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FIRE CONTROL APPARATUS FOR NAVAL GUNS.

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Fig. 1.

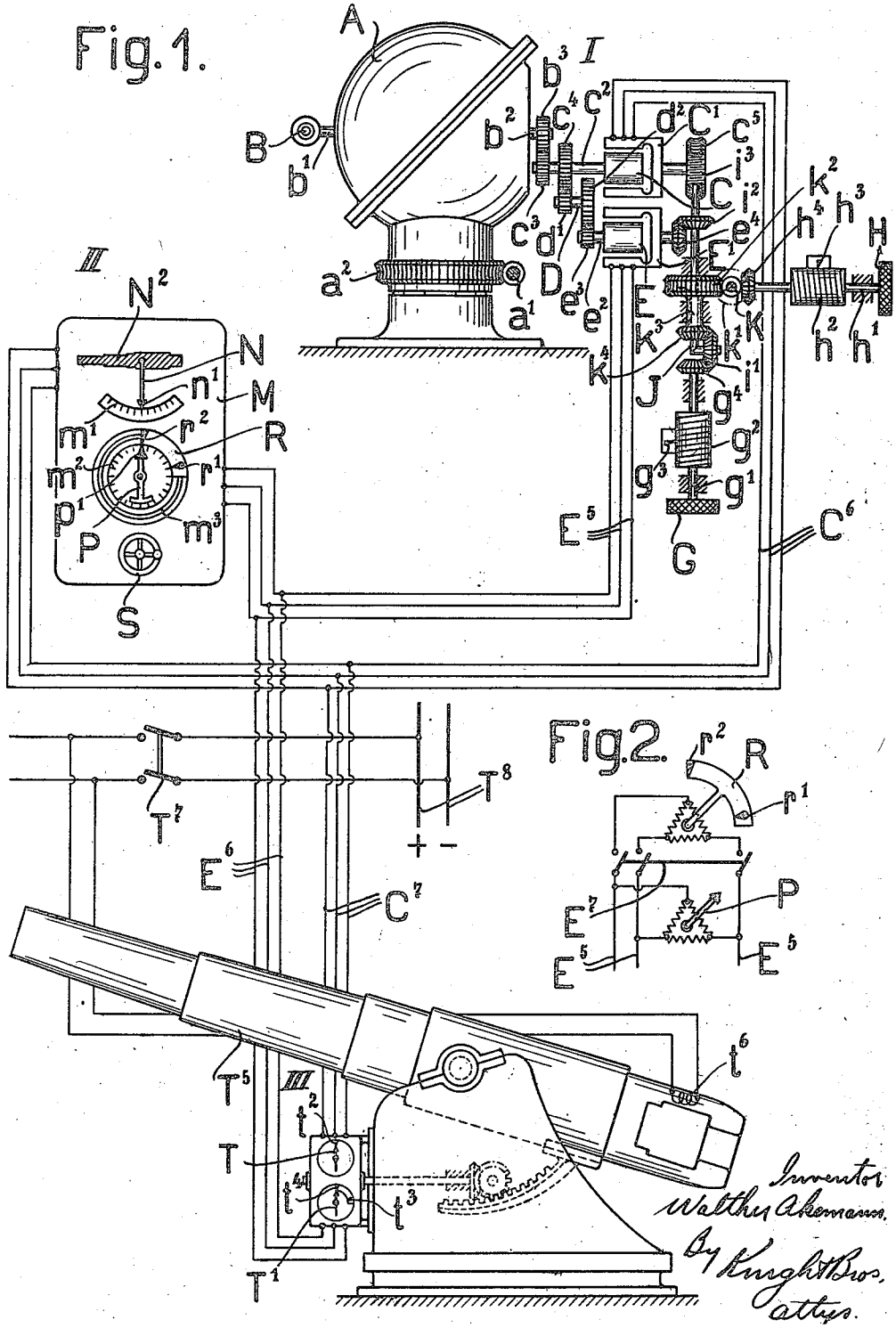

Fig. 2.

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FIRE-CONTROL APPARATUS FOR NAVAL GUNS.

1,379,506. Specification of Letters Patent. Patented May 24, 1921.

Application filed September 3, 1920. Serial No. 408,074.

To all whom it may concern:

Be it known that I, WALTHER AKEMANN, residing at Essen, 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.

This invention relates to fire control apparatus for naval guns, in which a gyroscopic apparatus is provided, which permits of taking into account the influence of the rolling movements of the ship on the angle of elevation of the gun which corresponds to the range of the target. The object of the invention is, first and foremost, to provide a fire control apparatus of this kind which insures a very high degree of readiness for being fired, of the gun which is equipped with it and in which that part of the fire control apparatus which is situated at the controlling station is distinguished by a particularly compact construction.

The invention will be described with reference to the accompanying drawing in which in Figure 1 is shown a diagrammatic representation of a construction of the invention and

Fig. 2 a modification of a detail of the construction shown in Fig. 1.

In the construction illustrated in Fig. 1 the fire control apparatus consists of three separate apparatus connected by electric conductors, of which the first one, denoted by I, is placed at an observing station situated high up in the ship (such as on a mast), the second, denoted by II, at the controlling station and the third, denoted by III, at the gun station.

The apparatus denoted by I placed at the observing station, consists of a casing A which can be rotated about a vertical axis by means of a worm gear a^1 a^2 in the upper part of which is suspended an electrically driven gyroscope and a transmitting apparatus which coöperates therewith together with the corresponding adjusting devices. The outer cardan ring of the gyroscope (not shown) has two horizontal pins b^1 and b^2, one of which (b^1) carries a horizontal sighting telescope B and the other one (b^2) a spur wheel b^3. This spur wheel b^3 gears into a spur wheel c^3 of the same diameter mounted on the armature shaft c^2 of a coarse transmitter comprising the armature C and the corresponding magnet frame C^1. The armature shaft c^2 also positively connected to the armature shaft e^2 of a fine transmitter comprising an armature E and the corresponding magnet frame E^1, by a spur wheel counter shaft gear, c^4, d^1, D, d^2, e^3, in the manner shown in the drawing, so that a rotation of the armature shaft c^2 will result in a corresponding rotation of the armature shaft e^2. The magnet frames C^1 and E^1 of the two transmitters are adjustable for the purpose of adjusting the range of the target and a preliminary ignition angle corresponding to the delay in the firing, the range of the target being adjusted by a milled head G mounted on a shaft g^1 together with an indicating apparatus g^2 g^3, and the preliminary ignition angle, by a milled head H mounted on a shaft h^1 together with an indicating apparatus h^2 h^3. The indicating apparatus g^2 g^3 is so constructed that its adjustment to a particular range of target is corresponded to by an angle of rotation of the magnet frames C^1 and E^1 which differs by a comparatively small fixed value from the angle of elevation given in the tables of ranges and corresponding to the adjusted range of the target. The milled head G is positively connected in the manner shown in the drawing directly to the one central wheel g^4, and the milled head H through a gearing h^4, k^1, K, k^2, k^3, to the other central wheel k^4 of a sun and planet gear, the planet wheel i^1 of which is positively connected by means of the gearing J, i^2, e^4, with the magnet frame E^1 and by means of the gearing J, i^3, c^5, with the magnet frame C^1.

From the transmitter C, C^1 lead conductors C^6 to a coarse receiver (not shown) and from the transmitter E, E^1 lead conductors E^5 to a fine receiver (not shown) both of which are inclosed in the box-like casing M placed at the controlling station II. The armature shaft of the coarse receiver projects through the front wall of the casing M and carries on its free end a downwardly bent pointer N provided with an indicating mark n^1 and also a small representation of the gun barrel situated at the gun station III. The indicating mark n^1 of the pointer N points to a rolling angle scale m^1 inscribed on the front wall of the casing M. The armature shaft of the fine receiver

which also projects through the aforesaid wall of the casing M carries on its free end a pointer P, which with its indicating mark p^1 stands opposite an angle scale m^2 of circular form on the front wall of the casing M. The ratio of transmission existing between the pointers N and P of the coarse and fine receivers is so selected that a movement of the pointer N, which extends over an angular distance determined by the distance apart of two division marks on the rolling angle scale m^1 is corresponded to by a rotation of the pointer P through a full 360°. In the front wall of the casing M is provided a circularly shaped guide groove m^3, concentric with the axis of rotation of the pointer P and surrounding the angle scale m^2 for a short distance. In the guide groove m^3 is pivotally mounted a sliding piece R of segmental shape which extends over one fourth of a circle. The sliding piece is rotated by a hand wheel S mounted on the aforesaid front wall of the casing and positively connected to the sliding piece R by gearing not shown. The sliding piece R is provided in the manner shown in the drawing with two marks r^1 and r^2 the distance of which corresponds to the angle of rotaton of the passage of the hull of the ship from the instant of the return from the rolling movement to the instant of firing and which are intended when the apparatus is used in a manner to be described later to register with the pointer P.

From the conductors E^5 and C^6 branch off in the manner shown in the drawing conductors E^6 and C^7 which lead to a fine and coarse receiver both mounted on the gun but not shown. The mounting of the receivers placed at the gun station III corresponds to the mounting of the receivers placed at the controlling station II and the pointer T of the coarse receiver mounted at the gun accordingly corresponds to the pointer N and the pointer T^1 to the pointer P. To the pointers T and T^1 are assigned in the manner shown in the drawing, marks t^2 and t^3, t^4, the carriers of which are positively connected to the gun barrel T^5 through the elevating gear. The angular distance of the marks t^3 and t^4 from each other is equal to that of the marks r^1 and r^2 and is so calculated that it corresponds to the divergence of the angle of rotation of the transmitter magnet frame C^1 and E^1 from the angle of rotation given in the tables of ranges and corresponding to the adjusted range of the target. In the breech piece of the gun barrel T^5 is placed a winding t^6 intended to excite the firing magnet, the ends of which are connected to a hand operated switch T^7 placed at the controlling station and connected to a source of current T^8.

In order that the working of the above described fire control apparatus may be clearly understood let it be assumed that the telescope B and the gun barrel T^5 have been adjusted for transverse and the ship while the switch is open is executing rolling movements about its horizontal position. Let it be also assumed that at the commencement of the use of the fire control apparatus the ship and the gun barrel assume a horizontal position and consequently the indicating devices at the controlling station II and the gun station III are in the positions shown in the drawing in which the marks t^2 and t^4 are opposite the pointers T and T^1.

If the gun barrel T^5 is to be elevated by the aid of the above described fire control apparatus to the elevation corresponding to the range of the target and fired at an instant which lies in the vicinity of the point of reversal of the rolling movement and say for example by a small period of time prior to the instant in which while rolling, the ship is passing through the points of reversal, the range of the target is first adjusted by rotation of the hand wheel G and read off on the indicating device g^2 g^3. The rotation of the milled head G causes a rotation of the magnet frame C^1 and E^1 which deviates by a small fixed amount from the angle of rotation which corresponds to the angle given in the tables of ranges and corresponds to the range of the target. The rotation of the magnet frames C^1 and E^1 cause in their turn, an accurately true angular rotation of the receivers placed at the controlling station II and at the gun and consequently of the pointers N and P and T and T^1 belonging to these receivers which therefore move away from the marks t^2 and t^4. The gun layer whose duty it is to attend to the elevating gear of the gun barrel T^5 rocks the gun barrel in accordance with the indications of the pointers T and T^1 in such a direction that the marks t^2 and t^4 positively connected thereto again stand opposite the pointers T and T^1 and the gun barrel accordingly assumes an elevation which deviates by the above mentioned fixed value from the angle of elevation given in the tables of ranges and corresponding to the adjusted range of the target.

As the pointers N and P of the receiver placed at the controlling station take part, absolutely true to angle, in the rotation of the magnet frame C^1 and E^1 of the transmitters C, C^1 and E, E^1 placed at the observing station, the pointer N and consequently the representation N^2 of the gun barrel will assume after the adjustment of the transmitting device to the range of the target a sloping position relatively to the central position shown in the drawing and coinciding with the sloping position of the gun barrel T^5 after its adjustment in respect to its horizontal position.

If the ship now rolls out of its middle po-

sition, upwardly for example, the telescope B held in its horizontal position by the gyroscope and consequently also the armatures C and E positively connected thereto make a relative oscillatory movement in respect to the corresponding magnet frames C^1 and E^1 by the amount of the angle of roll. In this oscillatory movement of the armatures C and E, the pointers N and P of the receivers placed at the controlling station and the pointers T and T^1 of the receivers provided on the gun, also take part true to angle. The said receivers and consequently the corresponding pointers N and P and T and T^1 are also at the same time rotated out of the angular position imparted to them at the adjustment of the range of the target through an additional angle which is equal at every instant to the angle of the rotation of the telescope B in respect to the casing A, that is to say, to the angle of roll at the moment. The additional rotation of the pointers N and P and T and T^1 takes place in such a direction that the additional angle is added to or subtracted from the angle corresponding to the range of the target, according as the telescope B is rotated in one direction or the other in the roll of the ship up or down. The pointers N and P and T and T^1 assume therefore at the instant of reversal of the rolling movement a position which deviates from the angle corresponding to the range of the target by the amount of the angle of roll.

The additional rotation of the pointer P situated at the controlling station II is followed by the man whose duty it is to adjust the sliding piece R by turning the hand wheel S, in such a way, that at the instant of the reversal of the rolling movement, that is to say, at the instant of stand-still of the pointer P that the mark r^2 is opposite the pointer P, then stops the hand wheel S. At the same time the man who sees to the elevating gear adjusts the gun barrel T^5 so that the marks t^2 and t^4 positively connected thereto are again opposite the pointers T and T^1 of the receivers on the gun at the instant of the reversal of the rolling movement, that is to say, at the instant of the standstill of the pointers T and T^1. The gun barrel T^5 has accordingly suffered a rotation by an amount which is equal to the angle of roll in addition to its previous elevation and in such a direction that it forms at the instant of the reversal of the rolling movement the same angle with a horizontal plane passing through its trunnions which it included with the same horizontal plane in the horizontal position of the ship after the adjustment to the range of the target. This angle, as has already been stated, is different by a comparatively small fixed value from the angle of elevation proper corresponding to the range of the target, and the angle of elevation imparted to the gun barrel T^5 is greater by the said fixed value than the angle of elevation corresponding to the range of the target when the firing of the shot takes place in the part of the rolling movement which lies above the central floating position. As soon as the man who works the elevating gear has made the last mentioned adjustment of the gun barrel, he stops the driving mechanism of the elevating gear and by means of a signaling device (not shown) gives a corresponding signal to the controlling station.

If the ship now rolls reckoned from the upper point of reversal, toward its central position again, the direction of rotation of the transmitter armatures C and E and therefore also of the pointers N and P and T and T^1 becomes reversed, while the stationary marks r^1 and r^2 and t^3, t^4 retain their position with respect to the ship. The gun layer at the controlling station now observes, as soon as he is informed by the signal given from the gun station of the adjustment of the gun aforesaid, the pointer P as the ship rolls back and by closing the switch T^7 fires the gun at the instant in which the pointer P just passes over the mark r^1. At this instant the pointer T^1 of the fine receiver at the gun is also just opposite the mark t^3 and the ship and the gun barrel which is therefore now at a standstill with respect thereto have accordingly been depressed by an angle which is equal to the aforesaid fixed value by the amount which the elevation of the gun barrel was greater than the elevation proper given in the tables of ranges and corresponding to the range of the target. The firing of the shot therefore takes place at an instant in which the gun barrel T^5 assumes an elevation with respect to a horizontal plane passing through its trunnions which is altered by the momentary oblique position and corresponding to the range of the target.

The above described adjustment of the gun barrel T^5 can also be varied by turning the hand wheel H through a preliminary ignition angle corresponding to the delay in the firing. The adjustment of a preliminary ignition angle is however generally not necessary, as the firing of the shot in the vicinity of the point of reversal of the rolling movement takes place at this point and the movement of the gun barrel therefore proceeds very slowly.

In the fire control apparatus which forms the subject matter of the present invention the apparatus situated at the controlling station II is distinguished by its particularly compact construction. This fact is of material importance in view of the limited accommodation at the controlling stations of war ships, the space in which is crowded up with a number of other appliances.

Furthermore the present invention insures the advantage of a high degree of readiness of fire for the gun equipped therewith. This advantage is based on the fact that in it the transmitting device provided with the telescope B is separated from the firing apparatus situated at the controlling station II. By this means in particular it is possible to place the transmitting apparatus in a particularly favorably situated point of observation (on a mast for instance) which as experience has shown gives a view of the target which is seldom obscured by smoke. Several of these transmitting devices may also be placed at different points on the ship of which each, on the failure to act of one of the others, can cooperate with the firing apparatus at the controlling station II. In like manner several firing devices may be placed about at different points of the ship which coöperate with one or more transmitting devices. Again the high degree of readiness for fire is based on the fact that the man who has to attend to the elevating gear of the gun can ascertain, from the instant of the reversal of the rolling movement by the position of the pointer T^1 with respect to the mark t^3, at what instant the firing of the shot will take place. He can therefore so regulate the manipulation of the elevating gear with certainty that even in the case of rapid rolling movements the adjustment of the gun barrel can be completed before the pointer T^1 reaches the mark t^3.

Without making any change in the essential features of the invention, it would be possible, to so construct this fire control apparatus that the sliding piece R at the controlling station II is not brought by hand into the position as regards angle assumed by the pointer P, but that the movement of this sliding piece R which is to take place is effected automatically on the adjustment of the pointer P. To effect this purpose the conductors E^5 which lead to the first receiver which sets the pointer P in rotation, might (see Fig. 2 of the drawing) lead on through switch E^7 to a second fine receiver of a like kind arranged co-axially with the aforesaid fine receiver and the shaft of which carries the sliding piece R provided with the marks r^1 and r^2.

It is clear without further explanation, that in the modification shown in Fig. 2 of the firing apparatus placed at the controlling station II, the sliding piece R when the switch E^7 is in the closed position, takes part true to angle and automatically, in the rotary movement of the pointer P which takes place on the adjustment of the range of the target, the firing delay and when the ship rolls, so that the man who attends to the firing apparatus only needs to open the switch at the instant of the reversal of the rolling movement of the ship in order to bring the sliding piece to a standstill, while the pointer P executes its rearward rotation.

It would also be possible to cause the sliding piece R to take part in the movement automatically by a mechanical coupling with the pointer P, which would have to be thrown out of action at the instant of reversal of the rolling movement of the ship.

Furthermore the pointer P of the fine receiver situated at the controlling station and also the mark r^1 of the sliding piece R might be placed in the circuit which contains the exciting winding t^6 of the firing magnet and the switch T^7. In this case the firing of the shot would take place automatically as the pointer P passes the mark r^1 if the switch T^7 has been previously brought into its closed position.

Finally the coarse transmitter armature C and the fine transmitter armature E might also each have a pointer assigned to them corresponding to the pointers N and P and a sliding piece constructed to correspond to the sliding piece R made adjustable to the pointer belonging to the fine transmitter armature E.

The firing of the gun would then take place, which would be of advantage if the firing device at the controlling station II was put out of action, by the aid of a switch placed near the transmitting apparatus (I) and from the point at which the observation of the target and the adjustment of the angle of elevation corresponding to the range of the target and the firing delay takes place. The method of working the apparatus does not differ in other respects from that already explained.

Claims:

1. An apparatus of the class described which comprises a sighting device, a gyroscopic apparatus for stabilizing said device, an electrical long distance controlling apparatus embodying transmitters and a range device, two sets of receivers in circuit with said electrical controlling apparatus, two sets of pointers operatable by said receivers, marks coöperating with one set of pointers arranged at the gun and operatively connected to the gun, and indicating its position of elevation, a mark coöperating with a pointer of the other set of pointers, and marks adjustable to correspond to the angle of roll of the ship.

2. An apparatus of the class described which comprises a sighting device, means for stabilizing the sighting device, a transmitter, means including a range device and a second adjusting apparatus for adjusting the transmitter, an electrical long distance controlling apparatus including said transmitter, two sets of receivers in said long distance apparatus, pointers operated by said

receivers, marks operatively connected to the gun barrel and coöperating with one set of pointers, a second pair of marks coöperating with one of the second set of pointers, an electrical firing device mounted on the gun and a circuit including said firing device and one of said pointers and second marks.

3. An apparatus of the class described which comprises a sighting device, a gyroscopic apparatus for stabilizing the sighting device, a pair of transmitters, means for adjusting said transmitters which embodies a range device, means for additionally adjusting said transmitters, an electrical long distance control apparatus embodying a circuit which includes the transmitters and two sets of coöperating receivers, pointers operated by the receivers, marks coöperating with the pointers, means operatively connecting the marks coöperating with the pointers of one set of receivers, to the gun barrel to indicate its position of elevation, a movable member at one of the receivers carrying a pair of marks, means for adjusting said movable member to correspond to the angle of roll of the ship, a firing device for the gun and electrical means connecting a pointer, one of the marks on said movable member and the firing device.

4. An apparatus of the class described which comprises a sighting device, a gyroscopic apparatus for stabilizing said sighting device, an electrical long distance control device which embodies a transmitter and a pair of coöperating receivers, means for adjusting the transmitter, pointers operatable by the receivers, marks coöperating with one set of receivers and operatively connected to the gun elevating gear to indicate its positions of elevation, a rotatable member at one of the receivers carrying a pair of marks, means operatable by the transmitter for moving said member, said pair of marks coöperating with one pointer of the other set of pointers, and adjustable to correspond to the roll of the ship.

5. An apparatus of the class described which comprises a sighting device, a gyroscopic apparatus for stabilizing said sighting device, an electrical long distance control device which embodies a transmitter, a pair of coöperating receivers, means for adjusting the transmitter, pointers operatable by the receivers, marks coöperating with one set of receivers and operatively connected to the gun elevating gear to indicate its positions of elevation, a rotatable member at one of the receivers carrying a pair of marks, means capable of being thrown out of operation for connecting the rotary member to said receiver, said pair of marks cooperating with one pointer of the other set of pointers, and adjustable to correspond to the roll of the ship.

6. An apparatus of the class described comprising a sighting device, a gyroscopic apparatus for stabilizing said device, a pair of transmitters, means for adjusting said transmitters corresponding to the range, two sets of coöperating receivers, means operatively connecting said transmitters to said receivers, pointers operatable by said receivers, marks coöperating with the pointers of one set of receivers, said marks being operatively connected to the gun barrel, a pair of marks coöperating with one of the pointers of the other set of receivers, said pair of marks adapted to be adjusted to correspond to the angle of roll of the ship, the other pointer of this latter set of receivers having rigidly secured thereto a representation of a gun barrel, substantially as and for the purpose set forth.

7. An apparatus of the class described comprising a multiplicity of observing stations, each station provided with a sighting device, a gyroscopic apparatus for stabilizing the sighting device, transmitters, means for adjusting said transmitters, which embodies a range device, a corresponding number of controlling stations, each controlling station being provided with a set of receivers, pointers operatable by said receivers, a pair of marks coöperating with one of said pointers and adjustable to correspond to the roll of the ship, a corresponding number of sets of receivers positioned adjacent the guns, pointers operatable by said receivers, coöperating marks operatively connected to the gun, electrical means connecting said transmitters and receivers, each set of transmitters and corresponding receivers being connected to the next set selectively.

The foregoing specification signed at Essen, Germany, this 17th day of June, 1920.

DR. WALTHER AKEMANN.

In presence of—
HANS GOTTSMANN,
JOHANN DECKERS.