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(54) **INTEGRATION OF A LARGE CALIBRE GUN ON A SHIP**

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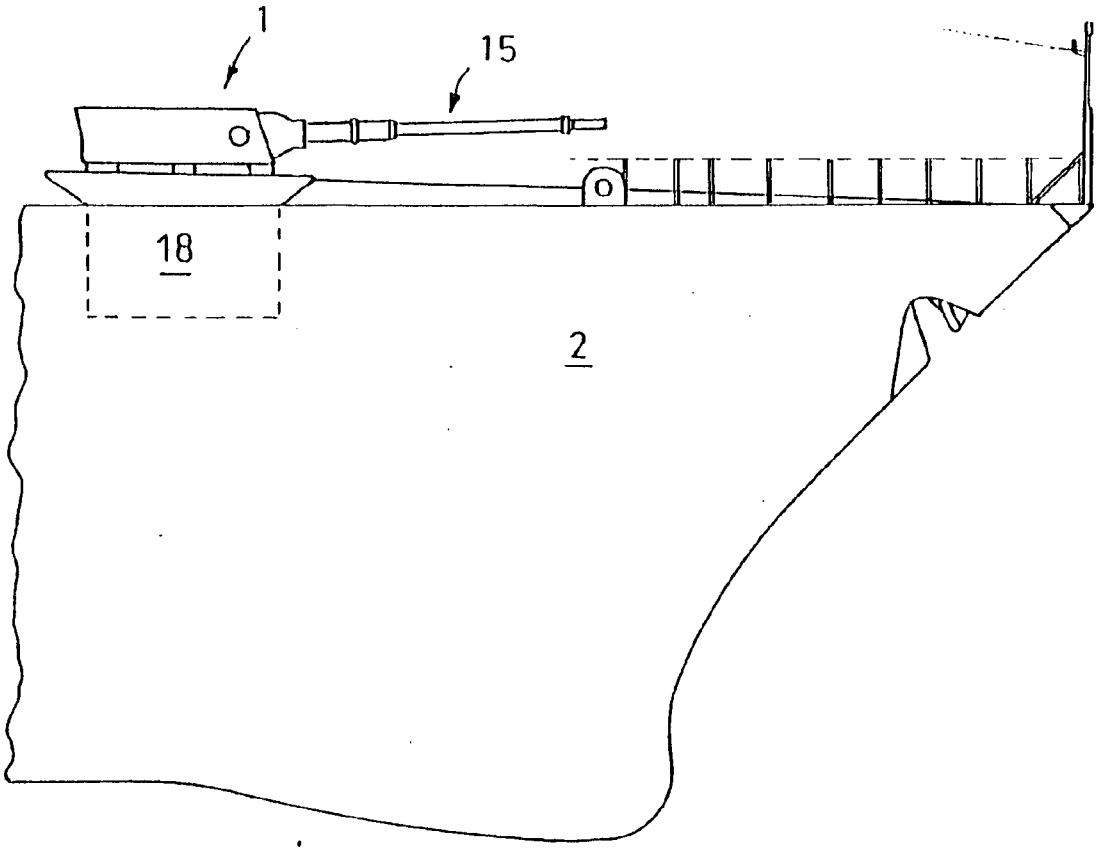
(57) **ABSTRACT**

A method for integrating a large-calibre gun on a ship, including connecting a turret having an armament of a lad gun with a calibre >127 mm in a modular configuration to an adaptor plate and a shock-absorbing mounting, and installing the turret on the ship so that an existing steel structure of the ship withstands increased recoil forces from the armament.



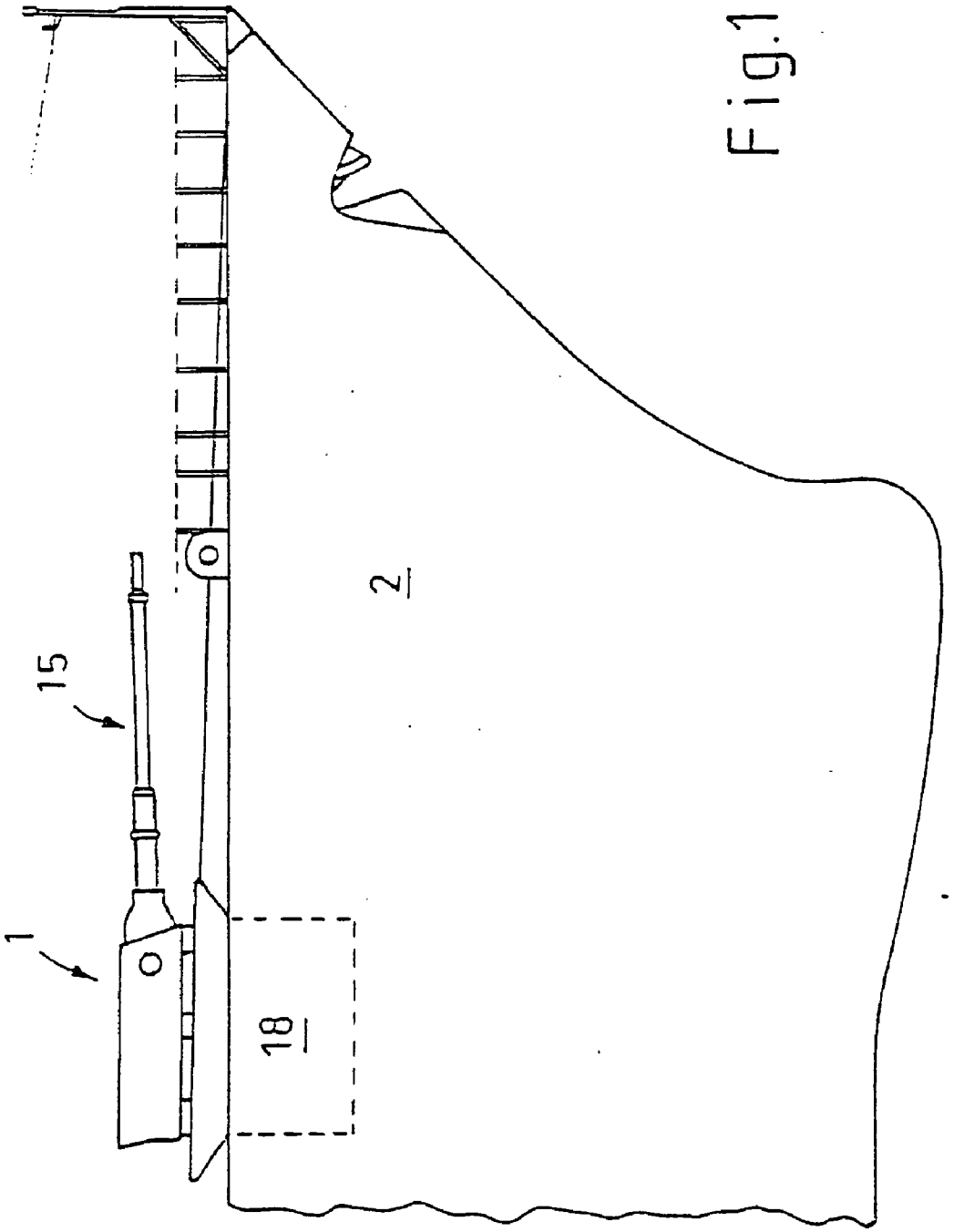


Fig.1

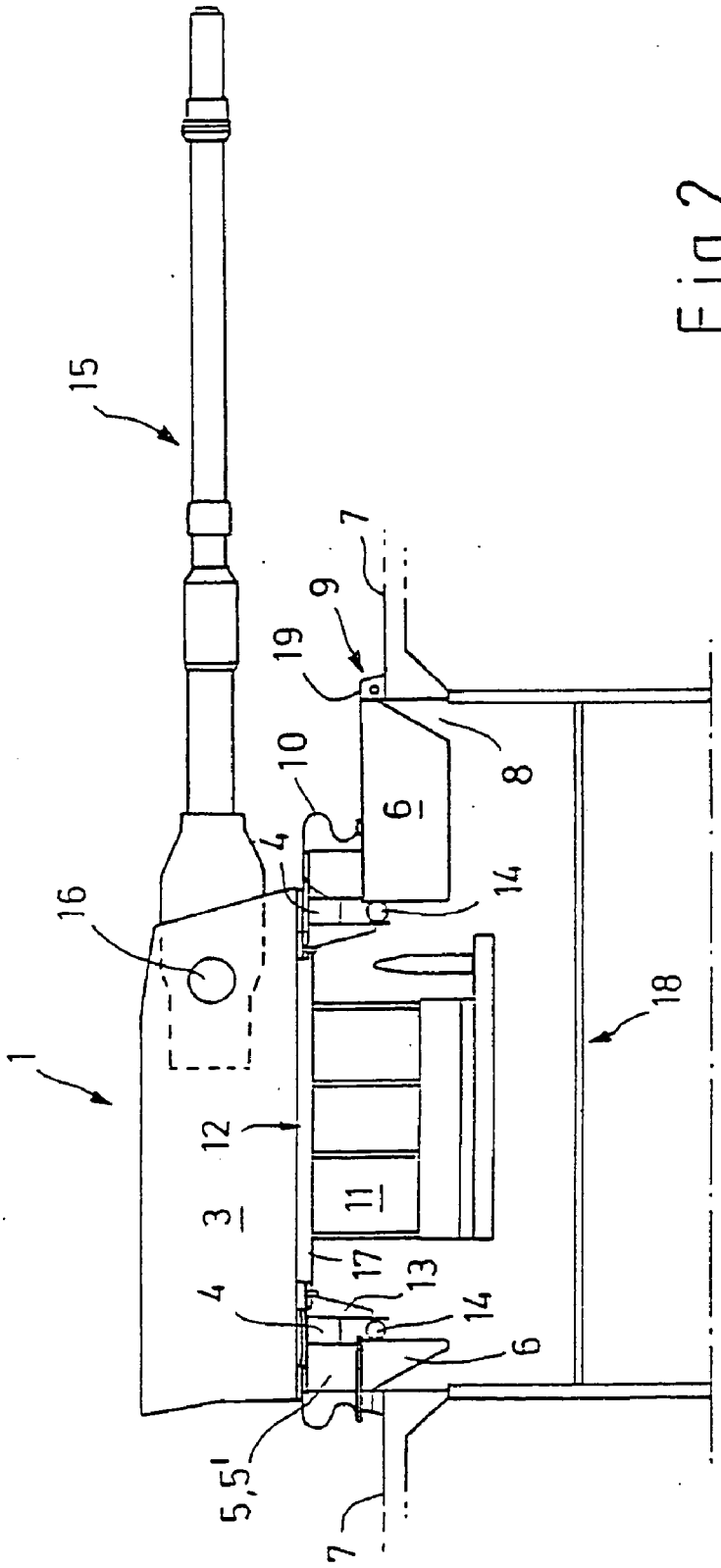


Fig.2

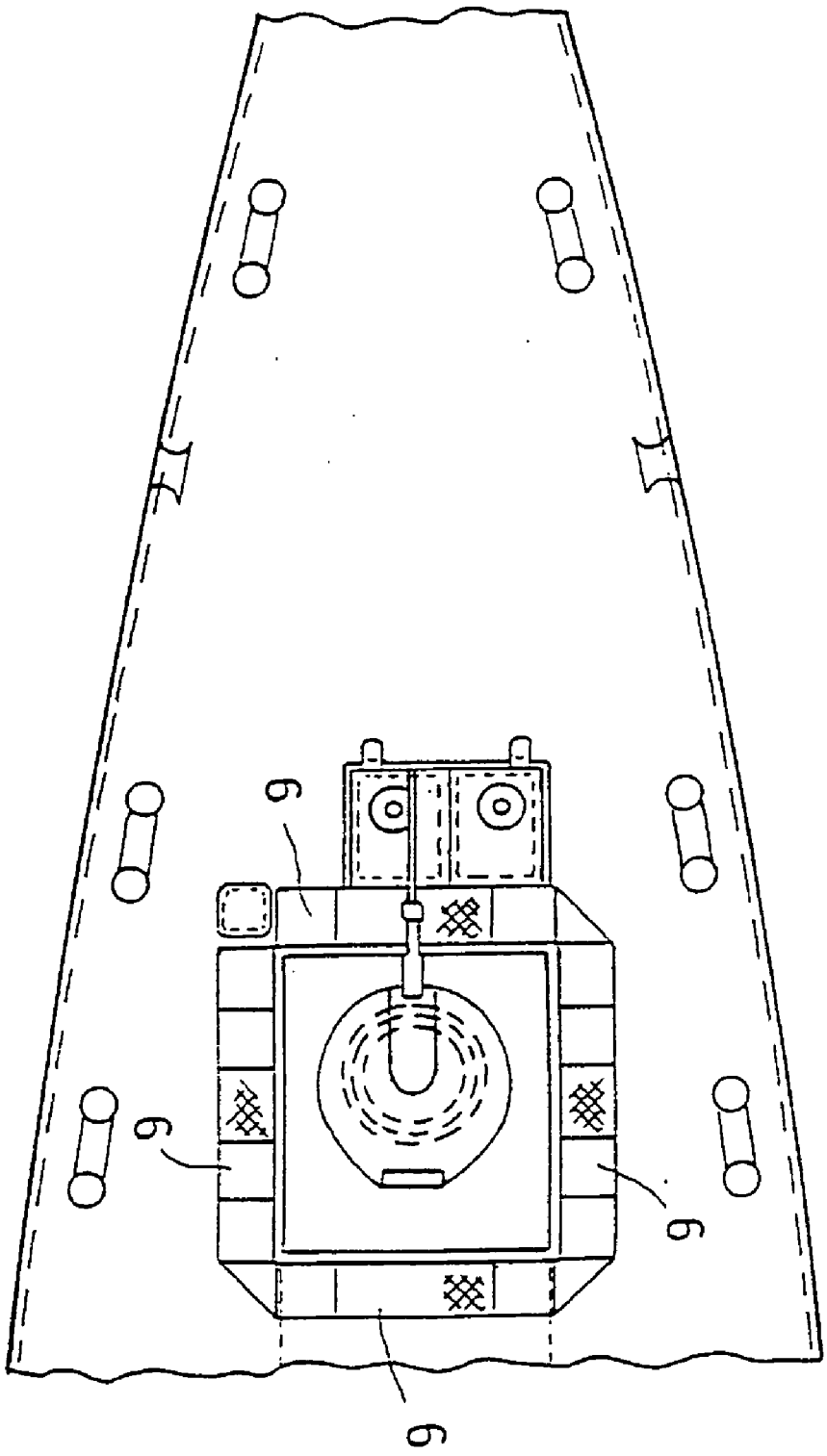


Fig.3

INTEGRATION OF A LARGE CALIBRE GUN ON A SHIP

TECHNICAL FIELD

[0001] The invention relates to a method for integration of a large-caliber gun on a ship, as claimed in the features of the precharacterizing clauses of claims **1** and **2**, and to a ship gun as claimed in the features of the precharacterizing clause of claim **6**.

PRIOR ART

[0002] According to the prior art, it is known for ships currently to fire up to ranges of 15 to 18 km with munition calibers of 57, 76, 100 up to a maximum of 127 mm. A number of nations have started to develop guided missiles with the capability to attack land targets. The effectiveness of the guns used is considered to differ depending on the caliber, the rate of fire and the type of ammunition used. However, in general it can be stated that the effect on the target increases with the caliber. Large-caliber guns of the types used by Army artillery are currently not used for this purpose because the ship structure will not withstand the recoil forces of large-caliber ammunition in the long term. Of the guns which are used on land, it is known that large-caliber ammunition can be fired accurately at targets at ranges up to 40 km. The recoil effects that occur in this case are minimized by appropriate technical solutions, such as recoil dampers.

[0003] The ship ammunition that is used at the moment is specially manufactured and is not compatible with land ammunition. Other ammunition, for example armor-piercing ammunition etc, cannot be used. In some circumstances, there are resupply difficulties during operations abroad. A further disadvantage of the currently used ship ammunition is the short range, as a result of which land targets cannot be attacked without considerable risk to the ship. A further disadvantage of the comparatively small caliber of ship guns is that the guns are susceptible to weather influences, for example wind, so that small ammunition is subject to comparatively wide scatter.

[0004] A further disadvantage of the known ship projectiles mentioned above is that they cannot carry intelligent submunitions, for example cluster munitions or smoke. In order to be effective, a high hit accuracy is required, that is to say a greater number of shots will be necessary in some circumstances.

[0005] The gun turrets that are currently fitted to ships are not gas-tight. Furthermore, they are hard-mounted on the ship, that is to say they are rigidly connected to the ship, which means that the recoil forces resulting from possible use of large-caliber ammunition would be introduced directly into the ship structure and would lead to its destruction. Reinforcement of the steel in the ship structure would lead to a heavy weight and the obvious disadvantages associated with this, as well as leading to considerable additional costs.

[0006] A gun such as this is known from EP 0 051 119 A1. An automatic loading system for large-caliber ammunition is described. In this case, a Howitzer (155 mm) is mounted on a carriage. The carriage is in turn firmly installed on a ship deck. This results in the problem that the recoil forces from the gun/carriage are introduced directly into the ship structure.

[0007] When conventional ship guns are used, the rolling of the ship about its longitudinal axis leads to considerable problems in the determination of the coordinates, so that the aiming accuracy also suffers, with undesirable scatter occurring.

DESCRIPTION OF THE INVENTION

[0008] The object of the invention is to satisfy the existing military requirements for provision of the capability for naval fire support (NFS) for the use of military ships in the coastal area, with fire support for amphibious operations being of particular importance in this context, for which purpose the projectile range should be considerably increased so that it is also possible to attack inland targets with a high hit accuracy. The aim is to achieve this object for newly built ships and during ship conversions without any major modifications to the steel structure and with as little financial cost and time penalty as possible.

[0009] This object is achieved by the features specified in patent claims **1** and **5**.

[0010] The invention is based on the knowledge that the use of land guns on ships, which has not been possible until now, satisfies the new naval requirement by the use of existing technology, which even exceeds expectations, rather than by expensive new development. The use of the land guns with a caliber of >127 mm on a ship advantageously makes it possible to use the proven technology of large-caliber land guns for newly built ships. In a further advantageous manner, the turret of a land gun can be connected to an adaptor plate and a shock-absorbing mounting and can be installed on the ship in such a way that the existing steel structure of the ship withstands the increased recoil forces. It is particularly simple for this installation to be in a modular form, so that no significant modifications need be made to the ship, and the installation can be carried out in a short time. Land guns with a caliber of >127 mm can be used without modification, with the recoil forces to be transmitted to the gun deck being absorbed in a particularly advantageous manner by a shock-absorbing mounting so that the advantageous adaptation (which can be produced in a technologically simple manner) and refinement of the adaptor plate and additional shock damping for the gun deck allows the ship technology standard to be linked to the land technology standard, with this new naval requirement being covered by existing land guns, preferably from the armored 155 mm howitzer, rather than by expensive new development.

[0011] The modular (for example) use of the turret and of the weapon system from the armored 155 mm howitzer as a ship gun makes it possible in a particularly advantageous manner to achieve a long range and high effectiveness on the target with little scatter. The gun according to the invention can also advantageously carry intelligent submunitions, for example cluster munitions or smoke munitions. In the coastal area, the use of a turret with a weapon system from the armored 155 mm howitzer as a ship gun allows fire support for land operations from a safe position with an advantageous range of >40 km. In a further advantageous manner, the modular installation of the armored howitzer on the ship can be sealed such that it is NBC-proof by the use of a radial damper, thus preventing any danger to the operator.

[0012] When the armored 155 mm howitzer is used as a ship gun, the recoil forces must be reduced. A shock-absorbing, elastic mounting results in the introduction of the force being extended over time, thus resulting in technically acceptable residual accelerations for the ship deck. Despite the use of this elastic mounting, an attitude reference arranged above the elastic mounting on the gun guarantees correct target aiming. This attitude alignment is made possible by arranging an inertial platform with GPS and satellite navigation on the turret, which is used to determine the three-dimensional position of the weapon barrel and the geographical position on the earth, thus avoiding the disadvantages of the ship-related influences on previous ship guns. For the reason mentioned above, the invention now allows shots to be fired from a moving ship at a moving target.

[0013] The long range allows the ship to be further away from the land, thus making it considerably more difficult to find the position of the ship. In contrast, land targets can easily be located from the ship by means of helicopters and drones. The invention also advantageously allows the use of projectiles with submunitions, as a result of which, when bomblets are used, it is in any case possible to attack targets without requiring 100% exact target coordinates, which represents a particular advantage for attacks from ships at sea. In a further advantageous manner, the invention allows the combat range for seaborne targets at sea to be doubled. The proven, intelligent sensor system of the armored howitzer allows the turret to always be newly aimed even though the ship is continuing to move. The high aiming accuracy results in a considerable reduction in the number of shots to be fired. The use of the turret and the weapon system from the armored 155 mm howitzer results in ammunition compatibility between the various land and seaborne armed forces units. In future, the invention will also allow naval ships to attack targets well in land, with the use of intelligent (sub-) munitions also being possible.

BRIEF DESCRIPTION OF THE DRAWING

[0014] The invention will be described in detail with reference to one exemplary embodiment, in the following figures.

[0015] FIG. **1** shows a side view of the modular installation of a turret with a weapon system from an armored howitzer on a ship.

[0016] FIG. **2** shows the modular configuration of the turret of the armored howitzer, illustrated enlarged.

[0017] FIG. **3** shows a plan view of a previous ship gun with the mounting device on the deck, which is also used for mounting the turret of the armored 155 mm howitzer.

APPROACHES TO IMPLEMENTATION OF THE INVENTION

[0018] FIG. **1** shows the configuration of a land gun **1** on the upper deck **7** of a naval forces ship **2**. The illustrated example shows a turret **3**, which can rotate, with armament **15** (which can be elevated) from a land gun, based on the example of the armored 155 mm howitzer that is successfully used by the land-based armed forces.

[0019] The turret **3** is equipped with an inertial platform (which cannot be seen) with GPS satellite navigation on the turret **3**. This measures the attitude of the barrel **3** in three dimensions, and the geographical position on the earth. The accurate position of the gun turret **3** is determined by satellite navigation, in consequence allowing the necessary aiming of the barrel **15** to be calculated. A fire control computer (which is not illustrated) receives the desired target coordinates and determines the necessary ballistic curve independently of ship-dependent influences. In order to fire a shot, the turret **3** is rotated about its axis in accordance with the target calculation, and the barrel **3** is elevated about the trunnion axis **16**.

[0020] The recoil forces from the weapon barrel **15** occur only after the shot has been fired. The aiming required for the next shot must be calculated again. On the ship, it is necessary to prevent the recoil forces from causing damage to the ship structure. This is advantageously achieved by means of an adaptor **4** (as illustrated in FIG. **2**) and an adaptor plate with a shock-absorbing mounting **5**, which are connected to one another and are installed on the ship in such a way that the existing steel structure of the ship **2** will withstand the increased recoil forces.

[0021] The shock-absorbing mounting **5** is supported by a mounting frame **6**. The mounting frame **6** can be mounted together with the adaptor plate in the turret in a modular form, as a unit. In this case, the mounting frame **6** is designed such that it equalizes out the space of a hole which is provided on the free deck **7** of the ship, and can be mounted on the existing hole rim area **9** of the deck **7**.

[0022] This is achieved by means of a multiple screw attachment **19**, of appropriate size, in the rim area **9** as the connection to the ship structure, which can be connected directly to the upper deck without any intermediate foundation (for example encapsulation compound).

[0023] The lower half of the turret ring mount **12** is connected to an intermediate frame **4**, **13** and/or to the adaptor **4** or the adaptor plate, or is inserted in it, with the intermediate frame **13** being connected to the shock-absorbing mounting **5**. The adaptor plate **4** and the intermediate frame **13** are shaped appropriately (in a manner which is not illustrated) and can be scaled appropriately for the respective distance between bulkheads, with integrated reinforcing structures for static and dynamic introduction of the forces resulting from the weight of the gun into the structure of the ship on which it is mounted.

[0024] The shock-absorbing mounting elements **5** comprise energy-absorbing damper and shock elements and, with a damping movement of approximately 150 mm, reduce the forces to be transmitted to the deck to an acceptable level. The shock-absorbing mounting **5** comprises mounting elements **5'** which are arranged like segments on the circumference. The mounting elements **5'** are connected to the intermediate frame **4**, **13** in such a way that they absorb compressive and tensile forces depending on the firing direction and elevation angle, and are accordingly compressed or extended elastically in order to absorb shock. The mounting elements **5'** can be loaded and are elastically deformable on a number of axes corresponding to the firing direction, and are composed, for example, of a rubber mixture, a steel spring or some other suitable elastically deformable spring or damping element.

[0025] The mounting frame **6** is designed in such a way that it is fitted as a unit on the deck, and can be firmly

connected, in a modular form to the shock-absorbing mounting **5** and the turret **3**. The mounting frame **6** also allows installation in a different sequence. For example, the frame **6** can also be mounted on the deck first, with the remaining parts subsequently being inserted into the mounting frame.

[**0026**] A radial damper **14**, which is preferably in the form of a hollow rubber flexible tube, is arranged between the intermediate frame **13** and the mounting frame **6**, for air-tight NBC sealing.

[**0027**] On the free deck, a sealing skirt **10** protects the mounting elements **5** and, to some extent, the mounting frame **6** against waves of water. The module **18** of the armored howitzer can be connected to the ship in a shock-proof manner in various ways, which are not illustrated.

[**0028**] A deformable seal between the lower face and the upper deck ensure gas-tightness as well as grounding/electrical bonding. The installation of the armored howitzer on a naval forces ship also leads to the following advantageous improvements:

[**0029**] the ammunition supply can be fully automated;

[**0030**] STEALTH technology is used for the turret;

[**0031**] horizontal feeding is possible;

[**0032**] the turret can advantageously be connected to the compressed-air system in the ship, so that there is no need for a separate compressor for an automatic loader;

[**0033**] the use of active barrel coolant;

[**0034**] the use of an extended recoil device in order to simplify the damping elements;

[**0035**] link between the fire control and the operational system on the ship, and transfer of target data from ship-protected fire control devices.

LIST OF REFERENCE SYMBOLS

[**0036**] **1** Gun

[**0037**] **2** Ship

[**0038**] **3** Turret

[**0039**] **4** Adaptor plate

[**0040**] **5** Shock-absorbing mounting

[**0041**] **5'** Damping element/mounting element

[**0042**] **6** Mounting frame

[**0043**] **7** Deck

[**0044**] **8** Hole

[**0045**] **9** Rim area

[**0046**] **10** Sealing skirt

[**0047**] **11** Turret basket area

[**0048**] **12** Turret ring mount

[**0049**] **13** Intermediate frame

[**0050**] **14** Radial damper

[**0051**] **15** Armament/weapon system/barrel

[**0052**] **16** Trunnion axis

[**0053**] **17** Ring mount part

[**0054**] **18** Module

[**0055**] **19** Multiple screw attachment

1-15. (canceled)

16. A method for integrating a large-calibre gun on a ship, comprising connecting a turret having an armament of a land gun with a calibre >127 mm in a modular configuration to an adaptor plate and a shock-absorbing mounting, and installing the turret on the ship so that an existing steel structure of the ship withstands increased recoil forces from the armament.

17. The method as claimed in claim 16, including supporting the shock-absorbing mounting by a mounting frame, and mounting the mounting frame together with the adaptor plate and the turret in a modular form on the ship, the mounting frame being used for three-dimensional compensation for a hole which is provided on a free deck of the ship, and being mounted on an adjacent hole rim area of the deck.

18. The method as claimed in claim 17, including providing a sealing skirt to protect the shock-absorbing mounting on the mounting frame against waves of water.

19. The method as claimed in claim 17, including providing a turret basket area located under the turret with NBC sealing by means of a radial damper located between the mounting frame and an intermediate frame which is connected to a turret ring mount of the adaptor.

20. A ship gun, comprising: a turret which can rotate in an azimuth direction; a weapon system which can be aimed in elevation, the turret and the weapon system being of a land-based gun with a caliber of more than 127 mm and of modular construction; and a shock-absorbing mounting attachable to the ship, the turret being mounted with the weapon system in the shock-absorbing mounting so as to prevent unacceptable recoil forces from acting on the ship structure.

21. The ship gun as claimed in claim 20, wherein the turret and the weapon system are an armored howitzer with a calibre of 155 mm.

22. The ship gun as claimed in claim 20, and further comprising a ring mount attached to the turret, the ring mount having a lower ring mount part connected to an intermediate frame or to an adaptor or an adaptor plate, or inserted in the intermediate frame, the intermediate frame being connected to the shock-absorbing mounting.

23. The ship gun as claimed in claim 20, wherein the shock-absorbing mounting is configured to have a maximum damping movement of approximately 150 mm.

24. The ship gun as claimed in claim 22, wherein the shock-absorbing mounting is composed of mounting elements which are arranged like segments on a circumference.

25. The ship gun as claimed in claim 24, wherein the mounting elements are connected to the intermediate frame so as to absorb compressive or tensile forces depending on firing direction and elevation angle and are compressable or extendable elastically accordingly, for shock damping.

26. The ship gun as claimed in claim 24, wherein the mounting elements are configured so as to be loadable and elastically deformable on a number of axes.

27. The ship gun as claimed in claim 26, wherein the mounting elements are composed of a rubber mixture, a steel

spring or some other suitable elastically deformable spring or damping element.

28. The ship gun as claimed in claim 24, and further comprising a mounting frame firmly connectable on one side to a free deck of the ship and on another side supports the shock-absorbing mounting.

29. The ship gun as claimed in claim 28, and further comprising a radial damper arranged to form an airtight NBC seal between the intermediate frame and the mounting frame.

30. The ship gun as claimed in claim 29, wherein the radial damper is a hollow rubber flexible tube.

31. The ship gun as claimed in claim 28, and further comprising a sealing skirt arranged so as to protect the mounting elements and the mounting frame from waves of water.

32. The ship gun as claimed in claim 20, wherein the turret is equipped with an inertial platform which contains a GPS-assisted, high-precision inertial navigation system, which directly determines attitude of a weapon barrel of the weapon system in three dimensions and geographical position on the earth without ship-related influences.

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