger cable to pass therethrough.

[0026] A resilient member, such as a spring, is preferably provided to act on the second hollow tubular member to bias the trigger mechanism towards the armed configuration. The trigger cable preferably passes through the resilient member.

[0027] The first hollow tubular member is preferably rigidly coupled to the second portion of the coupling means.

[0028] The trigger mechanism may be activated substantially simultaneously upon changing the coupling means from the first configuration to the second configuration, or alternatively after a delay, such as between 0.1 s and 1.0 s. The delay may be more or less in dependence on operational requirements.

[0029] As will now be appreciated, in a preferred embodiment, the trigger mechanism is mechanical. However, it is also contemplated that the trigger mechanism may alternatively be electrical or hydraulic. For example, the trigger may comprise an electrically activated detonator, where upon changing the coupling means from the first configuration to the second configuration an electrical circuit coupled to the electrically activated detonator is completed, thereby activating the trigger.

[0030] The means for releasably coupling the device to a deployment system preferably further comprises a retaining system for retaining the device to the coupling means. The retaining system preferably comprises at least one retainer, the retainer preferably being at least one ball bearing, configured to be partially received in at least one recess in a device. The retaining system further comprises a first hollow tubular member having an inner diameter configured to slidably receive the device, where provided the housing of the attaching means coupled to the device. The first hollow tubular member of the retaining system comprises at least one through hole for receiving the at least one ball bearing, the diameter of the or each through hole preferably being less than the diameter of the ball bearing.

[0031] The retaining system preferably further comprises a second hollow tubular member having a portion with a first inner diameter and a portion with a second inner diameter greater than the first inner diameter. The first diameter being such that the first hollow tubular member of the retaining system is a sliding fit within the second hollow tubular member. The wall thickness of the first hollow tubular member, and the diameter of the at least one ball bearing are configured such that when the first hollow tubular member is within the second hollow tubular member, the inner surface of the portion of the second hollow tubular member having the first diameter acts of the at least one ball bearing to retain it in the recess of the device.

[0032] When the second hollow tubular member of the retaining system is moved relative to the first hollow tubular member, from a first position in which the at least one ball bearing is retained in the recess of the device to a position where the portion of the second hollow tubular member of the retaining system having the second inner diameter is adjacent the at least one ball bearing, the at least one ball bearing is released from the recess in the device, thereby releasing the device. In this way, the coupling means is moved to the third configuration.

[0033] Preferably, the second hollow tubular member is coupled to the second hollow tubular member of the trigger mechanism for moving the second hollow tubular member of the retaining system relative to the first hollow tubular member of the retaining system. The retaining system preferably further comprises at least one resilient member, such as a spring, configured to bias the second hollow tubular member towards the first hollow tubular member. Preferably, the second hollow tubular member of the retaining system comprises a base, the at least one resilient member acting of the base and the second portion of the coupling means.

[0034] The first hollow tubular member of the retaining system is preferably rigidly coupled to the first hollow tubular member of the trigger mechanism, and to the second portion of the coupling means.

[0035] According to a further aspect of the present invention, there is provided an unmanned vehicle comprising a system for attaching a device to an object as described herein. In this embodiment, the unmanned vehicle is preferably a remotely operated vehicle, more preferably a remotely operated underwater vehicle. In one embodiment, the unmanned vehicle is used to attach a charge device to ordnance for neutralisation.

[0036] According to a second aspect of the present invention, there is provided a charge deployment system for ordnance neutralisation. The system comprises: at least one deployment unit, the or each unit comprising: a housing for stowing a charge device in a stowed position; means for releasably coupling the charge device to the deployment unit, comprising: a first configuration in which the device is rigidly coupled to the deployment unit; a second configuration in which the device is flexibly coupled to the deployment unit; and means for controllably changing the configuration of the coupling means from the first configuration to the second configuration. The or each deployment unit further comprises means for controllably moving the charge device from the stowed position to a deployment position. The deployment system further comprises a controller for controlling the or each moving means, and the or each coupling means.

[0037] The charge deployment system enables the charge to be presented and attached to the ordnance under control of a remote user, which increases the efficiency of deploying charges to neutralise ordnance. Therefore, the accuracy of charge deployment may be increased. Furthermore, the attrition rate of the charges may be reduced. In addition, by providing means for releasably coupling the charge to the deployment unit having such first and second configurations enables the charge to be flexibly retained on the deployment system after the charge is attached to the ordnance, while reducing the influence of movement of the deployment system relative to the ordnance and thus reducing the risk of the charge being separated from the ordnance after attachment. In this way, it can be ensured that the charge device is securely attached to the ordnance before being released from the deployment system, again reducing the attrition rate of the charges.

[0038] As used herein, the term 'ordnance' includes: underwater mines, which include ground mines, in-volume mines, floating mines, shallow moored mines, and drifting mines; modern or historical underwater and land based ordnance, which include iron bombs, depth charges, torpedoes, and artillery shells; underwater and land based, improvised explosive devices (IEDs).

[0039] As used herein, the term 'neutralisation' refers to any means of disabling ordnance, and includes complete high-order detonation, partial-high order detonation, and low order detonation such as disabling the ordnance firing mechanism or disrupting the ordnance firing train.

[0040] Preferably, the system further comprises: means for attaching the charge device to the ordnance; and a trigger mechanism for triggering activation of the attaching means. The trigger mechanism is preferably activated upon changing the configuration of the coupling means from the first configuration to the second configuration. As such, it will be appreciated that the charge deployment system may comprise a system for attaching a device to an object as described herein. Therefore, the advantages of that attaching system can be provided in addition to the advantages of charge deployment system.

[0041] The deployment system preferably further comprises at least one actuator configured to change the configuration of the coupling means from the first configuration to the second configuration. In a preferred embodiment, each deployment unit comprises an actuator. The actuator may be a servo-motor. The coupling means may comprise at least one cable configured to change the configuration of the coupling means from the first configuration to the second configuration. The cable may be actuated by the servo-motor, the servo-motor preferably being attached to a portion of the charge deployment system remote from the charge. By providing the servo-motor remote from the charge, and therefore remote from the ordnance the influence of the deployment system electromagnetic signature on the ordnance may be minimised.

[0042] In a preferred embodiment, the system comprises a plurality of deployment units. Preferably, the system comprises two, three, four, five, six or more deployment units. In a particularly preferred embodiment, the system comprises three deployment units.

[0043] The or each housing for stowing the charge device may be removable. The housing of the or each deployment unit may be releasably mounted to the respective deployment unit. In this way, the charge system can be more easily loaded into the deployment system. Where the system comprises a plurality of deployment units, the plurality of releasably coupled housings may be coupled to each other, such that they may be mounted to the deployment system as a single unit. The housings may be coupled together by a frame.

[0044] In a preferred embodiment, the moving means is further configured to controllably move a charge and coupling means from the deployment position to the stowed position. By enabling the charge to be controllably moved from the deployment position to the stowed position, the charge may be re-stowed if the charge deployment is aborted. For example, the charge deployment may be aborted if the ordnance has been misidentified, or if attachment of the charge device to the ordnance was not successful.

[0045] The moving means preferably comprises a linear actuator. The linear actuator preferably comprises a hydraulic cylinder, the hydraulic cylinder comprising a hollow cylinder and piston inserted into the cylinder. The hydraulic cylinder may be a telescopic hydraulic cylinder. The hydraulic cylinder may use water, preferably seawater, as a hydraulic fluid. In this alternative embodiment, the deployment system further comprises ancillary systems to enable the control of the hydraulic cylinder, such as a hydraulic pump or an accumulator.

[0046] The hydraulic cylinder is preferably manufactured from a non-ferrous material, more preferably a composite material. The composite material is preferably a fibre reinforced polymer. The fibre may be carbon fibre or glass fibre. The plastic may be epoxy, polyester, vinyl ester, nylon, or thermoplastic.

[0047] Providing a hydraulic cylinder linear actuator may enable the extension of the charge from the housing to be increased, for example up to 2000 mm. In addition, enabling the hydraulic cylinder to be manufactured from a composite material, the signature of the charge deployment system may be reduced. Enabling an increased extension coupled with a composite structure enables the system to neutralise modern ordnance having highly sophisticated detection sensors, with reduced risk of accidental detonation of the ordnance.

[0048] Alternatively, the linear actuator may comprise: a rotatable threaded rod; and, a motor for rotating the threaded rod, wherein the coupling means comprises a threaded hole for accepting the threaded rod. The motor may be indirectly coupled to the threaded rod. By indirectly coupling the motor to the threaded rod, the speed of rotation of the threaded rod may be more easily controlled. The motor may be indirectly coupled to the threaded rod by a gear and chain system. The motor may be a stepper motor or an electro-mechanical servo motor.

[0049] In a further alternative, the linear actuator may comprise: at least one telescopic rail; a flexible belt; a pulley; and a motor configured to act on the flexible belt. The linear actuator may comprise a pair of telescopic rails. The belt and pulley being configured to act of the at least one telescopic rail to extend the rail. The belt may be a toothed belt, the pulley being a geared wheel. The motor may be indirectly coupled to the flexible belt. By indirectly coupling the motor to the flexible belt, the speed of extension of the telescopic rail may be more easily controlled. The motor may be indirectly coupled to the flexible belt by a gear and chain system. The motor may be a stepper motor or an electro-mechanical servo motor.

[0050] The linear actuator and moving means may be configured to extend the charge between about 100 mm and about 2000 mm from the housing, preferably between about 200 mm and about 1200 mm, and in a preferred embodiment about 1000 mm from the housing.

[0051] The or each deployment unit may further comprise a shield configured such that in a closed position the attachment mechanism in the stowed position is shielded from contact by an external body, the shield being movable from the closed position to an open position such that in open position a charge may be attached to an ordnance. Thus the risk of accidental initiation of the attachment mechanism may be reduced.

[0052] In addition, during accidental triggering of the attachment mechanism, the shield preferably prevents the attachment mechanism from exiting the housing.

[0053] The shield may be moved from the closed position to the open position by a linkage coupling the shield to the coupling means, such that the shield moves when the coupling means moves.

[0054] The shield is preferably hinged to the deployment unit, the hinge being biased such that the shield is biased towards the closed position. The shield may be made from a resilient material. The resilient material may be polycarbonate, or poly(methyl methacrylate) - "Perspex".

[0055] The controller is preferably configured to independently control the or each moving means of the or each deployment unit. As such, any charge housed in the deployment units may be moved from the stowed position to the deployment position.

[0056] The controller preferably comprises a receiver for receiving instructions from a remote location, the controller being configured to control the moving means in dependence on the received instructions. A remote operator provides the instructions from the remote location.

[0057] When the remote operator selects a deployment unit, the operator retains complete control of the movement and thereby position of the charge throughout the operational procedure. The operator extends the charge to its deployment position by means of a positive hand control and is able to stop the extension and retract the weapon at any time during the procedure. Mission abort up until placement of the weapon is therefore implicit in the system.

[0058] Preferably, the housing of each deployment unit is a hollow cylinder. The hollow cylinder preferably has a circular transverse cross-sectional shape.

[0059] The or each deployment unit is configured to enable any one of a plurality of charge types to be used in dependence on the type of ordnance to be neutralised. The plurality of charge types may include: a shaped charge; a blast charge; and an ordnance firing mechanism immunisation charge.

[0060] The or each deployment unit is preferably configured to enable any one of a plurality of charge attachment means to be used in dependence on the type of ordnance to be neutralised. The plurality of charge attachment means may include: an explosive powered captured-fastener gun; a magnet; a suction device; and chemical adhesion. The suction device may be a suction cup. The chemical adhesive may be a cyanoacrylate glue. The cyanoacrylate glue may be in the form of a gel. In a preferred embodiment the attachment means is an explosive powered captured-fastener gun.

[0061] The system preferably further comprises a chassis configured to be mountable to an unmanned vehicle. The chassis is preferably a tooling skid conventionally used on unmanned vehicles.

[0062] According to a further aspect of the present invention, there is provided a charge system, for use in a charge deployment system, comprising: a housing; an explosive charge within the housing; means for detonating the explosive charge; and means for attaching the charge to the ordnance. An external surface of the housing comprises an interface, for interfacing with a coupling means on a deployment system.

[0063] In one embodiment, the interface comprises at least one recess configured to receive a corresponding portion of a coupling device. The interface may comprise an annular recess configured to partially receive a plurality of ball bearings, the ball bearings forming a portion of the coupling device. Alternatively, the interface may comprise a plurality of recesses, disposed about the circumference of the housing, each configured to partially receive a ball bearing.

[0064] The charge system may further comprise a means for arming the charge device comprising a coupling between the housing for stowing the charge device and the charge device, wherein the arming means arms the charge device when the coupling between the housing for stowing the charge device and the charge device is broken.

[0065] The arming means may form part of a safety and arming device, configured to prevent detonation of the explosive charge until the charge is at or below a predefined depth of water.

[0066] The safety and arming device may be further configured to prevent detonation of the explosive charge until an arming pin is removed. The arming pin may be coupled to a deployment system by the coupling between the housing for stowing the charge device and the charge device. The arming pin may be automatically removed when the charge system is released from the deployment system. The coupling may be a cable, the cable being attached to the deployment system. The safety and arming device may be further configured to prevent detonation of the explosive charge until a user removes an arming pin. The arming pin removed by the user may be additional to the arming pin coupled to the deployment system.

[0067] According to a yet further aspect of the present system there is provided a charge deployment and initiation system comprising a charge deployment system for ordnance neutralisation as described herein, a charge system as described herein, and a charge initiation system.

[0068] The system may further comprise a transmitter for transmitting a detonation signal to each charge. The transmitter may be configured to transmit a radio frequency signal, or an acoustic signal. The transmitter may be configured to operate only when it has a line of sight to the charge, and so the transmitter may be positioned up to about 14 km from the charge.

[0069] Each means for detonating the explosive charge preferably comprises a receiver for receiving the detonation signal. In an alternative embodiment, each means for detonating the explosive charge comprises a timer configured to detonate the explosive after a predetermined period of time. As will be appreciated, in this embodiment a transmitter is not required, and so a simplified version of the charge deployment, and initiation system can be provided.

[0070] In the embodiment comprising the transmitter and receiver, the transmitter is preferably configured to transmit a coded signal. Each receiver is then configured to detonate the explosive charge on receipt of a pre-determined coded signal. This enables each charge system to be provided with a different code to enable each charge system to be detonated separately. Alternatively, or in addition, two or more of the charge systems may be provided with the same code such that when the transmitter transmits that coded signal, the two or more charge systems are detonated simultaneously. The receiver and transmitter can preferably be programmed with the detonation code immediately prior to launching the deployment system on a sortie. In this way, the operator can determine the most appropriate method of neutralising the plurality of ordnance based on as much information as possible.

[0071] Each charge preferably comprises a float comprising the receiver, the float being configured to float to the surface after the charge is deployed underwater. In one embodiment, the float is configured to float to the surface after a pre-determined period of time. The pre-determined period of time can preferably be programmed into the charge system immediately prior to launching the deployment system on a sortie. The pre-determined period of time is preferably between about 12 hours and about 672 hours, more preferably between about 12 hours and about 144 hours. In this way, and where necessary, the charge system can be deployed in a covert manner, and then detonated more or less immediately after the float is released to the surface to receive a detonation signal at a later time.

[0072] Preferably, the float is coupled to the explosive charge by a shock tube detonator, such as a NONEL shock tube detonator. When the float is released from the charge system, the shock tube detonator spools from the float enabling the float to reach the surface without being hindered by the shock tube becoming tangled or caught up. The length of shock tube detonator provided may be between about 10 m and about 300 m, or more depending on the requirements of the situation. As will be appreciated, sufficient shock tube is provided to ensure the float can reach the surface of the water in which the ordnance is located.

[0073] Alternatively, the float is coupled to the explosive charge by an electrical cable, the electrical cable being configured to transmit a detonation signal to a detonator provided adjacent the explosive charge. Providing an electrical cable between the float and the charge may enable operation at greater depths than when using shock tube detonators since the cable is thinner, and therefore a greater length of cable may be provided within the same space available on the float.

[0074] Each float may comprise a scuttling charge configured to scuttle the float after detonating the explosive charge. The scuttling charge is preferably detonated after a short time delay from the primary detonation of the explosive charge in the charge system. The scuttling charge may also be detonated using a shock tube detonator, such as a NONEL.shock tube detonator. The delay between primary detonation and the detonation of the scuttling charge may be between about 5 ms and about 50 ms, more preferably about 10 ms. The scuttling charge may be PE-4, or any other suitable plastic explosive. By scuttling the float there is a reduced risk of arisings being left at the surface after neutralisation of the ordnance.

[0075] Where an acoustic signal is transmitted, the charge may not require a float to receive the signal. In this case, the charge may receive the acoustic signal directly.

[0076] Each charge system is preferably configured to enable any one of a plurality of explosive charge types to be used in dependence on the type of ordnance to be neutralised. The plurality of explosive charge types may include: a shaped charge; a blast charge; and an ordnance firing mechanism immunisation charge.

[0077] Where a plurality of charge systems are provided on the charge deployment system, a different charge type may be loaded into each deployment unit, to enable different ordnance types to be neutralised in a single sortie. In this way, the charge deployment system may be provided with a combination of charge types. This may also be advantageous if the specific type of ordnance is not known beforehand. Alternatively, or in addition, a different attaching means may be provided in each deployment unit. This may be especially advantageous if it is found that one type of attaching means does not secure the charge system to the ordnance, because another type of attaching means can be tried without having to abort the sortie.

[0078] According to a further aspect of the invention, there is provided an unmanned vehicle comprising a charge deployment system for ordnance neutralisation as described herein.

[0079] The system enables a charge to be deployed and triggered without destroying the unmanned vehicle, and so the cost of operation may be reduced as compared to known charge deployment systems.

[0080] The vehicle may be a remotely operated vehicle (ROV). The vehicle may be an autonomous vehicle. The vehicle is preferably an underwater vehicle.

[0081] The unmanned vehicle preferably further comprises a camera system, the camera system comprising: a camera; and a transmitter for transmitting camera images to a remote location, the camera being configured to enable identification of ordnance prior to deploying a charge.

[0082] The system is designed to enable identification of the target before the decision is taken to engage and so there is no unnecessary expenditure of neutralisation charges on unidentified contacts unlike the known disposal systems. This, may significantly reduce charge attrition rate and thereby increases operational efficiency.

[0083] The unmanned vehicle preferably further comprises a navigation system configured to enable the location of the unmanned vehicle to be determined.

[0084] The unmanned vehicle preferably further comprises a sonar system configured to detect ordnance. When poor underwater visibility prevents the camera identifying the target the system is designed to enable identification of the target before the decision is taken to engage and so there is no unnecessary expenditure of neutralisation charges on unidentified ordnances unlike the known disposal systems. This may significantly reduce charge attrition rate and thereby increases operational efficiency.

[0085] The unmanned vehicle may be operated from a MCMV or an unmanned surface vehicle.

[0086] The unmanned vehicle may be particularly suited to deployment from ashore from a containerised module or from a craft of opportunity. In any one of these operational configurations one of its major advantages is the expeditionary nature of its operation. In the "stowed" position the charges are retracted into the respective housings of the deployment units, only moving to the "deployment" position under the control of the remote operator. This allows identification of possible targets before the decision is taken to deploy the charge and thereby greatly reduces the charge attrition rate. The charge is attached to the ordnance by the ROV, released from its housing and is left "ready" until the predetermined firing signal is transmitted or the countdown timer is activated. There is no requirement for a separate inspection or training configuration and so remote operators are able to train in exactly the same way they will operate. The significant reduction in cost of the charge, compared with existing systems, allows the present system to be used on a regular basis increasing the opportunity for live training and permitting regular use against historical/ nuisance ordnance for routine ordnance clearance operations and underwater demolitions.

[0087] Any feature in one aspect of the invention may be applied to other aspects of the invention, in any appropriate combination. In particular, method aspects may be applied to apparatus aspects, and vice versa. Furthermore, any, some and/or all features in one aspect can be applied to any, some and/or all features in any other aspect, in any appropriate combination.

[0088] It should also be appreciated that particular combinations of the various features described and defined in any aspects of the invention can be implemented and/or supplied and/or used independently.

[0089] The invention will be further described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 shows a schematic cross-sectional view of a system for attaching a device to an object according to the invention, the system in a first configuration;

Figure 2 shows a schematic cross-sectional view of the system shown in Figure 1, the system in a second configuration;

Figure 3 shows a schematic cross-sectional view of the system shown in Figure 1, the system in a third configuration;

Figure 4 shows a schematic perspective view of a charge deployment system according to the invention;

Figure 5 shows a schematic end view of the system shown in Figure 4;

Figure 6 shows a schematic cross-sectional view of a deployment unit in the stowed position;

Figure 7 shows a schematic cross-sectional view of a deployment unit with a charge in the stowed position;

Figure 8 shows a schematic cross-sectional view of a deployment unit with a charge in the deployed position;

Figures 9 show a perspective view of a charge deployment system according to the invention coupled to an unmanned vehicle in the stowed, deployed, and retreat positions and a charge attached to ordnance; and

Figure 10 shows a view of a charge deployment system according to the invention coupled to an alternative unmanned vehicle.

[0090] Figure 1 shows a system 100 for attaching a device 102 to an object (not shown). The system 100 comprises: a coupling system for releasably coupling a device 102 to a deployment system (not shown); an attachment device 106 for attaching the device to the object; and a trigger mechanism 108 for triggering the attachment device 106.

[0091] The coupling system 104 has a first configuration in which the device 102 is rigidly coupled to the deployment system, a second configuration in which the device 102 is flexibly coupled to the deployment system, and a third configuration in which the device 102 is released from the deployment system.

[0092] The system 100 further comprises cables 110 and 112, such as Bowden cables as shown, for changing the configuration of the coupling system 104 and for activating the trigger mechanism 108. The cables 110 and 112 are coupled at their distal ends, not shown, to an actuator configured to operate both cables simultaneously such that the coupling system is moved from the first configuration to the second configuration at substantially the same time as the trigger mechanism is activated.

[0093] As will be appreciated from the figures and the description, all but the device 102 and the attachment device 106 remain attached to the deployment system (not shown). The system 100 is therefore reloadable with further devices 102, and thereby reusable.

[0094] The coupling system 104 comprises: a first portion 114 configured to be rigidly mounted to the deployment system via mounting holes 116; a second portion 118 on which the device 102 is releasably coupled. An engagement member 120 is slidably coupled to the first portion 114, and biased towards the second portion 118 by spring 122. The second portion 118 comprises a recess 124 configured to receive the frustoconical end of the engagement member 120 when the coupling system is in the first configuration (shown in Figure 1) to rigidly couple the first portion 114 to the second portion 118.

[0095] The first portion 114 and the second portion 118 are also coupled together by a plurality of resilient mounts 126. In this example four resilient mounts 126 are provided (only two are shown), but more or fewer may be used depending on the application. Each mount 126 comprises a bolt, and a spring disposed about the shaft of the bolt. Each bolt is received in a threaded hole in the second portion 118. The bolt is threaded only on a portion of the shaft such that the non-threaded portion projects from the second portion 118. As can be seen, the spring acts on the first portion 114 and the second portion 118 to bias the first portion away from the second portion 118.

[0096] In the first configuration shown in Figure 1, the force acting on the engagement member 120 by the spring 122 is such that the bolts of the resilient members 126 are in tension. In this way the second portion 118 is rigidly coupled to the first portion 114, and therefore the device 102 is rigidly coupled to the deployment system.

[0097] When the engagement member 120 is disengaged from the recess 124, the first portion 1145 and the second portion 118 are solely coupled together by the resilient mounts 126. The second configuration is described in further detail below with reference to Figure 2.

[0098] The trigger mechanism 108 comprises: a captive firing pin 128 having a first end and a second end; and a spring 130, adjacent the first end of the pin, configured to act on the pin to cause it to impact a percussion cap of the attachment device to trigger the attachment device 106. The trigger mechanism is activated at the same time as changing the configuration of the coupling system 104 from the first configuration to the second configuration.

[0099] The firing pin comprises a plurality of recesses 132 each configured to partially receive a ball bearing 134. The trigger mechanism comprises a first hollow tubular member 136, for receiving the pin 128. The tubular member 136 has a plurality of through holes in the side wall for receiving ball bearings. The diameter of the through holes, is less than the diameter of the ball bearings.

[0100] The trigger mechanism 108 further comprises a second hollow tubular member 138 having a portion 140 with a first inner diameter and a portion 142 with a second inner diameter greater than the first inner diameter. The first diameter being such that the first hollow tubular member 136 is a sliding fit within the second hollow tubular member 138. The wall thickness of the first hollow tubular member 136, and the diameter of the ball bearings 134 are configured such that when the first hollow tubular member 136 is within the second hollow tubular member 138, the inner surface of the portion 140 of the second hollow tubular member acts on the at least one ball bearing to retain it in the recess 132 of the pin 128. In this configuration, the pin is in the armed position having the potential energy of the spring 130 ready to be converted into kinetic energy of the pin to trigger the attachment device.

[0101] When the second hollow tubular member 138 is moved relative to the first hollow tubular member 136, from a first position in which the ball bearing is retained in the recess of the pin to a position where the portion 142 of the second hollow tubular member having the second inner diameter is adjacent the at least one ball bearing, the at least one ball bearing is released from the recess in the pin, thereby activating the trigger.

[0102] As can be seen, the cable 112 is coupled to a base of the second hollow member 138, and is configured to move the member 138 relative to the first hollow member 136. The first hollow tubular member 136 is rigidly coupled to the second portion 118 of the coupling system 104 by fasteners 146. The fasteners 146 comprise a bolt and collar to axially space apart the first hollow tubular member 136 from the second portion 118.

[0103] A spring 144 is provided to act on the second hollow tubular member 138 to bias the trigger mechanism towards the armed configuration. The trigger cable 112 passes through the spring.

[0104] The coupling system 104 further comprises a retaining system 148 for retaining the device 102 to the coupling system 104. The retaining system comprises a plurality of ball bearings 150, configured to be partially received in a recess, such as an annular recess 152, in the device 102. The retaining system 148 further comprises a first hollow tubular member 154 having an inner diameter configured to slidably receive the device 102. The first hollow tubular member 154 comprises a plurality of through holes for receiving the ball bearings 150, the diameter of the through holes is less than the diameter of the ball bearings 150

[0105] The retaining system 148 further comprises a second hollow tubular member 156 having a portion 158 with a first inner diameter and a portion 160 with a second inner diameter greater than the first inner diameter. The first diameter being such that the first hollow tubular member 154 is a sliding fit within the second hollow tubular member 156. The wall thickness of the first hollow tubular member 154, and the diameter of the ball bearings are configured such that when the first hollow tubular member 154 is within the second hollow tubular member 156, the inner surface of the portion 158 acts of the ball bearings 150 to retain them in the recess of the device 102.

[0106] When the second hollow tubular member 156 is moved relative to the first hollow tubular member 154, from a first position in which the ball bearings 150 are retained in the recess of the device 102 to a position where the portion 160 is adjacent the ball bearings, the ball bearings are released from the recess in the device, thereby releasing the device 102 from the coupling system 104. In this way, the coupling means is moved to the third configuration.

[0107] As can be seen, the second hollow tubular member 156 is coupled to the second hollow tubular member 138 of the trigger mechanism such that activating the trigger mechanism also partially moves the second tubular member 156 of the retaining system, but not sufficiently to release the device 102.

[0108] The retaining system further comprises spring 162, configured to bias the second hollow tubular member 156 towards the first hollow tubular member 154.

[0109] The first hollow tubular member 154 is rigidly coupled to the second portion 118, also by the fasteners 146. In some examples, the first hollow tubular member 154 is integrally formed with the first hollow tubular member 136 of the trigger mechanism.

[0110] Referring to Figure 2, the system 100 is shown in the second configuration where the engagement member 120 is disengaged from the recess 124, and the trigger mechanism 108 has been triggered, as described above. As can be seen, the second portion 118 is now only coupled to the first portion 114, and is thus they are flexibly coupled together. As will be appreciated, any movement of the device will cause the resilient mounts 126 to move, enabling relative movement of the second portion 118 and the first portion 114.

[0111] Referring to Figure 3, the system 100 is shown in the third configuration where the device 102 has been released, as described above.

[0112] The detailed operation of the attachment system 100 will now be described when the system is coupled to a deployment system, and an unmanned vehicle used to deploy charges to neutralise ordnance.

[0113] Figure 4 shows a schematic perspective view of a charge deployment system 400. In this example, the charge deployment system 400 comprises three deployment units 402, 404 and 406. The deployment units 402, 404 and 406 are coupled to a chassis 408 in the form of a skid adapted to be coupled to an unmanned vehicle. Each deployment unit is substantially identical, and comprises: a hollow cylindrical housing 410 in which a charge may be housed: a coupling system 104 for mounting a charge device; a linear actuator (not shown) for advancing and retracting the mount on which a charge is stowed within the deployment unit; and a shield, in the form of a safety gate 412. Each shield is coupled by a linkage to the mount for mounting a charge, and so as the linear actuator moves the mount, the shield is moved from a closed position (as shown) to an open position (not shown).

[0114] The system 400 is configured for underwater operations, and as such each housing 410 is provided with a plurality of perforations to reduce the possibility of trapped air, and so as to improve the responsiveness of the system in the water.

[0115] Figure 5 shows an end view of the charge deployment system 400. As can be seen, each housing 410 comprises a stop bar 500 at the end of the hollow cylinder. The stop bar prevents easy access to the charge when it is in the stowed position, and increases the rigidity of the housing.

[0116] Figure 6 shows a schematic cross-sectional view of a deployment unit 402, 404, 406 in a stowed position. Each deployment unit 402, 404, 406 comprises a hollow cylindrical housing 410 in which a charge may be housed: a coupling system 104 for mounting a charge; a linear actuator 600 for advancing and retracting the coupling system 104; and a shield, in the form of a safety gate 412. The linear actuator comprises a telescopic water hydraulic ram and ancillary systems for powering the ram (not shown). A controller (not shown) is provided and configured to receive commands to extend and retract the hydraulic ram from the stowed position, as shown in Figure 6 to a deployed position, described below. In addition, the coupling system 104 is coupled to the safety gate 112 via a linkage (not shown) so that as the coupling system 104 moves from the stowed position (as shown) to the deployment position the safety gate is raised.

[0117] Figure 7 shows a schematic cross-sectional view of a deployment unit with a charge 700 in the stowed position. As will be appreciated, Figure 7 shows the same cross-sectional view as shown in Figure 6, and so like reference numerals refer to like components. The charge comprises: a charge portion 702 comprising a disruptor charge, such as a high-explosive; an attachment portion 704 for attaching the charge to the ordnance; a trigger portion 706; and a trigger line 708 which couples the trigger portion 706 to the charge portion 702. The cable 710 forms part of a safety and arming system. Upon release of the charge 700, the cable 710 removes an arming pin which finally arms the charge, ready for detonation. The safety and arming device also comprises a hydrostatic arming device which only allows the charge to be detonated once it is below a predefined depth of water. The safety and arming device may also comprise a manual arming pin, removed by the operator as the unmanned vehicle is launched.

[0118] The attachment portion 102 may be powder-actuated captured fixing gun, a magnetic grab for ferrous target ordnance, where silent attachment is required, a suction device or chemical adhesion. The power-actuated captured fixing gun, may be a nail gun or the like configured to ensure that upon firing the nail gun, the nail remains partially within the attachment portion 102 to both ensure the charge is attached to the ordnance and to reduce the risk of injury upon accidental firing of the attachment. In this stowed configuration, the attachment portion is protected from accidental knocks, or accidental attachment, by the safety gate 412.

[0119] Figure 8 shows a schematic cross-sectional view of a deployment unit with a charge in a semi-deployed position. In the fully deployed position, the charge 700 may be upto 200 mm from the unmanned vehicle to minimise electromagnetic interference by the unmanned vehicle on the ordnance. Again, as will be appreciated, Figure 8 shows the same cross-sectional view as shown in Figure 7, and so like reference numerals refer to like components. In Figure 8, the charge 700 is shown in the deployed position, and ready for the attachment portion 102 to attach the charge to the ordnance.

[0120] Figures 9 show the charge deployment system 400 coupled to an unmanned vehicle. In this example, the unmanned vehicle 900 is an underwater remotely operated vehicle (ROV). The ROV is tethered, via tether 902, to a surface vessel, such as a mine countermeasures vehicle. The ROV 900 receives power and commands via the tether 902. Figure 9(a) shows the charge deployment system with all three deployment units in the stowed position. That is to say, all three charges are housed completely within the deployment unit and the attachment mechanism of the charges is shielded by the safety gates.

[0121] Figure 9(b) shows a charge 904 in one of the deployment units in the deployment position. The remote operator, situated on the surface vessel, has sent a command to the deployment system controller to deploy the charge. The linear actuator has therefore been activated, and the charge is moved forwards to the deployment position which in turns moves the safety gate, where provided, to the open position. In this configuration the charge is ready to be attached to the target ordnance.

[0122] Figures 9(c) and 9(d) show the charge 904 having been attached to a tethered mine 906, and the ROV being manoeuvred away from the mine. Once the operator is satisfied that the charge 904 is secured to the mine, the charge is released from the deployment unit by changing the configuration of the coupling means from the second configuration to the third, release, configuration.

[0123] Figure 10 shows a charge deployment system 400 coupled to an alternative unmanned vehicle 1000 in the form of an underwater ROV.

[0124] In use, the charge deployment system 400 combined with the unmanned vehicle 900, 1000, such as a remotely operated vehicle (ROV) may be operated as follows for different types of ordnance. It will of course be understood that the charge deployment system and ROV may be operated in any other suitable manner:

<u>Surface / Drifting Mine - Target visual on surface</u>

[0125] Once the mine has been located, visual contact confirmed, and an approximate position established, the MCMV or Surface Support Craft, positions itself upwind and at approximately 150 m such that the target is clearly visual to a remote operator.

[0126] The ROV is made ready and the neutralisation charge is prepared in accordance with the recommended drill. The neutralisation charge is mounted within the deployment unit.

[0127] The ROV is launched with the neutralisation charge from the engaged side in accordance with Standard Operating Procedures (SOP's). When a tracking system, such as an acoustic tracking system (Sonar) is confirmed as operational, and on achieving a minimum range of 50 m from the MCMV, the ROV is taken in to manual control and brought to the surface. The remote operator confirms when the ROV is visual. At this point there will be approximately 100 m distance to run to the target ordnance.

[0128] The remote operator pilots the ROV towards the target giving approximate ranges. Some information may be received by the tracking system but this should be secondary to the visual primary means of closing the range to the target due to the potential ambiguity of such tracking systems information with the ROV at the surface.

[0129] When the ROV is approximately 30 m from the target, the ROV is stopped. When the remote operator has the target illuminated on the ROV Sonar, he maintains the range of ROV from target at no closer than 25 m. Consideration can be given to using a semi-automatic mode to maintain the constant range.

[0130] The MCMV, or surface support craft may then be manoeuvred to open the range from the target ordnance. The remote operator maintains the range of the ROV from the target ordnance at no closer than 25 m.

Shallow Moored Mine - Target not visual on surface

[0131] In this case, pre-requisites in terms of MCMV positioning are the same as for the engagement of a floating drifting mine which is visual.

[0132] The target ordnance is illuminated by the MCMVs sonar. The ROV vehicle is prepared as described above, and launched in a routine automatic run to engage the target ordnance. Again, the ROV is maintained at approximately 25 m from the target ordnance.

[0133] Procedure for visual or shallow-moored mines after ROV reaches 25m from target ordnance

[0134] The MCMV is manoeuvred to a safe operating distance, such as 500 m. On completion, the remote operator of the ROV closes the range to the target ordnance using the ROV tracking system. The target ordnance may be engaged using the tracking system only, but the remote operator may be assisted by a camera in the final stages of the engagement run.

[0135] Following engagement and confirmation by the remote operator that the target is ordnance that requires neutralisation, the remote operator sends instructions to the charge deployment system controller to move the charge from the stowed position to the deployed position by the linear actuator. In doing so, the charge attachment means is exposed from behind the safety gate, where provided.

[0136] The remote operator then makes a final, slow speed, run to the target ordnance to attach the charge. When the charge is adjacent the target ordnance, the remote operator sends a control signal to change the configuration of the coupling means from the first, rigidly coupled, configuration to the second, flexible, configuration. At the same time, the attachment device is triggered, securing the charge to the target ordnance. Before initiating a retreat, the operator may use a camera on-board the ROV to check that the charge has been attached correctly. If the charge is attached correctly, it is released from the deployment unit. If the charge is not correctly attached, a further charge may be attached from a different deployment unit.

[0137] Once the ROV has made a complete retreat, the charge may be remotely triggered to detonate, or it may be controlled by a remote line from the MCMV, such as NONEL shock tube, or it may operate on a timer system.

[0138] The ROV may then be recovered onboard the MCMV, or where the deployment system comprises more than one deployment unit, a further ordnance may be targeted in the same way as described above.

[0139] Where more than one ordnance is targeted in a single sortie, the charges are preferably triggered to detonate only once all required charges have been deployed. The charges may be detonated simultaneously or, more preferably sequentially.

[0140] The embodiments and examples described above illustrate but do not limit the invention. It will be appreciated that other embodiments of the invention may be made and it is to be understood that the specific embodiments described herein are not intended to be limiting.

Claims

1. A system for attaching a device to an object, comprising:

    means for attaching the device to an object;
    a trigger mechanism for triggering activation of the attaching means; and
    means for releasably coupling the device to a deployment system, comprising:

        a first configuration in which the device is rigidly coupled to the deployment system;
        a second configuration in which the device is flexibly coupled to the deployment system; and
        means for controllably changing the configuration of the coupling means from the first configuration to the second configuration, wherein, the trigger mechanism is activated upon changing the configuration of the coupling means from the first configuration to the second configuration.

2. A system according to Claim 1, wherein the coupling means further comprises a third configuration in which the device is released from the deployment system.

3. A system according to Claim 1 or 2, in which the trigger mechanism and the coupling means are provided in a housing, the housing being mountable to the deployment system, and in which the attaching means is provided in a housing coupled to the device, the attaching means housing being releasably coupled to the deployment system by the coupling means.

4. A system according to any of Claims 1, 2 or 3, wherein the coupling means comprises:

    a first portion configured to be rigidly mounted to the deployment system;
    a second portion on which the device is releasably coupled; and
    an engagement member slidably coupled to the first portion or the second portion;
    wherein, the other of the first portion and the second portion comprises a recess configured

to receive the engagement member when the coupling means is in the first configuration to rigidly couple the first portion to the second portion.

5. A system according to Claim 4, wherein the first portion and the second portion are coupled together by at least one resilient mount, each mount preferably comprising a helical spring, wherein the configuration of the coupling means is changed from the first configuration to the second configuration by sliding the engagement member from a position in which it is engaged with the recess, to a position in which it is disengaged from the recess, such that the first portion and the second portion are coupled only by the or each resilient mount.

6. A system according to Claim 5, the or each resilient mount comprising:

a retainer having a shaft and a retaining portion; and
a resilient element disposed about the shaft,
wherein, a first end of the shaft is fixed to the first portion or the second portion of the coupling means, the shaft passing through a hole in the other of the second portion and the first portion, and the second end of the shaft comprises the retaining portion, which prevents the first portion and the second portion from completely separating, and
wherein, a first end of the resilient element acts on the first portion, and a second end of the resilient element acts on the second portion, such that the first portion and the second portion are biased apart.

7. A system according to Claim 6, wherein in the first configuration, the engagement member causes the or each shaft to be in tension.

8. A system according to any of Claims 4 to 7, wherein the engagement member comprises a frustoconical end, the recess being correspondingly frustoconical.

9. A system according to any of the preceding claims, wherein the trigger mechanism comprises:

a pin, preferably being a captive pin, having a first end and a second end; and
a store of potential energy, preferably being a compressed spring, adjacent the first end of the pin, configured to convert the stored potential energy to kinetic energy of the pin upon changing the configuration of the coupling means from the first configuration to the second configuration,
wherein, the second end of the pin is configured to act on the attaching means to trigger attachment.

10. A charge deployment system for ordnance neutralisation, comprising:

at least one deployment unit, the or each unit comprising:

a housing for stowing a charge device in a stowed position;
means for releasably coupling the charge device to the deployment unit, comprising:

a first configuration in which the device is rigidly coupled to the deployment unit;
a second configuration in which the device is flexibly coupled to the deployment unit; and
means for controllably changing the configuration of the coupling means from the first configuration to the second configuration; and

means for controllably moving the charge device from the stowed position to a deployment position; and

a controller for controlling the or each moving means, and the or each coupling means.

11. A system according to Claim 10, further comprising:

means for attaching the charge device to the ordnance;
a trigger mechanism for triggering activation of the attaching means,
wherein, the trigger mechanism is activated upon changing the configuration of the coupling means from the first configuration to the second configuration,
such that the charge deployment system comprises a system for attaching a device to an object according to any of Claims 1 to 9.

12. A system according to Claim 10 or 11, further comprising at least one actuator configured to change the configuration of the coupling means from the first configuration to the second configuration.

13. A system according to Claim 10, 11 or 12, wherein the or each housing for stowing the charge device is removable.

14. A system according to any of Claims 10 to 13, further comprising a means for arming the charge device comprising a coupling between the housing for stowing the charge device and the charge device, wherein the arming means arms the charge device when the coupling between the housing for stowing the charge device and the charge device is broken.

15. An unmanned vehicle comprising a charge deployment system for ordnance neutralisation according to any of Claims 10 to 14.

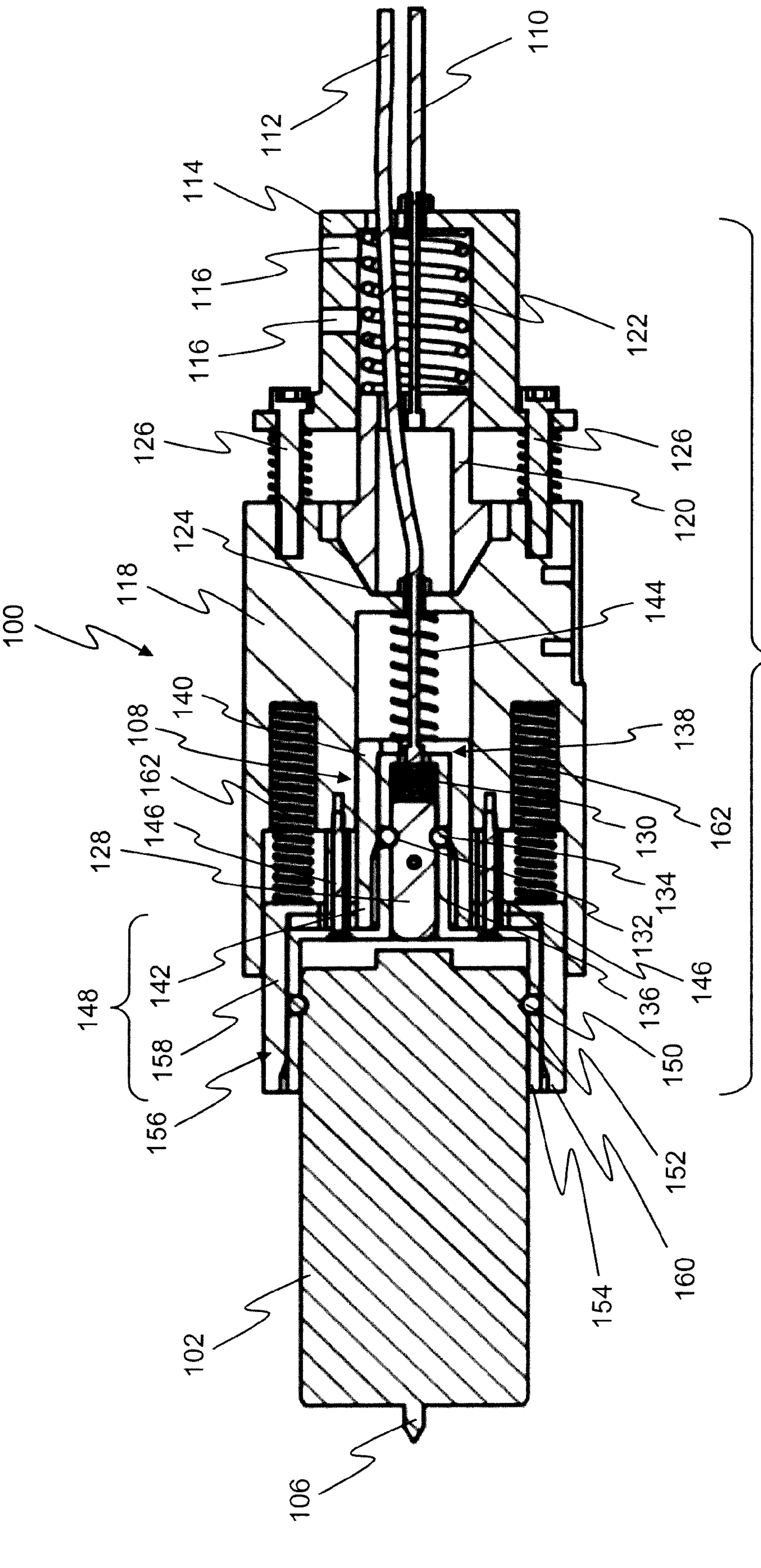
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Figure 1

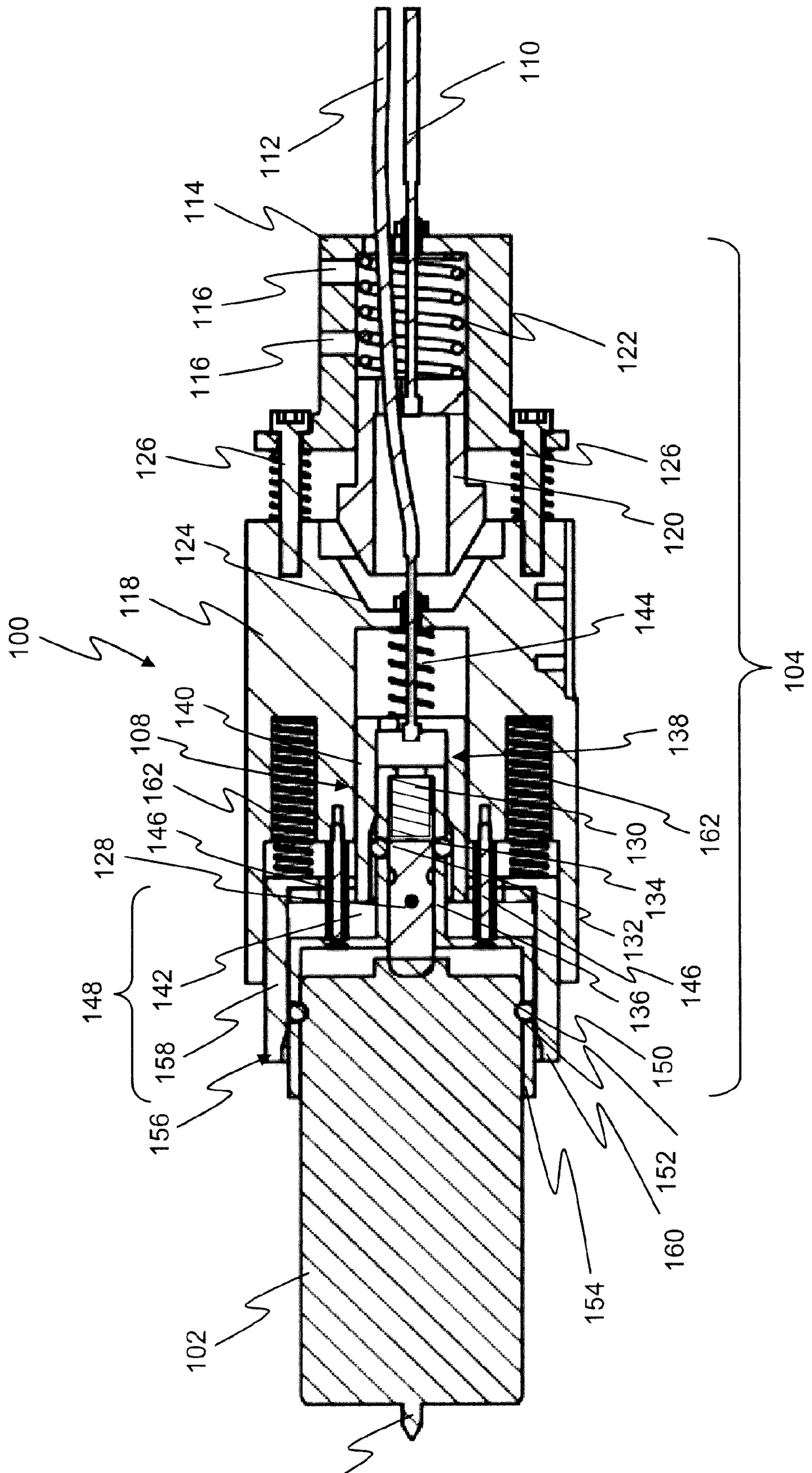
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Figure 2

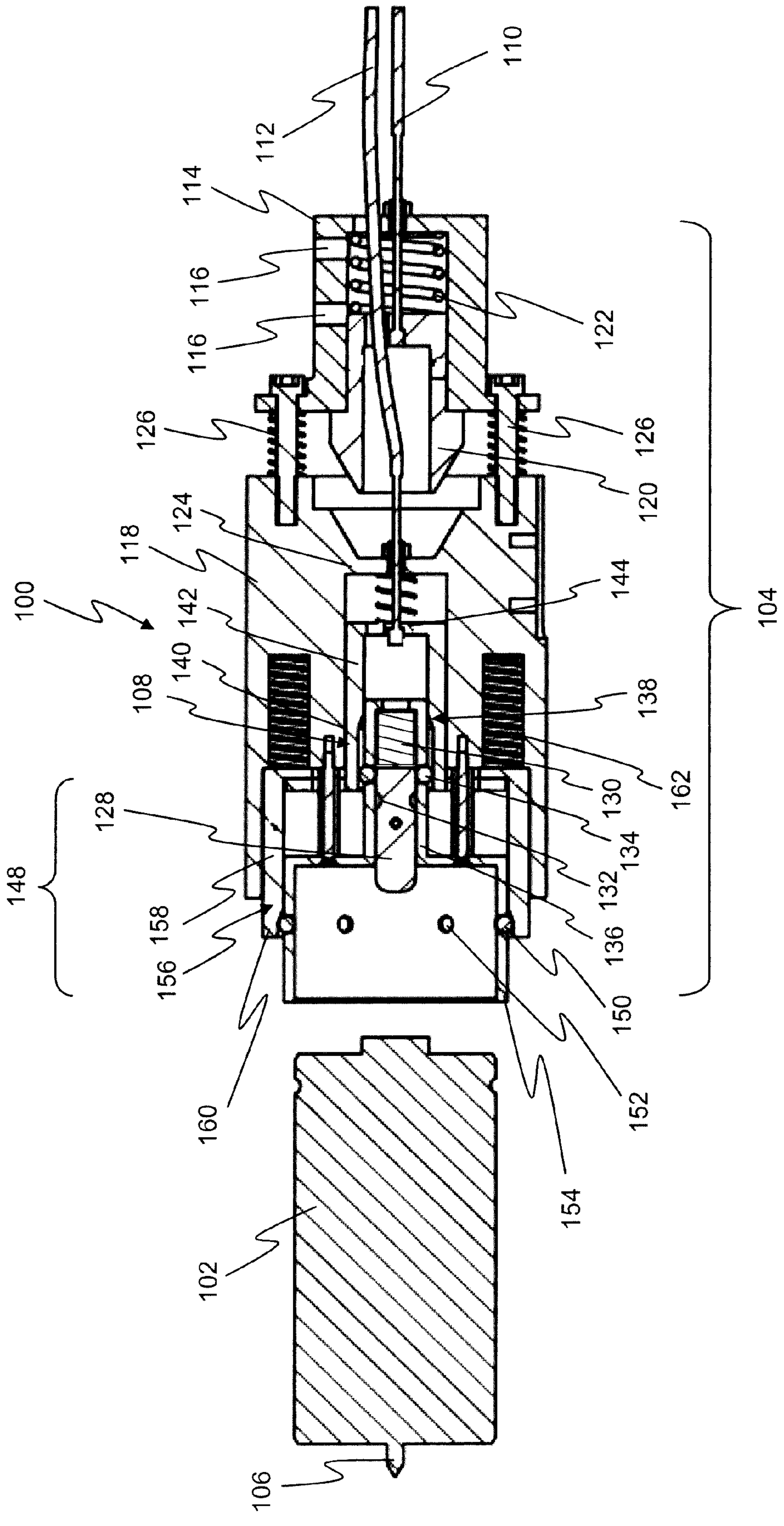
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Figure 3

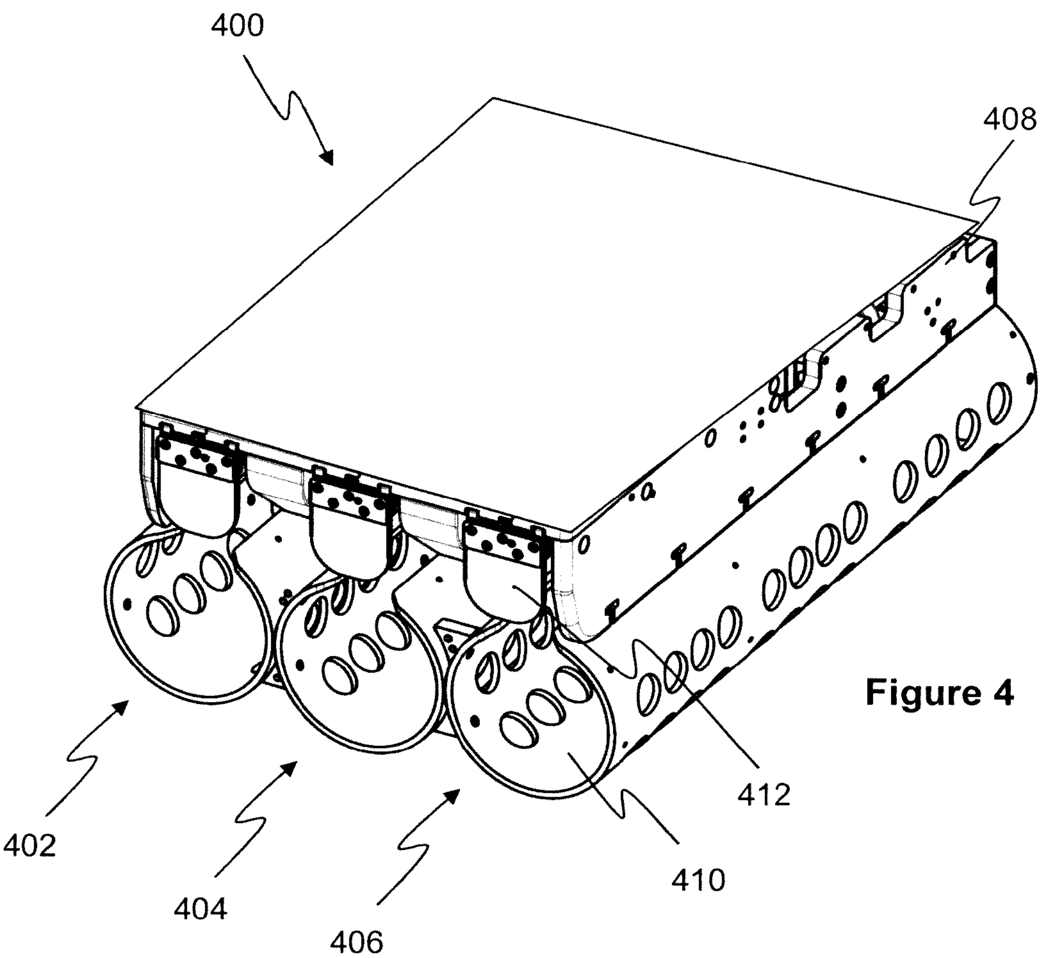

Figure 4

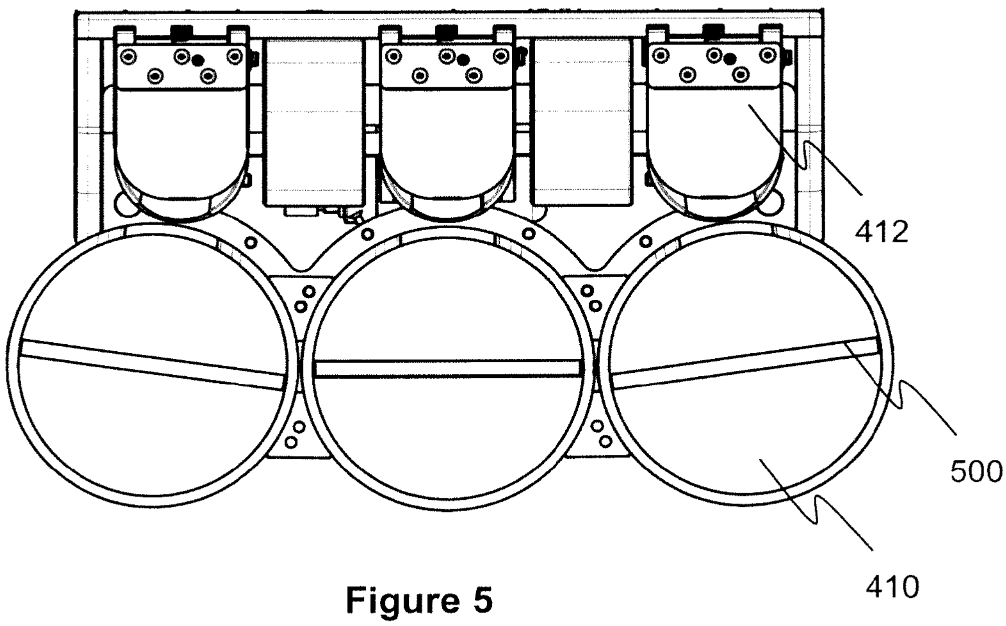

Figure 5

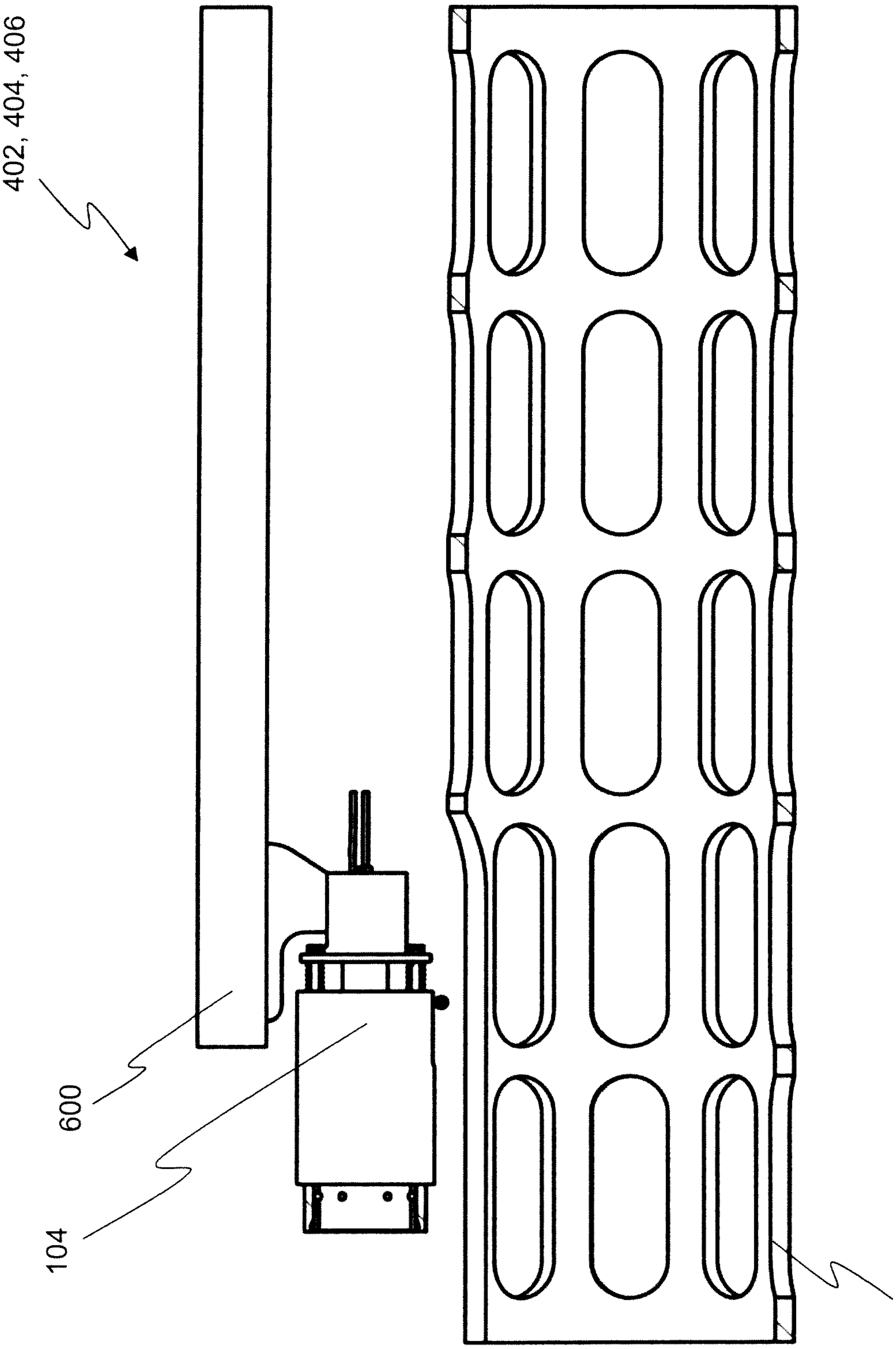

Figure 6

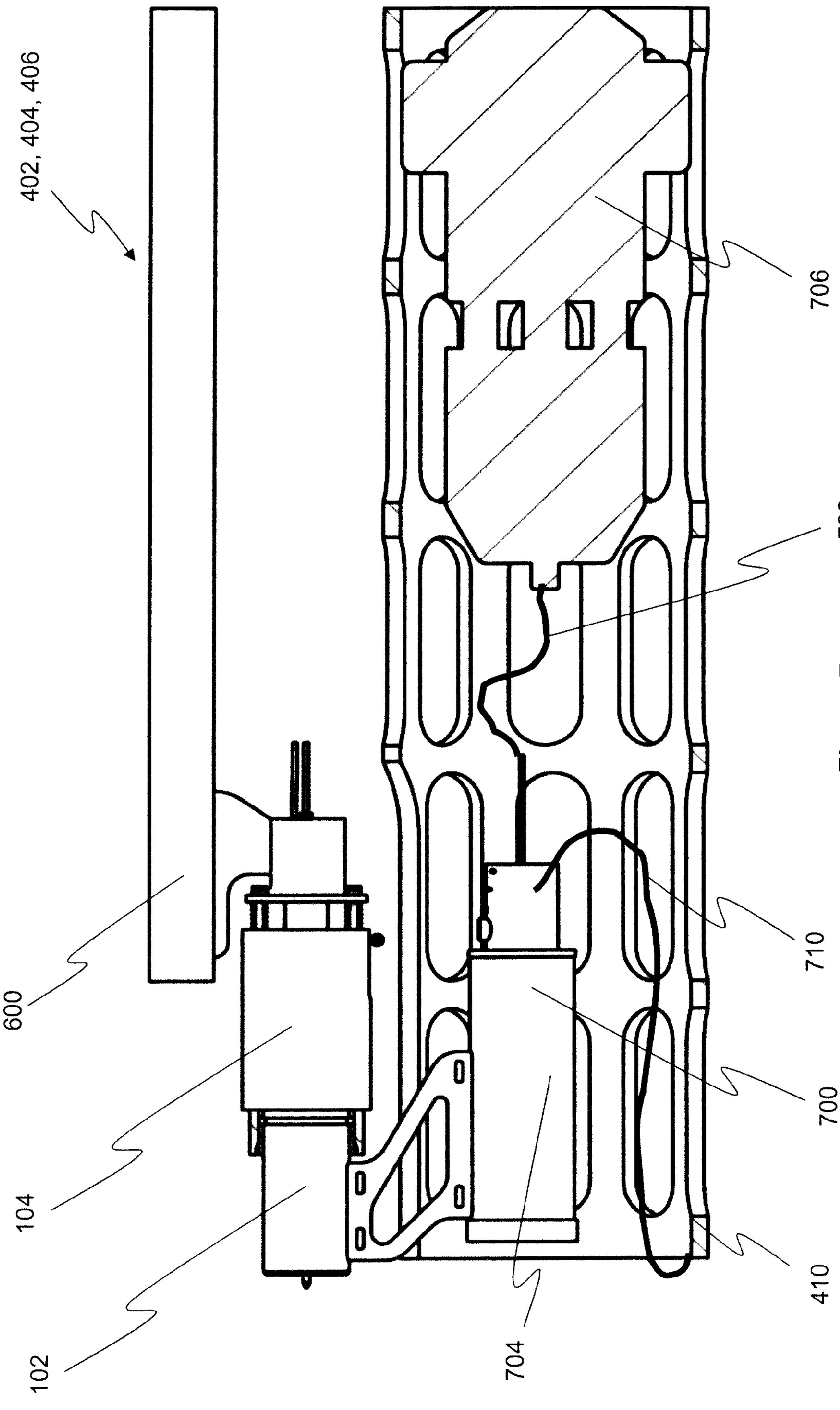

Figure 7

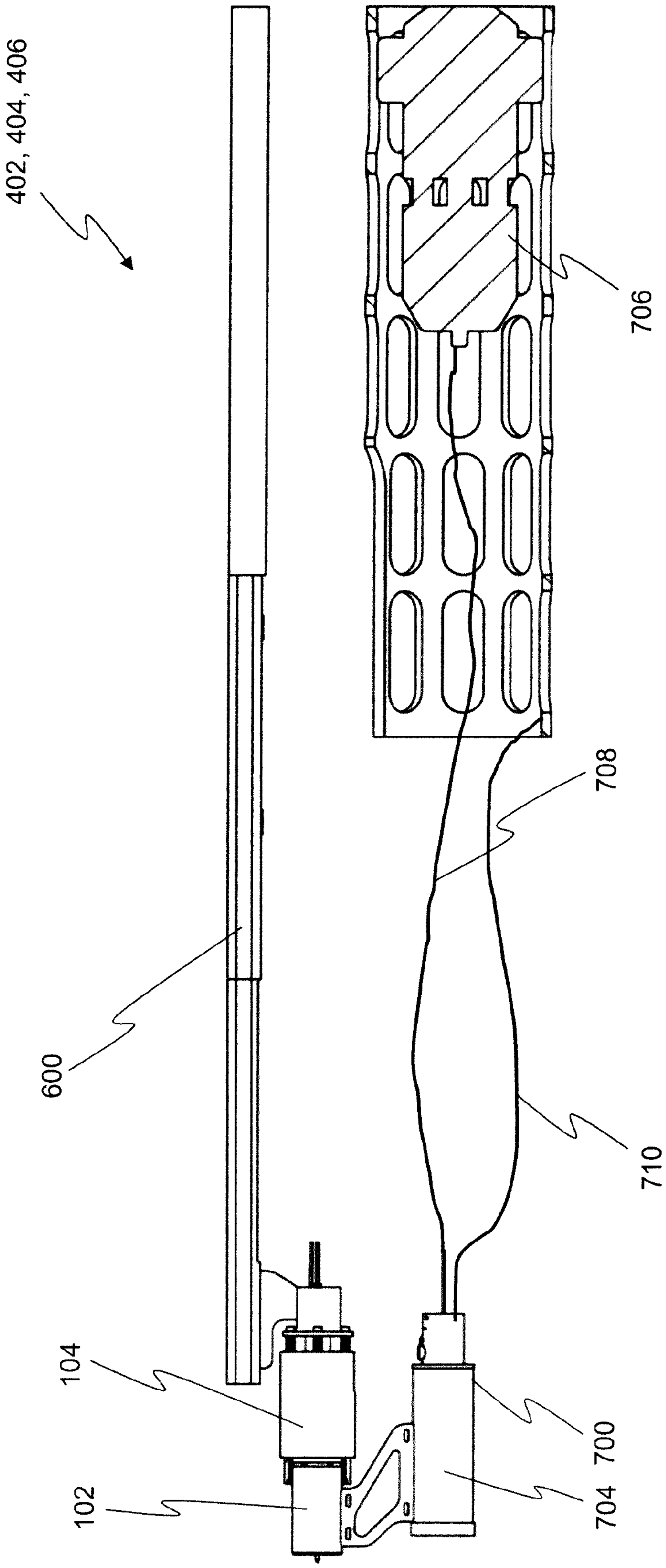

Figure 8

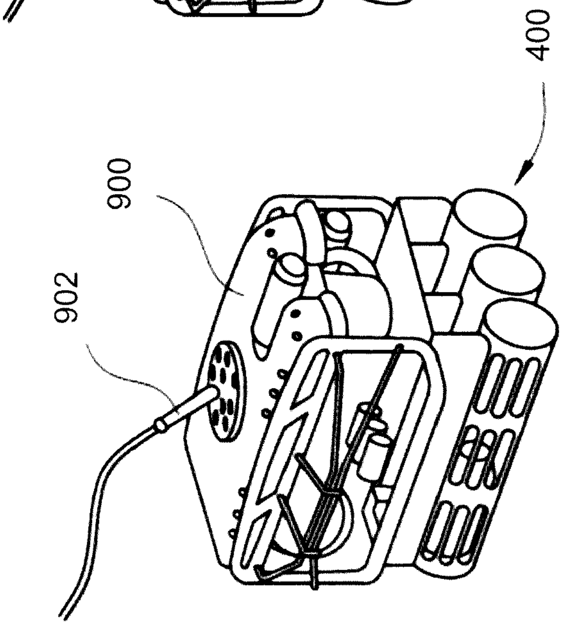

Figure 9(a)

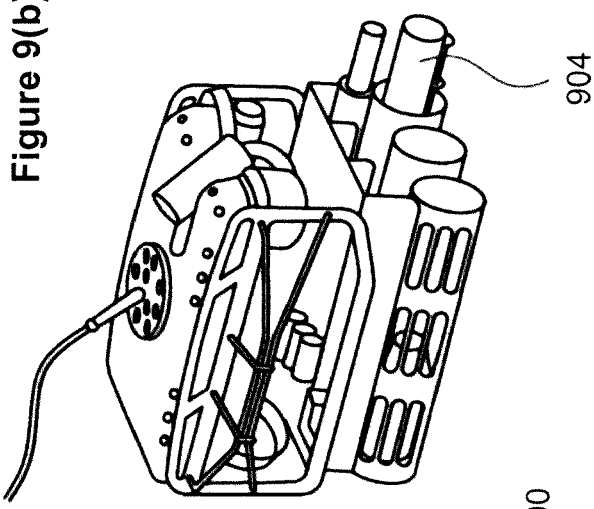

Figure 9(b)

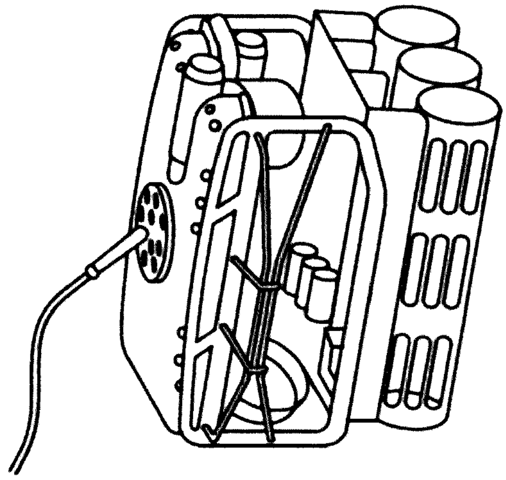

Figure 9(c)

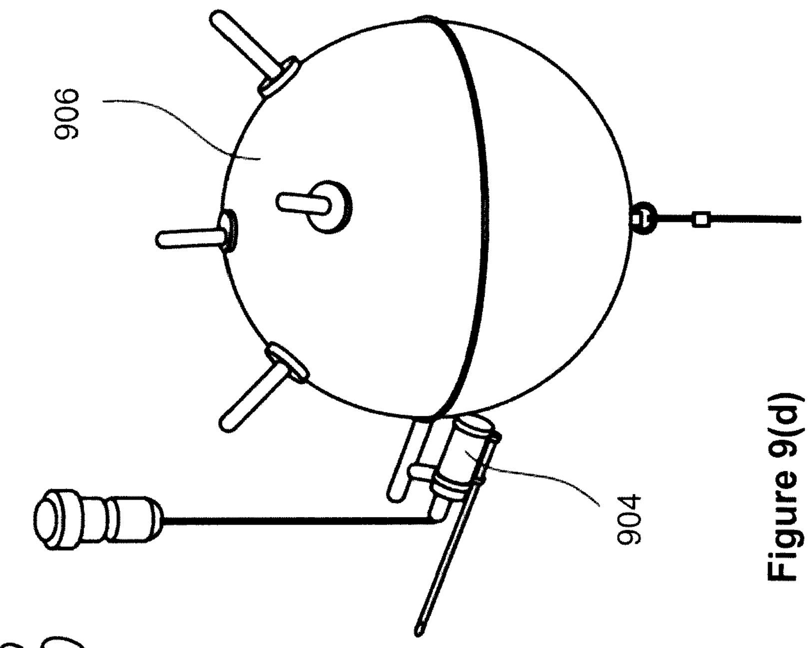

Figure 9(d)

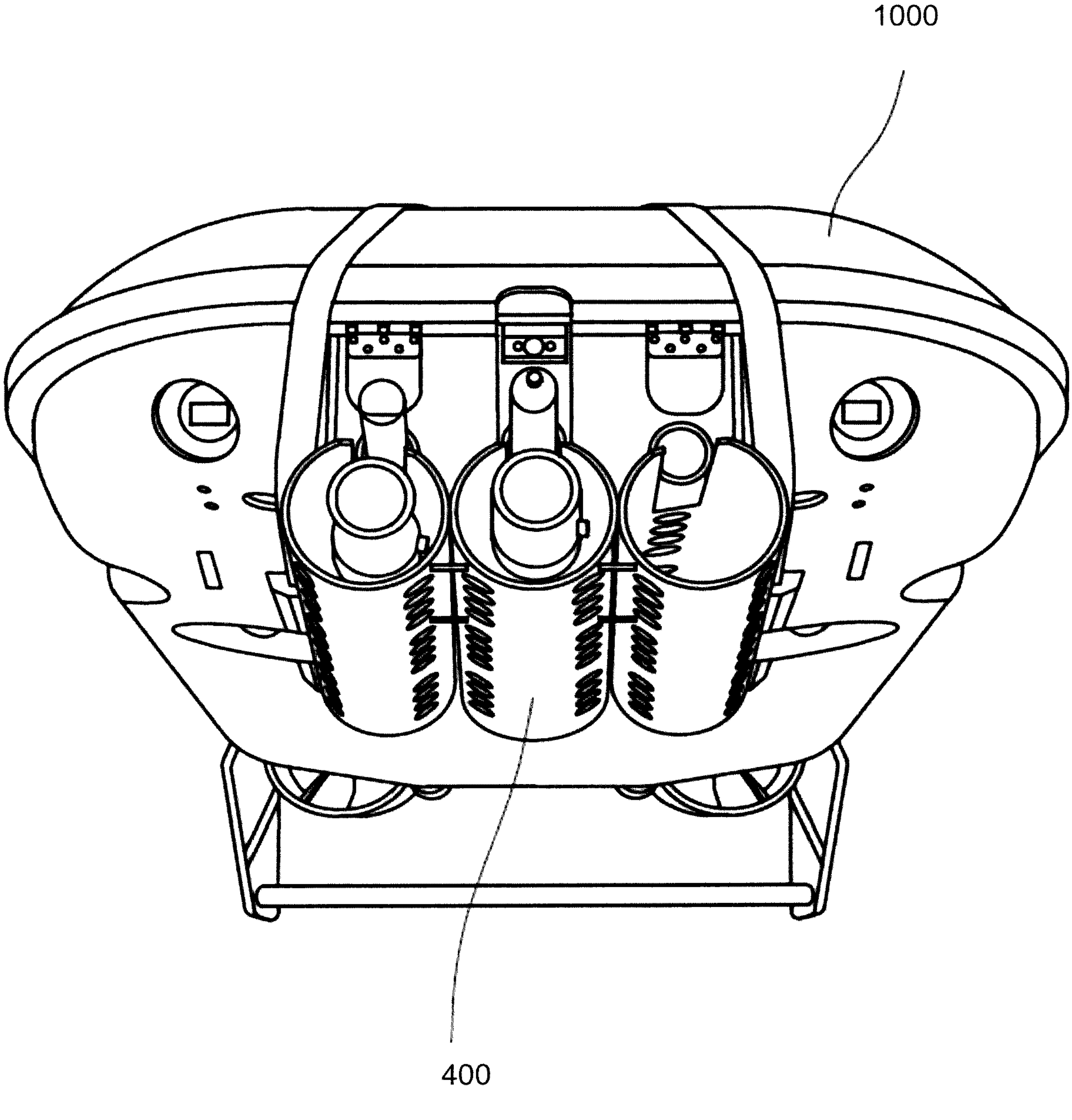

Figure 10

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PARTIAL EUROPEAN SEARCH REPORT

under Rule 62a and/or 63 of the European Patent Convention. This report shall be considered, for the purposes of subsequent proceedings, as the European search report

Application Number
EP 15 44 5003

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2013/199358 A1 (PERRIN KIM [GB] ET AL) 8 August 2013 (2013-08-08) * paragraphs [0070] - [0072], [0074], [0078]; figures 2a, 2b, 2d-g * -----	1-9	INV. F42D5/04 B63G7/02
A	WO 2015/022533 A1 (SAAB SEAEYE LTD [GB]) 19 February 2015 (2015-02-19) * page 7, line 28 - page 8, line 26; figures 5,6,7d * -----	1-9	

TECHNICAL FIELDS SEARCHED (IPC)
B63G
F41H
F42D
F41F

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC so that only a partial search (R.62a, 63) has been carried out.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:

see sheet C

2

Place of search	Date of completion of the search	Examiner
The Hague	22 June 2016	Seide, Stephan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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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INCOMPLETE SEARCH SHEET C

Application Number
EP 15 44 5003

Claim(s) completely searchable:
1-9

Claim(s) not searched:
10-15

Reason for the limitation of the search:

Claims 1 and 10 have been drafted as separate independent apparatus claims.

Under Article 84 in combination with Rule 43(2) EPC, an application may contain more than one independent claim in a particular category only if the subject-matter claimed falls within one or more of the exceptional situations set out in paragraph (a), (b) or (c) of Rule 43(2) EPC.

Claim 1 refers to a system for attaching a device to an object, comprising means for attaching the device to an object, a trigger mechanism for triggering activation of the attaching means, and means for releasably coupling the device to a deployment system, comprising a first configuration in which the device is rigidly coupled to the deployment system, a second configuration in which the device, is flexibly coupled to the deployment system, and means for controllably changing the configuration of the coupling means from the first configuration to the second configuration, wherein, the trigger mechanism is activated upon changing the configuration of the coupling means from the first configuration to the second configuration.

Claim 10 refers to a charge deployment system for ordnance neutralisation, comprising at least one deployment unit, the or each unit comprising a housing for stowing a charge device in a stowed position, means for releasably coupling the charge device to the deployment unit, comprising a first configuration in which the device is rigidly coupled to the deployment unit, a second configuration in which the device is flexibly coupled to the deployment unit, and means for controllably changing the configuration of the coupling means from the first configuration to the second configuration, and means for controllably moving the charge device from the stowed position to a deployment position, and a controller for controlling the or each moving means, and the or each coupling means.

Thus, claims 1 and 10 do neither involve a plurality of interrelated products (Rule 43(2)(a) EPC), nor a different use of an apparatus (Rule 43(2)(b) EPC) or alternative solutions to a particular problem, where it is inappropriate to cover these alternatives by a single claim (Rule 43(2)(c) EPC).

After invitation by the Search Division to indicate the claims complying with Rule 43(2) EPC, the applicant has indicated claims 1-9.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 44 5003

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-06-2016

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