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(54) A LEVELLING DEVICE FOR A WEAPON

(71) We, AKTIEBOLAGET BOFORS, a Swedish joint-stock company, acting under the laws of Sweden, of S-690 20 Bofors Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a levelling device for a weapon such as an artillery piece on a ship, to provide for levelling of the base plane of the weapon in relation to the base plane of fire control equipment associated with the weapon.

In order that data transmission from the fire control equipment to for instance a gun shall be correct, it is necessary that the flat foundations for both the fire control equipment and the gun are entirely parallel, Although great care is taken in building a ship to make the two planes parallel, notwithstanding this, changes take place in the ship's hull which resulted in dislocations in the parallelism between the two planes. These changes primarily take place when the ship is launched into the water since the ship's hull is then subjected to forces of an entirely different nature than those in the building-berth. However, changes in the ship's hull can also take place later on, during the life of the ship, due to vibrations, bumping against the bottom etc. The differences in the parallelism become still more prominent if the fire control equipment is located at a great distance from the gun.

In order to restore the parallelism, it has previously been necessary, after the launching of the ship, to carry out re-working of at least one of the planes, which has involved high costs and delays.

It has also previously been proposed to take into account deviations from parallelism between the base plane of the gun and the base plane of the fire control equipment by introducing a correction of the values calculated by the fire control equipment for the setting of the gun to compensate for the deviation from parallelism. However, the introduction of such a correction becomes complicated, due to the fact that the correction must also be made dependent on the elevation of the gun. Even though it is possible with the aid of various electric circuits to achieve such a correction, the equipment required is very complicated and expensive.

The purpose of the present invention is to provide a levelling device with the aid of which it is possible, in a simple way, to restore parallelism between the base plane of a gun mounted on the device and the base plane on which the device is mounted.

According to the invention therefore we provide a levelling device for a weapon comprising an upper ring having a plane upper surface for supporting the base of a weapon and a lower spherical surface and a lower ring having a plane lower surface and a spherical upper surface complementary to the lower spherical surface of the upper ring, the spherical surfaces of the rings being in contact to enable the upper ring to be tilted relative to the lower ring.

With this device it is possible to adjust the upper ring so that the base plane of the weapon when mounted on the plane surface of the upper ring will be level with the base plane of the deck or other surface on which the device is mounted.

In the following, a preferred embodiment of the invention will be described in more detail, with reference to the accompanying drawings, in which:

Figure 1 shows a side view of an embodiment of the present invention,

Figure 2 is a plan view of the device of figure 1

Figure 3 shows a detailed view of the adjusting members shown in figure 1, and

Figure 4 shows a detailed view of the securing members shown in figure 1.

Figure 1, shows the base cone 1 of a gun which is placed on the deck 2 of a ship. As previously mentioned, it is of great importance that the base plane 3 of the gun is levelled so that it is parallel to the plane of fire control equipment. In order to provide for horizontal adjustment of said base plane, the

base cone of the gun rests upon a flat foundation comprising an upper ring 4 having a plane upper surface and a lower ring 5 having a plane lower surface, the contact surface 6 between the rings one complementary to the other. With the aid of adjusting members 7, which will be described in more detail with reference to figure 3, the upper ring 4 can be tilted in relation to the lower ring 5 due to the spherical surface between the two rings. The upper ring can moreover be secured in relation to the lower ring with the aid of securing members 8. These members will also be described in more detail in the following. See figure 4. The centre of the spherical surface, as well as the centres of the two rings, is located on the centre line 9 of the base cone 1, for instance in the trunnion centre of the gun.

Figure 2 shows the adjusting members 7 and the securing members 8 which are evenly spaced along the upper and the lower rings.

From figure 3 it will be noted that the upper ring 4 comprises a flat surface 10 facing the base cone 1, to which the base cone can be screwed or welded. The lower ring 5 comprises a flat surface 11 which can be in contact with a planed ring-shaped foundation 12, built into a ship's deck.

The lower ring 5 is provided with a number of horizontal adjusting screws 13, which are screwed into through holes 14 from the outer envelope surface of the ring and are evenly spaced around the ring. In the spherical surface of the upper ring, there are corresponding recesses 15, so that the adjusting screws 13 can be screwed against a vertical surface 16. The recess 15 has such a size that the diameter of the hole is greater than the diameter of the adjusting screw, and the upper ring can thereby be displaced in relation to the lower ring by means of the adjusting screws. The displacement then takes place in the spherical contact surface 6 between the rings.

Further, the upper ring 4 is provided with vertical securing screws 17—see figure 4—which, as in the case of the adjusting screws, are evenly spaced around the ring. The securing screws have such a length that, through the vertical through holes in the upper and lower rings, they can be screwed down into the ring-shaped foundation 12 in the ship's deck. In order to permit displacement of the upper ring in relation to the lower ring, the holes 18 for the securing screws in the upper ring have a diameter which exceeds the diameter of the screw. On the other hand, in the lower ring the holes 19 have a normal clearance for the screws, Washers 20 are placed between the heads of the securing screws and the flat, upper surface 10 of the ring 4.

The device described for levelling of the base plane of a gun on a ship can be used in, for instance, the following way.

When deviations in parallelism between the base plane of the gun and the plane of the fire control equipment have been established, the securing screws 17 are first loosened all the way around on the upper ring 4. Thereafter, the upper ring 4 is displaced with the aid of the adjusting screws 13. When the gun has been set parallel to the plane of the fire control equipment in this way, the adjusting screws 13 are tightened up against their planes 16 in the recesses 15 in the upper ring. After this adjustment, the vertical securing screws 17 are tightened up again.

Experience has shown that it is quite sufficient to be able to adjust the upper ring within an angular range of $\pm$ 5 mils. With a radius R = 800 mm of the spherical surface 6, the holes 18 for the securing screws in the upper ring can have a diameter which exceeds the diameter of the screws by approx. 8 mm.

WHAT WE CLAIM IS:—

1. A levelling device for a weapon comprising an upper ring having a plane upper surface for supporting the base of a weapon and a lower spherical surface and a lower ring having a plane lower surface and a spherical upper surface complementary to the lower spherical surface of the upper ring, the spherical surfaces of the rings being in contact to enable the upper ring to be tilted relative to the lower ring.

2. A device according to Claim 1 including a plurality of adjusting members with the aid of which the upper ring can be tilted in relation to the lower ring.

3. A device according to Claim 2, wherein the adjusting members each comprise a horizontal adjusting screw, the screws being evenly spaced around the lower ring and wherein the upper ring has a plurality of recesses each with a vertical surface against which an associated screw bears to adjust the angle of tilt of the upper ring relative to the lower ring and the screw is screwed into the lower ring.

4. A device according to any one of the preceding claims, including a plurality of securing members to clamp the upper ring down onto the lower ring.

5. A device according to Claim 4, wherein the securing members comprise a plurality of vertical securing screws evenly spaced around the upper ring and arranged to be screwed through vertical aligned holes in the upper and lower rings into a foundation on which said device can be mounted.

6. A device according to Claim 5, wherein the holes in the upper ring have a diameter which exceeds the diameter of the screw, while the holes in the lower ring have normal clearance for the screws.

7. A levelling device for a weapon substantially as described herein with reference to the accompanying drawings.

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1570204 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

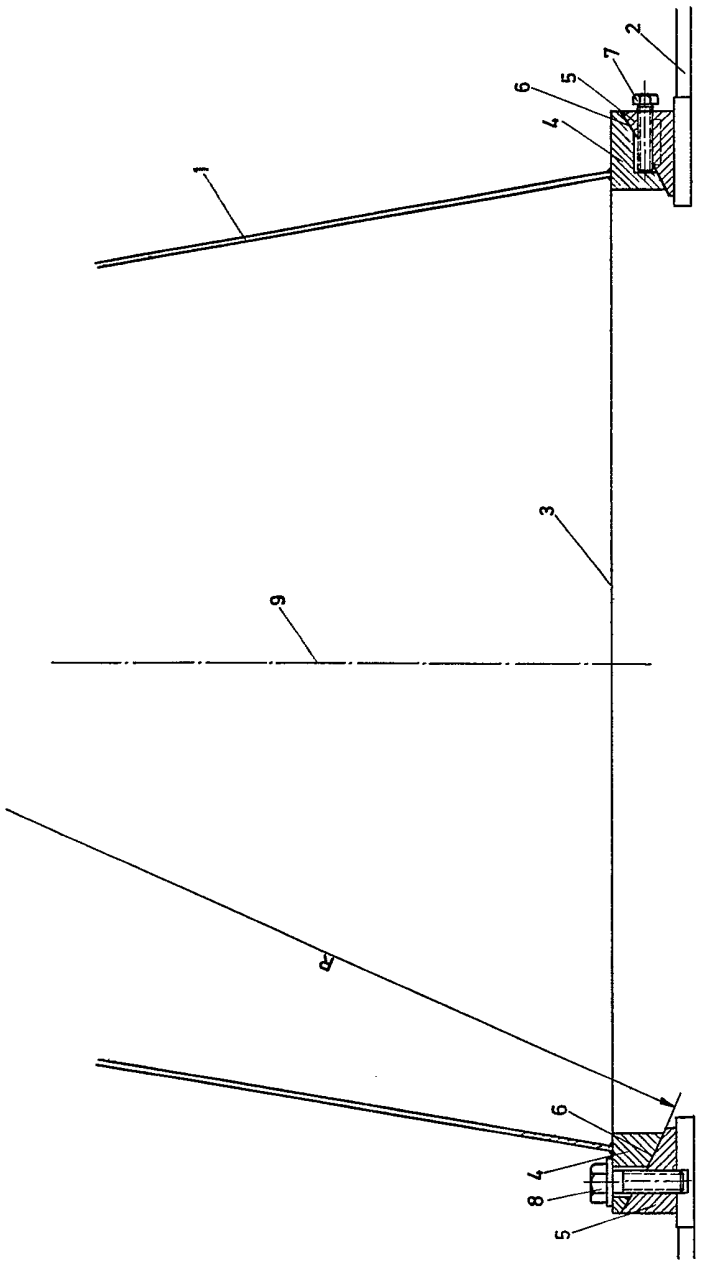


Fig 1

1570204 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

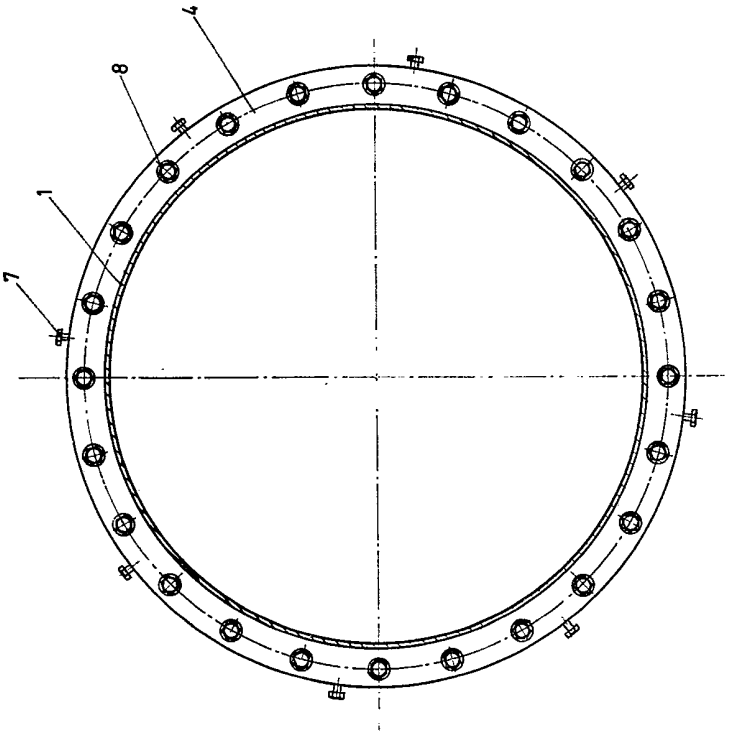


Fig 2

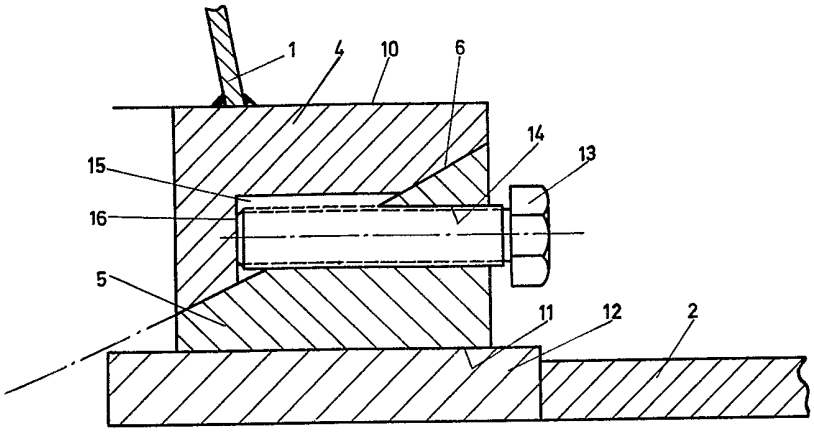


Fig 3

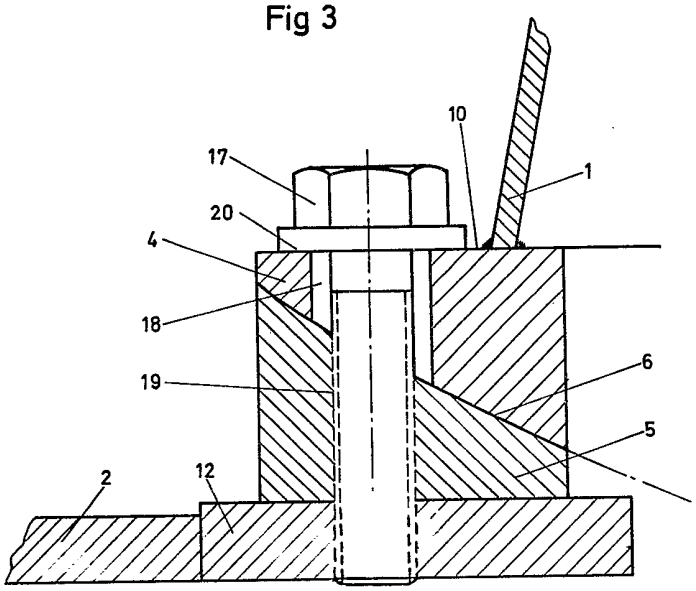


Fig 4