Oct. 20, 1925. 1,557,545

W. AKEMANN

FIRE CONTROL APPARATUS FOR NAVAL GUNS

Filed March 3, 1924 2 Sheets-Sheet 1

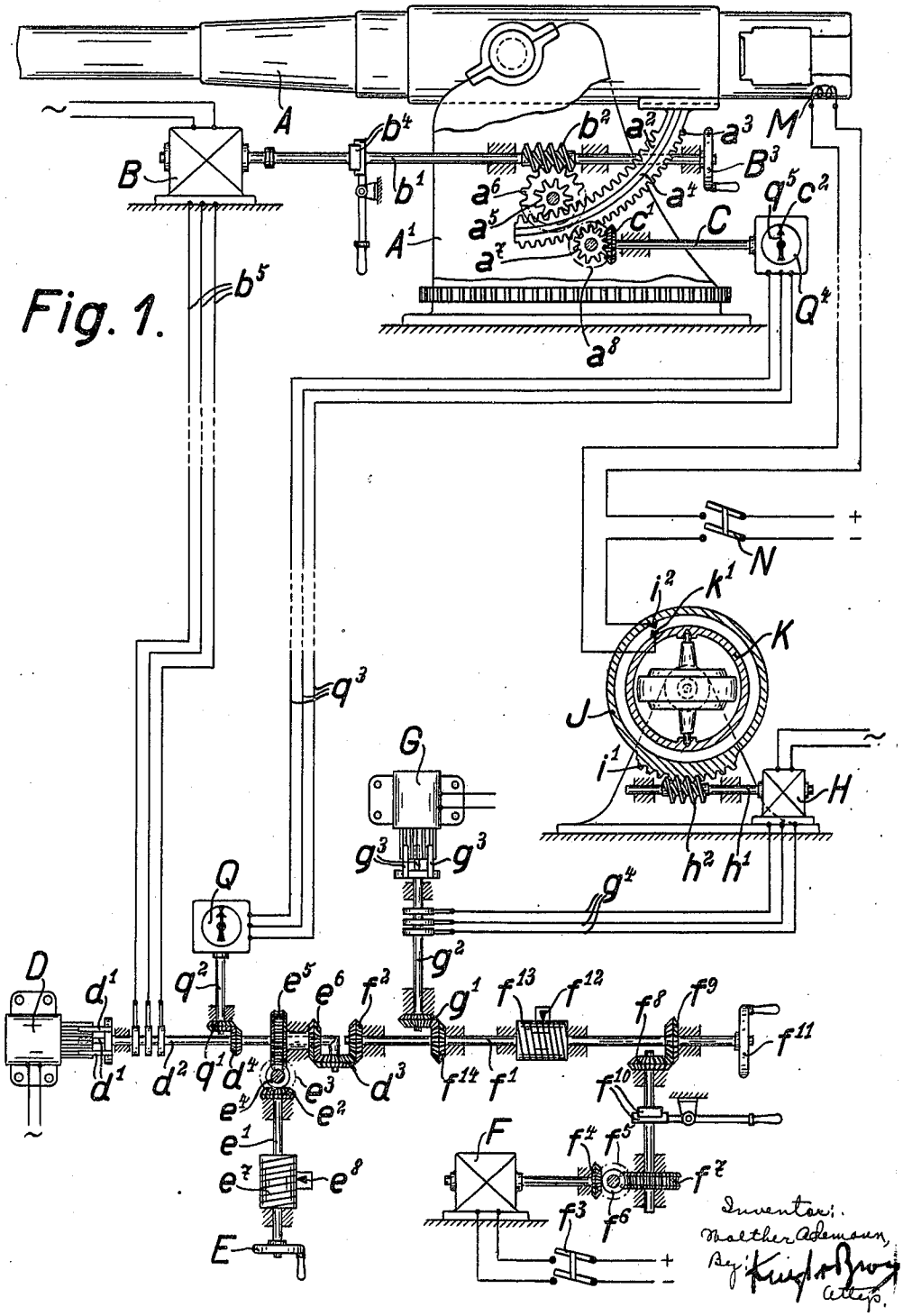


Fig. 1.

Inventor:
Walther Akemann,
By: Kruppa & Bruno
Attys.

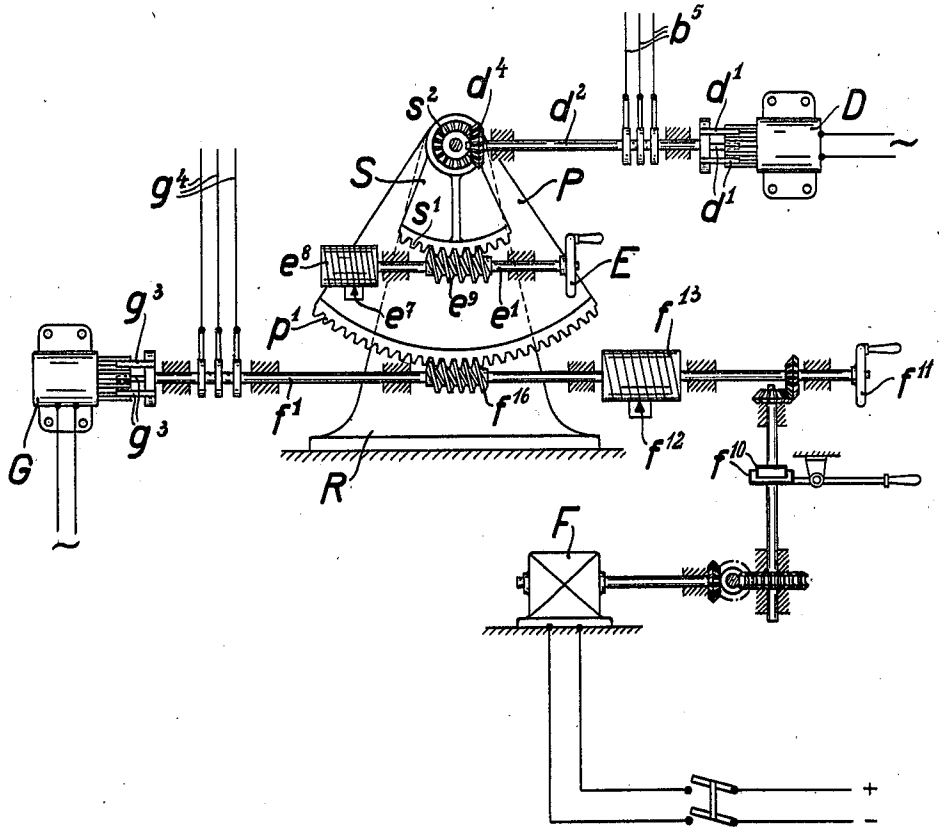
Oct. 20, 1925. 1,557,545

W. AKEMANN

FIRE CONTROL APPARATUS FOR NAVAL GUNS

Filed March 5, 1924 2 Sheets-Sheet 2

Fig. 2.



Inventor:
Walther Akemann,
By: Kurt Stoy
Atty.

Patented Oct. 20, 1925. 1,557,545

UNITED STATES PATENT OFFICE.

WALTHER AKEMANN, OF BERLIN-DAHLEM, GERMANY, ASSIGNOR TO FRIED. KRUPP AKTIENGESELLSCHAFT, OF ESSEN-ON-THE-RUHR, GERMANY.

FIRE-CONTROL APPARATUS FOR NAVAL GUNS.

Application filed March 3, 1924. Serial No. 696,708.

To all whom it may concern:

Be it known that I, WALTHER AKEMANN, residing at Berlin-Dahlem, Germany, a citizen of the German Republic, have invented a certain new and useful Improvement in Fire-Control Apparatus for Naval Guns, of which the following is a specification.

The invention relates to a fire control apparatus for naval guns which is provided with a firing device having a stabilized and a non-stabilized firing tongue, and with a long distance adjusting apparatus enabling the distant pointing of the gun. The object of the invention is to so improve apparatus of the character stated that a particularly advantageous connection is attained between the firing device and the long distance transmitting apparatus which latter is designed for the distant pointing of at least one gun.

With this end in view the invention consists in the arrangement, construction and combination of parts to be hereinafter described and particularly pointed out in the appended claims.

The invention will now be described in detail with reference to the accompanying drawing which diagrammatically illustrates, by way of example, two embodiments of the subject-matter of the invention and in which:

Fig. 1 illustrates the first embodiment, and

Fig. 2 that portion of the second embodiment which is situated in the transmitting station.

The embodiment shown in Fig. 1 will be described first.

The gun-barrel A is mounted in the mounting A^1, capable of lateral training, and is provided with a toothed elevating arc having a series of teeth a^2 and another series of teeth a^3. The teeth a^2 are engaged by a pinion a^5 which is positively connected to a shaft b^1 by means of a self-locking worm gear b^2 a^6. The other teeth, a^3, in mesh with a pinion a^8 of a gear a^7 a^8 c^1, are connected to a shaft C designed for adjusting a rotatable reading-off mark c^2 which indicates the elevation of the gun-barrel A.

The rotation of the shaft b^1 can be effected by a distant controlled receiving motor B or by a hand wheel B^3 mounted on the free end of shaft b^1. A quickly releasable clutch b^4 is interposed between the motor B and the worm b^2.

The armature, not shown, of the receiving motor B excited by alternating current, is connected by conductors b^5 to the corresponding transmitter D excited by similar alternating current in such a manner that it runs synchronously with the rotative part, formed by the brushes d^1, of the transmitter D. The rotatable brushes d^1 are mounted on one end of a shaft d^2 the other end of which, rectangularly bent down, carries the planet pinion d^3 of a planet gear. In order to rotate the shaft d^2 two shafts e^1 and f^1 are provided. The shaft e^1 is positively connected to one, e^6, of the central wheels of said planet gear, by means of a self-locking gear e^2 e^3 e^4 e^5, while the shaft f^1 is positively connected to the other central wheel f^2 of said gear. The shaft e^1 is further provided with a hand wheel E and a reading-off device e^7 e^8 indicating the distance target-gun. For rotating the shaft f^1 there is provided, in the first line, a continuous current motor F which may be connected to a network by a switch f^3 and the armature of which is positively connected to the shaft f^1 through the intermediary of a self-locking gear f^4 f^5 f^6 f^7 f^8 f^9 and a quickly releasable clutch f^{10}. In the second line, there is provided a hand wheel f^{11} which is mounted on the free end of shaft f^1 and rotates idly with this shaft if the latter is being driven by the motor F and which is made use of after the clutch f^{10} has been thrown out. The rotation of the shaft f^1 is further transmitted, by a gear f^{14} g^1, to a shaft g which carries on its free end brushes g^2 forming the rotative parts of a transmitter G. To the said brushes g^3 of the transmitter G which is excited by alternating current, is so connected by conductors g^4 the armature of the corresponding receiving motor H excited by similar alternating current, that it will rotate synchronously with said brushes g^3. The armature shaft h^1 is positively connected by a worm gear h^2 i^1 to the casing J of a gyroscope firing device, which casing is adapted to swing about an horizontal axis. This

casing J further carries one of the firing tongues, i^2, of an automatic firing device while the counter-tongue k^1, is adjustably mounted on a part K which is capable of being stabilized in the space by said gyroscope. The adjustability of the counter-tongue k^1 which does not form the subject matter of this invention and, therefore, is not illustrated here, is broadly shown in the specification of U. S. Patent No. 1,387,440. The said adjustability enables the influence of the velocity of the roll on the angle of advanced ignition and therewith on the angle of elevation to be automatically allowed for at the moment of the shot. The conditions are so chosen that with each angle of rotation of the shaft f^1 the angles of rotation imparted to the gun-barrel A and to the tongue i^2 are equal to each other. On the shaft f^1 is arranged a reading-off device f^{12} f^{13} indicating the rotations imparted to the gun-barrel A and to the tongue i^2 by the receivers B and H.

The two firing tongues i^2 and k^1 lie in a circuit which comprises the exciting winding M of the firing magnet and a hand-operated switch N. A shaft q^2, further, is positively connected to the shaft d^2 by a bevel gear d^4 q^1, said shaft q^2 driving the transmitter Q which is provided with a reading-off device, of a long distance indicating apparatus. The receiver Q^4 belonging to said transmitter Q and connected thereto by conductors q^3 shows a pointer q^5 indicating its adjustment and the axis of rotation of which coincides with that of the mark c^2.

The working of the above-described apparatus will be described from the position of the parts as seen in the drawing and it will also be supposed that the gyroscope is rotating and the ship assumes an horizontal position. Now, when the ship is rolling and the gun-barrel A which previously has been laterally trained is to have imparted to it the elevation corresponding to the range of the target with respect to an horizontal plane and has to be fired, prior to its passing, during the roll, through the horizontal position by an amount of time corresponding to the firing delay, then first the hand wheel E is turned until the division mark of the scale e^7 corresponding to the range of the target, registers with the mark e^8. The rotation of the hand wheel E causes, by the intermediary of the gear e^2 e^3 e^4 e^5 e^6 d^2 a rotation of the shaft d^2 effecting, in its turn, a corresponding rotation of the brushes d^1, which form the rotative part of the transmitter D, and by means of the gear d^4 q^1 q^2, also a rotation of the rotative part of the transmitter Q. The rotation of the rotative parts of the transmitters D and Q is correspondingly taken part in by the armature of the receiving motor B and by the rotative pointer q^5 of the receiver Q^4 of the long distance indicating apparatus Q q^3 Q^4. Further, the said rotation of the armature of the receiving motor B of the long distance adjusting apparatus D b^5 B is transmitted, firstly, by means of the gear b^4 b^1 b^2 a^6 a^5 a^2 a^4 to the gun-barrel A in such a manner that an elevation corresponding to the range of the target is imparted to the latter relative to its platform. Secondly the said rotation is transmitted, by means of the gear a^3 a^7 a^8 c^1 C, to the mark c^2 rotatable about the axis of pointer q^5. The conditions are so chosen that every rotation of the shaft d^2 causes rotations of the pointer q^5 and of the mark c^2 which rotations are equal to one another. In consequence thereof the pointer q^5 and the mark c^2 will permanently register, upon rotation of shaft d^2, as long as the long distance adjusting apparatus D d^1 b^5 B and the long distance indicating apparatus Q q^3 Q^4 q^5 will work normally.

In addition to the said elevation imparted to the gun-barrel A by turning the hand wheel E and corresponding to the range of the target, an inclination by a determined angle, for instance 3°, is imparted to the gun-barrel A and to the non-stabilized firing tongue i^2. To this end, after the clutch f^{10} has been thrown out, the hand wheel f^{11} is turned until the reading-off mark f^{12} registers with that division mark of the scale f^{13} which indicates 3°. This rotation of the hand wheel f^{11} is transmitted, firstly, by means of the intermediate gears shown in the drawing to the adjustable parts of the transmitters D and G and causes, by means of the receivers B and H a corresponding additional adjustment of the gun-barrel A and of the non-stabilized tongue i^2. The conditions are such as to cause, upon the rotation just mentioned of the hand wheel f^{11}, the gun-barrel A and the tongue i^2 to turn by 3° in counter-clockwise direction and to be lowered by 3° relative to their previous angular position. The described rotation of the hand wheel f^{11} is transmitted, secondly, by means of the long distance indicating apparatus Q Q^4 to the pointer q^5 and so imparts to it an adjustment that it permanently will register with the mark c^2 which likewise alters its angular position upon lowering the gun-barrel A. Therefore the gun-barrel A adjusted relative to its platform and taking part in the rolling movements of the ship, assumes in the moment of passing through its horizontal position, an angle of elevation, relative to its platform, which is by 3° smaller than the angle of elevation corresponding to the range of the target, and the firing tongue i^2 likewise taking part in the roll assumes in this moment still an angular distance from the tongue k^1 which is equal to the angle of 3° minus the amount of the angle of advanced ignition.

Now as hereinbefore explained, the fire

has to be initiated prior to the passage through the horizontal position by the amount of the angle of advanced ignition corresponding to the firing delay. It is therefore required to impart, during the rolling-up movement, to the rolling tongue i^2 and to the gun-barrel A, likewise rolling, an additional rotation by 3°. This additional rotation by 3° causes the tongue i^2 to face the tongue k^1 at the moment the ship is in advance of the horizontal position by the angle of advanced ignition, and the gun barrel A to assume an angle corresponding to the range of the target at the moment of the horizontal position of the ship.

As soon as the hereinbefore described adjustments, by the hand wheels E and f^{11}, of the gun-barrel and tongue i^2 have been terminated, the clutch f^{10} is thrown in. If now the ship takes the lower reverse point of the movement of roll or is in the vicinity thereof, first the switch N contained in the firing circuit, is thrown in by hand. Then, during the movement of roll directed towards the horizontal position the continuous current motor F is set in motion by throwing in the switch f^3. The rotation of motor F which takes place with a uniform angular velocity after a constant starting time, is transmitted by means of the gear f^4 f^5 f^6 f^7 f^{10} f^8 f^9 to the shaft f^1 and therewith, in the manner already described, also to the rotative parts of the transmitters D, Q and G. The gun-barrel A which is positively connected to the armature of the receiver B and the firing tongue i^2 positively attached to the receiver H will therefore be rotated with equal angular velocity in clockwise direction. The conditions are so that the tongue i^2 turned in clockwise direction by the motor F will face again the stabilized tongue k^1, during the upwardly directed movement of roll, in a moment in which the ship is still inclined relative to its horizontal position by the angle of advanced ignition, and that the tongue i^2 will again assume its angular position shown in the drawing relative to the tongue k^1 when the ship is in horizontal position. Thus the firing tongue i^2 has been rotated, during the rolling-up movement, until the horizontal position has been reached, by 3° in clockwise direction by the motor F. As the angular velocities of the tongue i^2 and of the gun-barrel are equal to one another, the gun-barrel has been raised, during the rolling-up, until the horizontal position has been reached, by 3° relative to its platform and therefore assumes again in this moment the elevation corresponding to the range of the target relative to its platform. When the tongues i^2 and k^1 touch each other and thus close the firing circuit containing the winding M of the firing magnet, the shot is effected automatically. The projectile thus leaves the gun-barrel in accordance with the firing delay mentioned, in that moment where the ship passes through the horizontal position and where the gun-barrel has again the elevation corresponding to the range of the target. As soon as the shot has been fired the motor F is stopped. In case it happens, after the recoil following the shot, of the gun-barrel A, that the elevation of the latter has undesirably altered itself by a small amount and that consequently the mark c^2 will no longer register with the pointer q^5, the clutch b^4 is thrown out, the gun-barrel is brought into the required elevation by turning the hand wheel B^3 and the clutch b^4 is then thrown in again.

The above-described inclination by 3° of the gun-barrel A and of the non-stabilized tongue i^2 is performed in order to render it possible, upon the rolling-up of the ship, to get the passage of the tongue i^2, partaking in the roll, past the stabilized tongue k^1, with a velocity which is by a constant amount greater than the relative velocity of the tongues i^2 and k^1 provoke by the velocity of roll of the ship. For, this increase of the rotative velocity of the tongue i^2 by a constant amount is suitable with regard to the properties of the mechanism, not shown, for automatically regulating the angle of advanced ignition (mechanism for automatically adjusting the tongue k^1 relative to the Cardan ring K) and is even necessary with little velocities of roll. For, this mechanism which does not form the object of the invention and therefore is not described, works in a satisfying manner only if the non-stabilizable tongue i^2 will be moved past the stabilizable tongue k^1 with a practically uniform velocity which does not exceed determined upper and lower limits.

The main advantage of the present invention rests in that it is possible to set the non-stabilizable tongue independently of the gun-barrel or in common therewith. For, this possibility is the presupposition for the mode of adjusting pointed out in the foregoing as being of particular advantage.

A further important advantage resides in the fact that the gyroscope device carrying the firing device is not fitted with the devices for training the gun-barrel and that it therefore needs little space only. This is particularly important in case the gyroscope device is mounted in a narrow spot, for instance the top of the ship. The use of a continuous current motor for driving the synchronously running transmitter and receiver offers the further advantage that, firstly, the synchronism will disappear not as easily, owing to the successive increase of the number of revolutions of the continuous current motor, as with the drive by hand which is not uniform owing to its nature.

Secondly the conditions may be so chosen that the starting time of the motor becomes constant.

The second embodiment differs from that described only by the apparatus situated in the transmitter station.

For driving the shaft f^1 fitted with the indicating device f^{12} f^{13} serve, in a manner exactly corresponding to the first embodiment, a hand wheel f^{11} and a continuous current motor F positively connected to the shaft f^1 by means of a releasable clutch f^{10}. The brushes g^3, however, forming the rotative part of the transmitter G are mounted directly on the free end of the shaft f^1. The receiver H, no longer shown (see Fig. 1), is situated in the gyroscope station and is connected to said transmitter G by conductors g^4. The shaft f^1 has mounted on it still a worm f^{16} which co-operates with teeth p^1 of a sector P swingingly mounted on a frame R. On the sector P is mounted for rotation the shaft e^1 fitted with the hand wheel E and with the reading-off device e^7 e^8 and positively connected, in its turn, to another sector S by means of a self-locking worm gear e^9 s^1. This sector S which is swingingly mounted on the sector P and is coaxial therewith is positively connected to the shaft d^2 carrying the brushes d^1 of the transmitter D by means of a bevel gear s^2 d^4. The receiving motor B, likewise no longer shown, see Fig. 1, is connected to the transmitter D by the conductors b^5.

The mode of handling the second embodiment is the same as that of the first described. It will be seen without further explanation that every rotation of the shaft f^1 causes a rotation of the rotative parts g^3 and d^1 of the transmitters G and D, while the adjustment, according to the range of the target, of the shaft e^1 will rotate only the adjustable part d^1 of the transmitter D. The advantage of the second embodiment over the first-described resides in that the planet gear which may cause inaccuracies if not manufactured with extraordinary precision, is dispensed with.

With both described embodiments it is possible to provide the range adjusting shaft e^1 still with a second motoric drive, with insertion of a releasable clutch, which drive may continuously impart to the shaft e^1 the additional adjustments corresponding to a variable range of the target.

Claims:

1. A fire control apparatus for naval guns, comprising the combination with one or several adjustable gun barrels of a pointing mechanism, a long distance adjusting device operatively connected with said pointing mechanism for adjusting said gun barrel or barrels and comprising a transmitter and a receiver, said receiver being positively connected to said pointing mechanism, an electric firing device, two cooperating contacts contained in said firing device and being situated in the circuit thereof, a stabilizing means for one of said contacts, the other of said contacts being non-stabilized, a long distance adjusting device enabling the adjusting of the non-stabilized contact of said firing device and comprising a transmitter and a receiver, said receiver being positively connected to said non-stabilized contact; and operating means for the transmitters of both said long distance adjusting devices, said means adapted for alternatively setting said gun barrel or barrels either independently of the adjustment of said non-stabilized contact or in common therewith.

2. A fire control apparatus for naval guns, comprising the combination with one or several adjustable gun barrels of a pointing mechanism, a long distance adjusting device operatively connected with said pointing mechanism for adjusting said gun barrel or barrels and comprising a transmitter and a receiver, said receiver being positively connected to said pointing mechanism, an electric firing device, two cooperating contacts in said firing device and being situated in the circuit thereof, a gyroscopic device for stabilizing one of said contacts, the other of said contacts being non-stabilized, a long distance adjusting device enabling the adjusting of the non-stabilized contact of said firing device and comprising a transmitter and a receiver, said receiver being positively connected to said non-stabilized contact; and operating means for the transmitters of both said long distance adjusting devices, said means being adapted for alternatively setting said gun barrel or barrels either independently of the adjustment of said non-stabilized contact or in common therewith.

3. A fire control apparatus for naval guns, comprising the combination with one or several adjustable gun barrels of a pointing mechanism, a long distance adjusting device operatively connected with said pointing mechanism for adjusting said gun barrel or barrels and comprising a transmitter and a receiver, said receiver being positively connected to said pointing mechanism, an electric firing device, two cooperating contacts contained in said firing device and being situated in the circuit thereof, a stabilizing means for one of said contacts, the other of said contacts being non-stabilized, a long distance adjusting device enabling the adjusting of the non-stabilized contacts of said firing device and comprising a transmitter and a receiver, said receiver being positively connected to said non-stabilized contact; and operating means for the transmitters of both said long distance adjusting devices, said means being adapted for alternatively setting said gun barrel or barrels either independently of the adjustment of said non-stabil-

ized contact or in common therewith and comprising a motor driven shaft in operative connection with both of said transmitters, and a hand operated shaft in operative connection with said first named transmitter and enabling the independent adjustment of said gun barrel or barrels.

4. A fire control apparatus for naval guns, comprising the combination with one or several adjustable gun barrels of a pointing mechanism, a long distance adjusting device operatively connected with said pointing mechanism for adjusting said gun barrel or barrels and comprising a transmitter and a receiver, said receiver being positively connected to said pointing mechanism, an electric firing device, two cooperating contacts contained in said firing device and being situated in the circuit thereof, a stabilizing means for one of said contacts, the other of said contacts being non-stabilized, a long distance adjusting device enabling the adjusting of the non-stabilized contact of said firing device and comprising a transmitter and a receiver, said receiver being positively connected to said non-stabilized contact; and operating means for the transmitters of both said long distance adjusting devices, said means comprising two separate driving means, one of said driving means being operatively connected to the transmitter of said first-named long distance adjusting device and the other being operatively connected to both of said transmitters.

5. A fire control apparatus for naval guns, comprising the combination with one or several adjustable gun barrels of a pointing mechanism, a long distance adjusting device operatively connected with said pointing mechanism for adjusting said gun barrel or barrels and comprising a transmitter and a receiver, said receiver being positively connected to said pointing mechanism, an electric firing device, two cooperating contacts contained in said firing device and being situated in the circuit thereof, a stabilizing means for one of said contacts, the other of said contacts being non-stabilized, a long distance adjusting device enabling the adjusting of the non-stabilized contact of said firing device and comprising a transmitter and a receiver, said receiver being positively connected to said non-stabilized contact; and operating means for the transmitters of both said long distance adjusting devices, said means comprising two shafts, each connected with one of said transmitters, a third shaft and a hand-wheel fixed thereto, a direct current motor and a clutch, said motor being adapted to be operatively connected to said third shaft by means of said clutch.

6. A fire control apparatus for naval guns, comprising the combination with one or several adjustable gun barrels of a pointing mechanism, a long distance adjusting device operatively connected with said pointing mechanism for adjusting said gun barrel or barrels and comprising a transmitter and a receiver, said receiver being positively connected to said pointing mechanism, an electric firing device, two cooperating contacts contained in said firing device and being situated in the circuit thereof, a stabilizing means for one of said contacts, the other of said contacts being non-stabilized, a long distance adjusting device enabling the adjusting of the non-stabilized contact of said firing device and comprising a transmitter and a receiver, said receiver being positively connected to said non-stabilized contact; operating means for the transmitters of both said long distance adjusting devices, said means being adapted for alternatively setting said gun barrel or barrels either independently of the adjustment of said non-stabilized contact or in common therewith; and a long distance indicating device embodying a transmitter, a receiver positioned at one of said gun barrels, means connecting said transmitter to said receiver for synchronous operation, and a pointer carried by said receiver, said transmitter being operated in conjunction with the transmitter of said first-named long distance adjusting device.

7. A fire control apparatus for naval guns, comprising the combination with one or several adjustable gun barrels of a pointing mechanism, a long distance adjusting device operatively connected with said pointing mechanism for adjusting said gun barrel or barrels and comprising a transmitter and a receiver, said receiver being positively connected to said pointing mechanism, an electric firing device, two cooperating contacts contained in said firing device and being situated in the circuit thereof, a stabilizing means for one of said contacts, the other of said contacts being non-stabilized, a long distance adjusting device enabling the adjusting of the non-stabilized contact of said firing device and comprising a transmitter and a receiver, said receiver being positively connected to said non-stabilized contact; operating means for the transmitters of both said long distance adjusting devices, said means being adapted for alternatively setting said gun barrel or barrels either independently of the adjusting of said non-stabilized contact or in common therewith; and a long distance indicating device embodying a transmitter, a receiver positioned at one of said gun barrels, means connecting said transmitter to said receiver for synchronous operation, and a pointer carried by said receiver, a counter mark operatively connected to said pointing mechanism and cooperating with said pointer, said transmitter being operated in conjunction with the transmitter of said first-named long distance adjusting device.

8. A fire control apparatus for naval guns, comprising the combination with one or several adjustable gun barrels of a pointing mechanism, a long distance adjusting device operatively connected with said pointing mechanism for adjusting said gun barrel or barrels and comprising a transmitter and a receiver, a transmission shaft interposed between said receiver and said pointing mechanism, clutch means interposed in said shaft, an electric firing device, two cooperating contacts contained in said firing device and being situated in the circuit thereof, a stabilizing means for one of said contacts, the other of said contacts being non-stabilized, a long distance adjusting device enabling the adjusting of the non-stabilized contact of said firing device and comprising a transmitter and a receiver, said receiver being positively connected to said non-stabilized contact; operating means for the transmitters of both said long distance adjusting devices, said means being adapted for alternatively setting said gun barrel or barrels either independently of the adjustment of said non-stabilized contact or in common therewith; a long distance indicating device embodying a transmitter, a receiver positioned at one of said gun barrels, means connecting said transmitter to said receiver for synchronous operation, and a pointer carried by said receiver, said transmitter being operated in conjunction with the transmitter of said first-named long distance adjusting device, a counter mark controlled by said shaft and cooperating with said pointer and a hand-wheel carried by said shaft for imparting an additional adjustment to said pointing mechanism upon the disengagement of said clutch means.

9. A fire control apparatus for naval guns, comprising the combination with one or several adjustable gun barrels of a pointing mechanism, a long distance adjusting device operatively connected with said pointing mechanism for adjusting said gun barrel or barrels and comprising a transmitter and a receiver, said receiver being positively connected to said pointing mechanism, an electric firing device, two cooperating contacts contained in said firing device and being situated in the circuit thereof, a stabilizing means for one of said contacts, the other of said contacts being non-stabilized, a long distance adjusting device enabling the adjusting of the non-stabilized contact of said firing device and comprising a transmitter and a receiver, said receiver being positively connected to said non-stabilized contact; and operating means for the transmitters of both said long distance adjusting devices, said means embodying two shafts operatively connected each to one of said transmitters, a sun- and -planet gear unit connecting said shafts; whereby the movement of one of said shafts is imparted to the other and a third shaft in connection with said sun- and -planet gear unit and enabling the adjustment of said gun barrel controlling transmitter independently of said non-stabilized contact controlling transmitter.

The foregoing specification signed at Berlin, Germany, this 9th day of February, 1924.

WALTHER AKEMANN.