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ORDNANCE CONTROL MEANS.

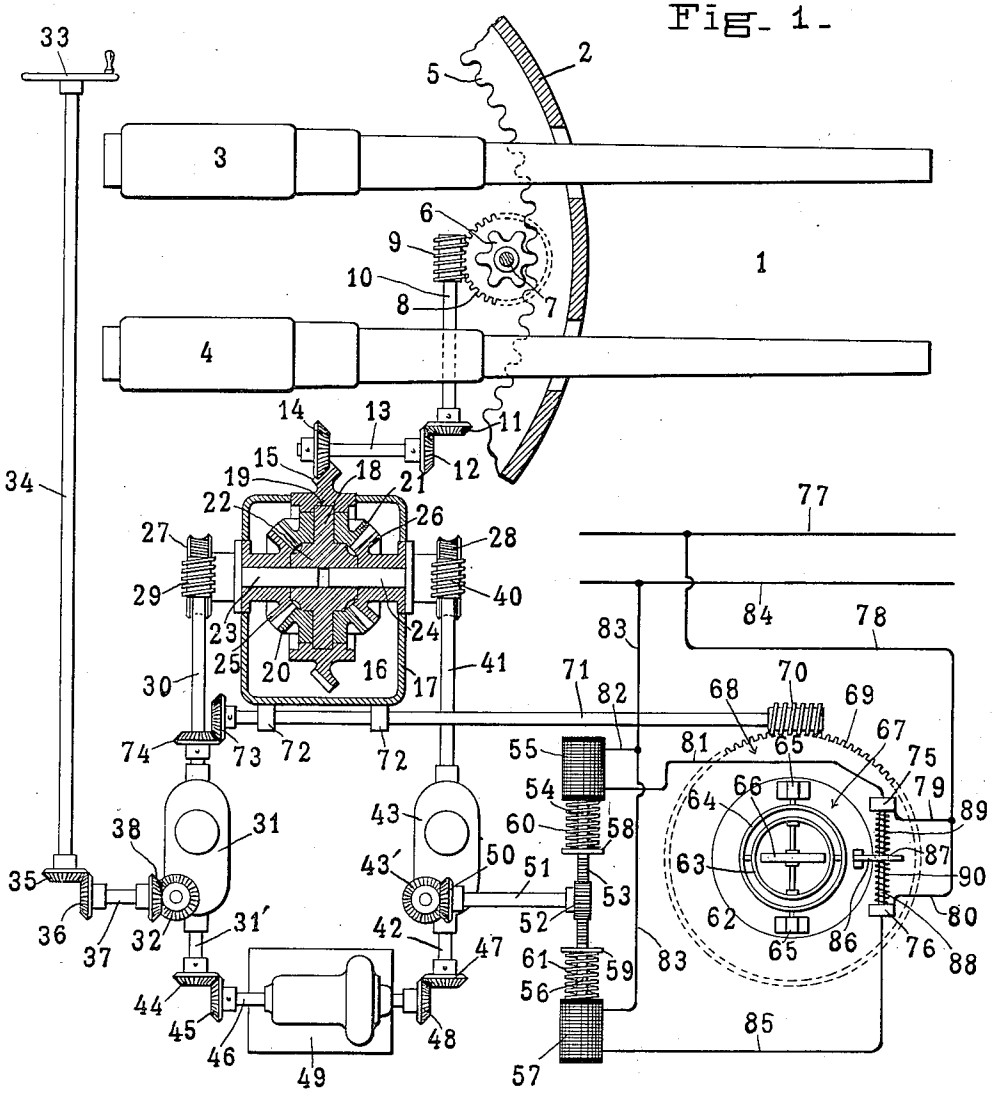
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2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES

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ORDNANCE CONTROL MEANS.

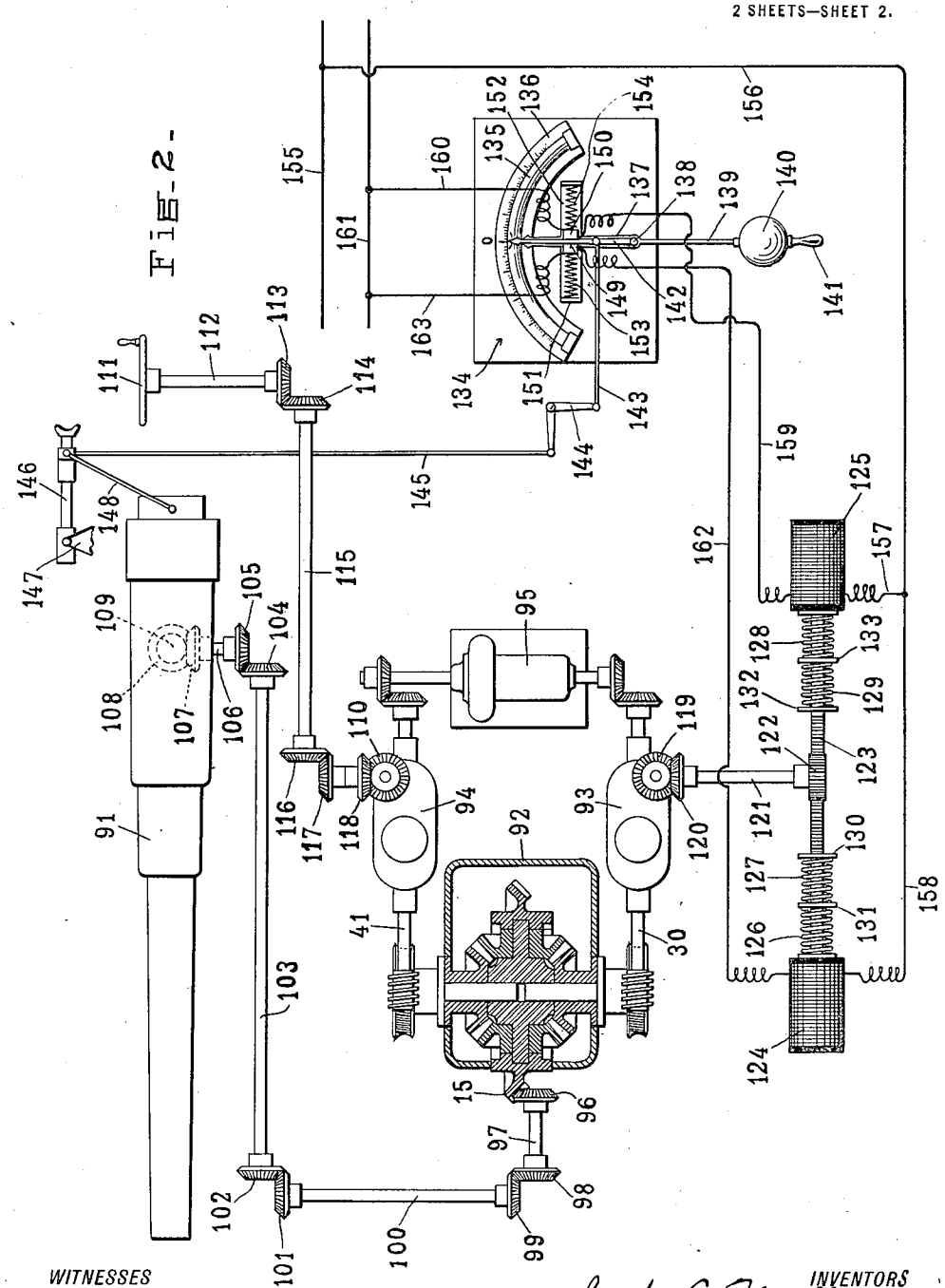
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2 SHEETS—SHEET 2.

Fig. 2.



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ORDNANCE-CONTROL MEANS.

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To all whom it may concern:

Be it known that we, EMANUEL SAQUI and STEPHEN A. FARRELL, residing at New York, in the county and State of New York, and Brooklyn, in the county of Kings, State of New York, respectively, have invented certain new and useful Improvements in Ordnance-Control Means, of which the following is a specification.

The present invention relates to the art of training instruments, and more particularly to the art of training ordnance members on shipboard.

The prime object of the present invention is to provide improved means whereby the member to be trained may be maintained in trained position despite undesirable movements of its support.

The embodiment of the invention disclosed and to be described herein relates to gunnery, and the particular object to be attained is to provide new and improved means whereby an ordnance member may be kept trained upon a target, despite motions of the vessel upon which the gun is mounted, other than the movements of travel of the vessel.

The invention contemplates the provision of means whereby the dimensions of the danger zone are greatly lessened and the chances of hitting the target correspondingly increased, in instances where it is important at all times to keep the piece trained continuously upon the target.

Another and important object of the invention is to provide means for automatically controlling the relative movements of the ordnance member upon shipboard relative to the ship to compensate for the undesirable movement of the latter and to combine with such automatic controlling means a system of manual control such that, by means of the two controls, working in unison, the ordnance member may be kept trained upon the target with a greater degree of accuracy than it has hitherto been possible to attain.

While our invention is not limited to any exact form of mechanism nor to any particular instrument to be trained, we have, for convenience, and as representative of the general idea underlying the same, shown it in the accompanying drawings in connection with an ordnance member to be trained upon shipboard.

In the accompanying drawings, wherein we have illustrated a merely preferred form of various embodiments of our invention Figure 1 is a schematic view illustrating a portion of the gun turret and the mechanism for controlling the operation thereof, whereby the ordnance member may be kept trained upon the target; and Fig. 2 is a similar view showing the mechanism for controlling the elevating and depressing of the ordnance member whereby the same may be kept pointed at the target.

Similar reference characters refer to similar parts throughout the several figures of the drawings.

Referring to the drawings and particularly to the mechanism disclosed in Fig. 1, the reference numeral 1 denotes a portion of the barbette upon which the turret, a portion of which is indicated at 2, is mounted and with respect to which the latter is adapted to revolve, so that the ordnance member may be kept trained upon the target. Within the turret, in the present instance, are mounted a pair of ordnance members indicated at 3 and 4 respectively, the gun carriages and platform for supporting the same being omitted in the interest of clearness of illustration. Before proceeding further, it should be understood that the barbette is the only portion of the mechanism disclosed in the drawings which remains stationary with respect to the ship, the remainder of said mechanism being carried within the turret and revolving with it.

The barbette as will be noted, is provided upon its inner edge with a plurality of radially disposed gear teeth 5, with which meshes gear wheel 6 carried upon a suitable shaft 7, suitably journaled within the turret. Shaft 7 has fixed thereon a worm wheel 8 which, in the present instance, is rotated by means of the worm 9 upon the shaft 10, said shaft at its opposite ends being provided with bevel gear wheel 11, which

meshes with similar gear 12 upon the shaft 13. Shaft 13, at its opposite end, carries a bevel gear wheel 14 which meshes with and is driven by the bevel gear wheel 15, the latter forming a part of the differential system of gearing indicated generally at 16. This system of differential gearing which, as shown, may be inclosed in a hermetically sealed casing 17, adapted to be filled with a lubricant, comprises a shaft 18, either end of which seats in a suitable socket 19 formed within the inner periphery of the gear 15, so that when said shaft is revolved in a direction transverse to its axis, as will hereinafter be explained, gear wheel 15 is revolved upon its axis to drive the gear wheel 14, and its associated train of mechanism. Shaft 18 near each end has journaled thereon bevel gear wheels 20 and 21 respectively. Extending transversely through the casing 17 and suitably journaled therein and in a bearing formed by an enlarged portion 22 of the shaft 18 are shafts 23 and 24 respectively, said shafts being mounted for independent revolution. Shaft 23 carries bevel gear wheel 25, which meshes with each of the gear wheels 20 and 21 and shaft 24 carries a gear wheel 26 which also meshes with each of the gear wheels 20 and 21; gear wheels 25 and 26 being disposed in opposed relation as shown.

Shaft 24 at its outer end is provided with a worm wheel 27, and shaft 24 at its outer end with a worm 28. Meshing with worm gear 27 and adapted to drive the same, is a worm 29 fixed upon a shaft 30 which latter shaft is adapted to be driven in either direction by means of the system of hydraulic control shown generally at 31. This system of automatic control, the details of which have been omitted, may consist of the well known hydraulic control now utilized in ordnance control upon shipboard wherein the direction of rotation as well as the relative speed of the driven shaft with respect to the driving shaft are controlled by means of a device known as a "tilting box." This tilting box, in accordance with its position within the casing, so controls the fluid under pressure therein that the speed or direction of rotation of the driven shaft which, in the present instance, is indicated at 30, is regulated with respect to the driving shaft which is indicated herein at 31'. This system of automatic control being well known in the art, will not be specifically described herein; it being sufficient for the purpose of this specification to state that the relative speed of the shaft 30 with respect to the shaft 31' may be controlled by the tilting box by means of a bevel gear wheel 32 which operates mechanism (not shown) for changing the position of the tilting box.

In the present embodiment of our invention the tilting box mechanism, a portion of which has been indicated at 32, is adapted to be controlled manually by hand wheel 33, upon shaft 34, the latter at its lower end carrying bevel gear wheel 35, meshing with bevel gear wheel 36 upon shaft 37, and the latter carrying the bevel gear wheel 38 which meshes with the bevel gear wheel 32.

Meshing with the worm gear 28 is a worm 40, upon the shaft 41, which is adapted to be driven from the driving shaft 42 through the instrumentality of a system of hydraulic control indicated generally at 43, such system being similar in all respects to that indicated at 31. The tilting box of this system is operated through means connected with the bevel gear wheel 43'.

Shaft 31' carries a bevel gear wheel 44, which meshes with bevel gear wheel 45 upon shaft 46 and shaft 42 is provided with a bevel gear wheel 47 which meshes with a bevel gear wheel 48, also fixed upon the shaft 46. Shaft 46 is adapted to be constantly rotated at a uniform speed by means of a suitable motor indicated generally at 49, which motor may be operated by current furnished by the ship's mains. The connection therewith with the motor is not shown in the present illustration. It will be noted that in the construction next above described the shafts 31' and 42 will be rotated by means of the motor 49 in opposite directions and at the same speeds.

The position of the tilting box of the system of hydraulic control 43, in the present instance, is adapted to be automatically controlled by mechanism which will now be described.

50 indicates a bevel gear wheel upon the shaft 51, the opposite end of which carries a spur gear wheel 52, which meshes with the teeth of the longitudinally reciprocating rack bar 53. One end 54 of the rack bar 53 forms the core of the solenoid coil 55, and the opposite end 56 of said rack bar forms a core of the solenoid coil 57. Interposed between suitable abutments 58 and 59, respectively, fixed upon the rack bar 53 and the solenoid coils 55 and 57 are extensile springs 60 and 61. These springs are so constructed and adjusted as to exert equal stresses against the abutments 58 and 59 whereby the rack bar 53 is maintained in the normal position shown in the drawings. From the construction above described it should be understood that a reciprocatory movement of the rack bar 53 in either direction will effect a change in the position of the tilting box of the system of automatic control 43, thereby varying the speed of rotation of the driven shaft 41 with respect to the driving shaft 42.

The means for regulating the current supplied to the solenoid coils 55 and 57, is a gyrostat denoted generally at 62, comprising the inner and outer gimbal rings 63, 64,

the latter of which is positioned upon suitable supporting blocks 65, and the former upon suitable pivots carried by gimbal ring 64. Journaled within the gimbal ring 63 is a gyrostatic member which in the present instance takes the form of the wheel 66. This wheel which may be revolved by any suitable means (not shown) at any desired speed, tends when so rotated to remain in any predetermined position. In the present instance the supporting blocks 65 of the gyrostat are carried upon a freely revoluble base member 67, which, when the gyrostatic wheel is in operation also tends through the influence of said gyrostatic wheel to remain in a predetermined rotative position despite any rotative movement of the turret.

68 denotes a rotative member which may take the form of a table, the periphery of which is provided with worm teeth 69 with which meshes the worm 70 carried by the shaft 71, said shaft being partially supported by means of the journal blocks 72 carried by casing 17. The opposite end of this shaft 71 is provided with bevel gear wheel 73, which meshes with a similar bevel gear 74 upon the shaft 30. The purposes of the driving connection interposed between the wheel 68 and the shaft 30 will be pointed out hereinafter.

Suitably carried upon the wheel 68 and arranged in opposed relation thereon, are variable resistance members 75 and 76. Inasmuch as these variable resistance members are identical in construction, a description of one will suffice to impart a clear understanding of this portion of our invention. Each variable resistance may comprise a box, the front wall of which is yieldable and may consist of a flexible metallic diaphragm or movable disk, the space between the front and rear walls being loosely filled with particles of carbon or equivalent resistance material, which when brought into more or less intimate contact interposes a varying resistance to the passage of an electric current. The yieldable or movable front wall of each variable resistance member is suitably insulated from the rear wall thereof, the only electrical connection between the two being established by means of the loosely disposed particles of carbon or other suitable resistance material. Leading from the side 77 of the ship's mains is a wire 78 which is connected by means of the wire 79 with the front wall of the variable resistance member 75, wire 78 being also connected with the front wall of the variable resistance 76, by means of a wire 80. Leading from the rear wall of the variable resistance member 75 is a wire 81 which connects with one end of the solenoid coil 55, the opposite end of said coil being connected by means of a wire 82 with a wire 83 which leads to the opposite side 84 of the ship's mains. A wire 85 connects with the rear wall of the electrical resistance member 76, and one end of the solenoid coil 57, the opposite end of said coil being connected with the wire 83, the latter as above described being connected with the side 84 of the ship's mains.

Extending outwardly from a suitable support upon base member 67 of the gyrostat is a finger 86, said finger extending midway between the variable resistance members 75 and 76 and provided with a slot indicated in dotted lines at 87, through which extends a rod 88, the opposite ends of said rod being fixed to the central portions of the movable front walls or diaphragms of the resistance members 75 and 76. An extensile spring 89 is interposed between the finger 86 and the front wall of the variable resistance 75, and a similar spring 90 is interposed between said finger 86, and the variable resistance 76. Springs 89 and 90 are so constructed and adjusted that when the finger 86 is in the position shown in the drawings they will exert an equal stress upon the diaphragms of the variable resistance members so that equal amounts of current from the ship's mains will flow through the resistance material within said variable resistance members.

The object of the construction above described is to compensate for such rotative movements of the support of the ordnance member as occur during undesirable movements of the vessel known as yawing, and also in turning of the vessel relative to the vertical axis. The manner in which the mechanism as described above compensates for such undesirable movements of the vessel may now be understood.

Supposing the ordnance member to be trained upon the target with the parts in the position shown, the motor 49 to be in operation, and the tilting boxes of the systems of hydraulic control 21 and 43 to be so disposed that the shafts 30 and 41 are stationary, the gear wheel 15 will therefore remain stationary, it being understood that when the shafts 30 and 41 are rotated at different speeds the gear wheel 15 will be revolved in one direction; the particular direction of revolution being determined by which of the shafts 30 or 41 is revolving at the greater speed. In other words when it is desired to move the turret in either direction it is only necessary to differentially rotate the shafts 30 and 41, whereupon the differential gearing indicated generally at 16 through the connected chain of mechanism will revolve the turret in one direction. Any yawing or rotative movement of the ship as above described will cause a corresponding movement of the table 68, and likewise a corresponding movement of the variable resistance members 75 and 76. Inasmuch however as the gyrostatic member 66 tends to maintain the base member 67 in a predeter-

mined position, a movement of either of the variable resistance members 75 or 76 to or from the finger 86 would tend to compress the carbon particles in one of said members and to release in a corresponding degree the carbon particles in the other member. Thus the current flow will be increased through one of the variable resistance members and decreased through the other, and the solenoid coils 55 and 57 will be differentially energized. This differential energization of the solenoid coils will effect a longitudinal movement of the rack member 53 which, through the spur gear 52 and shaft 51, bevel gear wheel 50 and 43', will so change the position of the tilting box in the system of hydraulic control 43 that the speed of shaft 41 will either be increased or decreased relative to the speed of the shaft 30 in such proportion that the ordnance member will tend to remain upon the target notwithstanding the tendency to be carried therefrom, owing to the undesirable movements of the ship. In other words, the purpose of the system of automatic control which has been described is intended as nearly as practicable to hold the ordnance member in a stationary position relative to the target, despite the undesirable movements of the vessel above specified.

Owing to the complexity of the undesirable movements of the vessel any failure of the system of automatic control to maintain the ordnance member trained upon the target may be corrected by means of a system of manual control operated by the hand wheel 33 which through its connected chain of mechanism will vary the position of the tilting box in the system of hydraulic control 31 as will cause such differential movement of the shafts 30 and 41 as will maintain the gun trained upon the target. In order that this system of manual control may operate without interference from the automatic control the effect of the manual rotation of the shaft 34 is compensated for by the shaft 71, which is rotated by shaft 30. The worm 70 rotates the wheel 68, thereby preventing such pressure on the diaphragms of the variable resistance members 75 and 76 as would tend to negative the effect of the manual control.

Referring now to the embodiment of our invention illustrated in Fig. 2 wherein we have shown it adapted for gun pointing, 91 indicates the ordnance member, the support of which has been omitted in the interest of clearness of illustration. 92 indicates a system of differential gearing similar in all respects to that illustrated in Fig. 1; and 93 and 94, respectively indicate systems of hydraulic controls similar to those illustrated in Fig. 1. These systems of hydraulic control are driven as by means of a common motor 95 which is also similar to that illustrated at 49 in Fig. 1. The ordnance member is raised and depressed by means of a train of gearing comprising the bevel gear wheel 96 which meshes with bevel gear wheel 15 of the differential gearing, the shaft 97, bevel gear 98, bevel gear 99, shaft 100, bevel gears 101 and 102, shaft 103, bevel gears 104 and 105, shaft 106 and bevel gear shown in dotted lines at 107, which meshes with the bevel gear 108 carried by the trunnion 109 of the gun. The tilting box of the system of hydraulic control 24 is controlled by the bevel gear 110, and this gear is adapted to be manually operated from the hand wheel 111 through the following train: shaft 112, bevel gears 113 and 114, shaft 115, bevel gears 116 and 117, bevel gear 118.

The system of hydraulic control 93 is adapted to be controlled automatically through an operation of the tilting box thereof, the bevel gear of which is shown at 119 and meshing with this bevel gear is a bevel gear 120 upon a shaft 121 which carries gear 122, the same meshing with the longitudinally movable rack bar 123. This rack bar, which is similar to that shown at 53 in Fig. 1 has its ends formed into cores which enter the coils 124 and 125. The rack bar 123 is maintained in the position shown by means of extensile springs 126, 127, 128 and 129.

130 indicates an abutment fixed upon the rack bar and 131 indicates an adjustable abutment screw threaded upon said rack bar. Spring 127 as interposed between abutments 130 and 131 and spring 126 between abutment 131 and the end of the solenoid coil 124. It will be obvious that by rotating abutment 131, the tension of the springs 126 and 127 may be varied at will. An abutment 132 similar to that shown at 130 is fixed upon the rack bar at the other side of the spur gear and the adjustable abutment 133 similar to that shown at 131 is interposed between the springs 128 and 129 for a similar purpose. It will be obvious that by means of the adjustable abutments the tension of the springs may be so adjusted that the rack bar may be held in the normal position shown in the drawings.

The reference numeral 134 denotes generally a clinometer which is fixed to the turret in the plane of the gun. This clinometer comprises the curved spirit tube 135 mounted upon the graduated scale 136, and the bubble of the spirit tube is adapted normally to rest in the highest point of said tube and in the zero position, as shown, when the support of the clinometer lies in a true horizontal plane. The indicating pointer of the clinometer is shown at 137 and is pivotally mounted to the base or support at 138.

139 indicates the shaft of the pendulum the weight of which is shown at 140, said portion forming part of the pointer 137 of the clinometer, and being in vertical alinement therewith, so that the pointer always

tends to remain in a perpendicular position and in registry with the bubble of the spirit tube when the clinometer is in a true horizontal plane. A handle 141 is fixed to the pendulum weight 140 by means of which the pendulum may be manually controlled if necessary.

Mounted on the pivot 138 of the pendulum is a second pointer 142, the upper end of which is adapted to register with the scale of the clinometer. This pointer is connected as by means of a rod 143, bell crank lever 144, rod 145 with a sighting instrument 146 which is arranged in a predetermined relation to the ordnance member 91. This sighting instrument is pivoted between the fixed supports, a portion of which is shown at 147 and is connected with the gun as by means shown at 148, so as to partake of the movements thereof when the same is elevated or depressed. It will be understood that the connection with the gun shown herein is purely diagrammatic, it being only necessary for the purposes of this specification to state that the sighting instrument is arranged in predetermined relation with the ordnance member.

149 and 150, respectively indicate variable resistance members which are constituted by carbon boxes such as are shown at 75 and 76 in Fig. 1; and the operation thereof is similar in all respects to the operation which has already been described. These variable resistance members are carried by the pointer 142 on opposite sides thereof. Interposed between the front walls or movable diaphragms of these variable resistance members 149 and 150 and upstanding flanges 151 upon laterally extending arms 152 upon the pointer 137 are extensile springs 153 and 154. Leading from one side 155 of the ship's mains is a wire 156 which connects as by means of the wires 157 and 158 with the solenoid coils 125 and 124, respectively. Leading from the opposite end of the solenoid coil 125 is a wire 159 which connects with the front wall of the variable resistance member 150, and leading from the rear wall thereof is a wire 160 which connects with the opposite side 161 of the ship's mains. Leading from the opposite end of the solenoid coil 124 is a wire 162 which leads to the front wall of the variable resistance member 149, the rear wall of which is connected by means of wire 163 with the side 161 of the ship's mains.

Having thus described the construction of this form of embodiment of our invention the operation thereof may now be understood. It will be understood that the springs 153 and 154 which act upon the variable resistance members will be so adjusted that normally such proportionate amount of current will flow through the solenoid coils 124 and 125 as will maintain the rack bar in the position shown; it being understood that the tilting boxes of the systems of hydraulic control are normally in such position as will allow shafts 30 and 41 to remain stationary.

Assuming first that the parts are in the position shown, that the ship is on an even keel with no motion whatever and it is desired to change the range. The sight-setter will then either elevate or depress the sighting instrument the desired number of degrees, which will be indicated upon a scale not shown herein. This operation through the train of mechanism already described will move the pointer 142 a corresponding number of degrees upon the scale of the clinometer 134. This will result it will be noted, owing to the pendulum remaining in a vertical position, in impressing stress upon one of the carbon boxes with a corresponding release of stress upon the other, whereupon the solenoid coils 124 and 125 will be differentially energized and the rack bar 123 caused to move in one direction, such movement of the rack bar effecting a corresponding movement of the tilting box of the system of hydraulic control 97. The differential gearing will thereupon through the mechanism already described either elevate or depress the ordnance member to the desired range, and such movement will continue until the pointer 142 has returned to the position shown in the drawings, and with the sighting instrument again in a horizontal position and trained upon the target. The gun will then be at the desired range and owing to the fact that the resistance members 149 and 150 will then discharge an equal amount of current from the ship's mains to the solenoid coils 124 and 125, a movement of the ordnance member through the operating means will be arrested.

Supposing now that the ordnance member is partaking of the undesirable movements of the vessel, the clinometer will likewise partake of such movements, but the pendulum which is attached to the pointer 137 will tend to remain in a vertical position. The pointer 142 will therefore be carried out of register with the bubble, which operation will impress differential pressures upon the diaphragms of the variable resistance members, whereupon the system of differential gearing will again be set in motion in such direction as will tend to hold the ordnance member upon the target despite the undesirable movements of the vessel. During this operation we contemplate manually operating the pendulum by means of the handle 41, so that the pointer thereof will always register exactly with the bubble of the clinometer, it having been found that due to the inertia of the parts, and the differences in the amplitude of vibration between the pendulum and the

rolling movement of the ship, that a pendulum such as described will not at all times remain in vertical position. However this may be corrected by grasping the pendulum and holding it in such exact registry as will always keep the gun upon the target through this system of control, which has been above described. In other words the manual control compensates for any deficiency in the system of automatic control, and so affects the operation of the controlling means that the ordnance member will tend to keep trained upon the target. In short it may be said that the system of automatic control described, acting in conjunction with the manual control which may be exercised through the medium of the pendulum is intended to hold the ordnance member as nearly stationary as possible which will have the same effect as if the gun were mounted upon a stable support despite the undesirable movements of the ship, whereupon the gun pointer through his manipulation of the handle 111 may easily take care of such slight errors of said combined automatic and manual control as will always keep the gun trained upon the target.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention, which as a matter of language, might be said to fall therebetween.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent, is:

1. The combination of a member to be trained, and means for shifting the position of said member, comprising differential gear mechanism, variable speed controlling means interposed between the motor and each side of said differential gearing, means for manually affecting the operation of one of said variable speed controlling means, and means for automatically affecting the operation of the other of said variable speed controlling means.

2. The combination of a member to be trained, means for shifting the position of said member, comprising a system of differential gearing, means for connecting said differential gearing with the member to be trained, driving means, means for connecting each side of said differential gearing with said driving means, including a variable speed controlling system, means for manually affecting the operation of one of said variable speed controlling systems, and means for automatically affecting the operation of the other of said systems.

3. The combination of a member to be trained, mounted upon a support subject to undesirable movements, means for moving said member, comprising motor means, means interposed between the motor means and the member to be trained comprising differential gearing, a system of variable speed control working upon each side of the differential gearing, means for manually changing the operation of one of said systems of speed control, and means controlled by the undesirable movements of the support for affecting the operation of the other of said systems of speed control.

4. The combination of a member adapted to be trained upon shipboard, and means for shifting the position thereof, comprising a motor, a pair of systems of variable speed control, both of which are connected with said motor, a system of differential gearing, means for connecting each side of said differential gearing with one of said systems of variable speed control, means for effecting a driving connection between said differential gearing and the member to be trained, and means for varying the operation of each of said systems of control.

5. The combination of a member adapted to be trained upon shipboard, and means for shifting the position thereof, comprising a motor, a pair of systems of variable speed control, both of which are connected with said motor, a system of differential gearing, means for connecting each side of said differential gearing with one of said systems of variable speed control, means for effecting a driving connection between said differential gearing and the member to be trained, and manually operated means for varying the operation of one of said systems of speed control, and automatically controlled means for varying the operation of the other thereof.

6. The combination of a member adapted to be trained upon shipboard, and means for shifting the position thereof, comprising a motor, a pair of systems of speed control, both of which are connected with said motor, a system of differential gearing, means for connecting each side of said differential gearing with one of said systems of speed control, means for effecting a driving connection between said differential gearing and the member to be trained, manually operated means for varying the operation of one of said systems of speed control, and inertia means for varying the operation of the other of said systems of speed control operable during the undesirable movements of the vessel.

7. The combination of a member to be trained mounted upon a support subject to undesirable movements, and means for moving said member relative to said support during the undesirable movements of the latter and for reversing the direction of movement of said member simultaneously with the reversal of the direction of movement of said undesirable support, comprising a motor, a system of differential gearing, means for connecting the motor with each side of said system of differential gearing, including a pair of independently operating systems of speed control, and a driving connection between the system of differential gearing and the member to be trained.

8. The combination of a member to be trained mounted upon a support subject to undesirable movements, and means for moving said member relative to said support during the undesirable movements of the latter and for reversing the direction of the movement of said member simultaneously with the reversal of the direction of movement of said undesirable support, comprising a motor, a system of differential gearing, means for connecting the motor with each side of said system of differential gearing, including a pair of independently operating systems of variable speed control and manually operated means for varying the operation of one of said systems of speed control.

9. The combination of a member to be trained mounted upon a support subject to undesirable movements, and means for moving said member relative to said support during the undesirable movements of the latter and for reversing the direction of the movement of said member simultaneously with the reversal of the direction of movement of said undesirable support, comprising a motor, a system of differential gearing, means for connecting the motor with each side of said system of differential gearing, including a pair of independently operating systems of hydraulic control, and inertia means for varying the operation of one of said systems of hydraulic control.

10. The combination of a member to be trained mounted upon a support subject to undesirable movements, and means for moving said member relative to said support during the undesirable movements of the latter and for reversing the direction of the movement of said member simultaneously with the reversal of the direction of movement of said undesirable support, comprising a motor, a system of differential gearing, means for connecting the motor with each side of said system of differential gearing, including a pair of independently operating systems of hydraulic control, manually operated means for varying the operation of one of said systems of hydraulic control, and automatic means for varying the other of said systems of hydraulic control.

11. The combination of a member to be trained mounted upon a support subject to undesirable movements, and means for moving said member relative to said support during the undesirable movements of the latter and for reversing the direction of the movement of said member simultaneously with the reversal of the direction of movement of said undesirable support, comprising a motor, a system of differential gearing, means for connecting the motor with each side of said system of differential gearing, including a pair of independently operating systems of speed control, manually operated means for varying the operation of one of said systems of speed control, and inertia means operable during the undesirable movements of the support for varying the operation of the other of said systems of speed control.

12. The combination of a member to be trained, mounted on a support subject to undesirable movements, and means for shifting the position of said member to hold the same relatively stationary with respect to the support during said undesirable movements, comprising a system of differential gearing, a driving connection interposed between said system of differential gearing and said member, driving means, and a pair of independently operated speed controlling means interposed between the driving means and said system of differential gearing.

13. The combination of a member to be trained, mounted on a support subject to undesirable movements, and means for shifting the position of said member to hold the same relatively stationary with respect to the support during said undesirable movements, comprising a system of differential gearing, a driving connection interposed between said system of differential gearing and said member to be trained, driving means, a system of speed control interposed between said driving means and one side of said system of differential gearing, and a system of speed control interposed between the motor means and the opposite side of said system of differential gearing.

14. The combination of a member to be trained, mounted on a support subject to undesirable movements, and means for shifting the position of said member to hold the same relatively stationary with respect to the support during said undesirable movements, comprising a system of differential gearing, a driving connection interposed between said system of differential gearing and said member, driving means, a pair of independently operated speed controlling means interposed between the driving means, and said system of differential

gearing and means for manually varying the operation of one of said systems of speed control.

15. The combination of a member to be trained, mounted on a support subject to undesirable movements, and means for shifting the position of said member to hold the same relatively stationary with respect to the support during said undesirable movements, comprising a system of differential gearing, a driving connection interposed between said system of differential gearing and said member, driving means, a pair of independently operated speed controlling means interposed between the driving means and said system of differential gearing, and inertia means operable during the undesirable movements of said support for varying the operation of one of said systems of speed control.

16. The combination of a member to be trained, mounted on a support subject to undesirable movements, and means for shifting the position of said member to hold the same relatively stationary with respect to the support during said undesirable movements, comprising a system of differential gearing, a driving connection interposed between said system of differential gearing and said member, driving means, a pair of independently operated speed controlling means interposed between the driving means and said system of differential gearing, manually controlled means for varying the operation of one of said systems of speed control at will and inertia means operable automatically during the undesirable movements of said support to vary the operation of the other of said systems of speed control.

17. The combination of a member to be trained mounted upon a support subject to undesirable movements, motor means, speed controlling means interposed between the motor means and said member, manual means for varying the operation of the speed controlling means, and gyrostatic means operating upon said speed controlling means for varying the operation thereof.

18. The combination of a member to be trained mounted upon a support subject to undesirable movements, motor means for shifting the position of said member, a plurality of speed controlling means interposed between the motor means and said member located in the driving connection thereof, manual means for varying the operation of one of said speed controlling means, and means operated by the undesirable movements of the support for varying the operation of the other of said speed controlling means.

19. The combination of a member to be trained mounted upon a support subject to undesirable movements, motor means for shifting the position of said member, a plurality of speed controlling means interposed between the motor means and said member located in the driving connection thereof, manual means for varying the operation of one of said speed controlling means, and gyrostatic means operated by the undesirable movements of the support for varying the operation of the other of said speed controlling means.

20. The combination with a member to be trained mounted upon a support subject to undesirable movements, of means for changing the position of said member, and a speed control for said means comprising a differential gearing, and means controlled by the undesirable movements of the support for automatically varying the operation of said differential gearing.

21. The combination with a member to be trained mounted upon a support subject to undesirable movements, of power means for changing the position of said member relatively to said support, a speed control interposed between the power means and said member, and means controlled by the undesirable movements of the support for automatically continually varying the operation of said speed control throughout any undesirable movement of said support.

22. The combination with a member to be trained mounted upon a support subject to undesirable movements, of power means for changing the position of said member relatively to said support, a speed control interposed between the power means and said member, and means for automatically varying the operation of said speed control, being effective in gradually increasing degree as said support moves toward an undesirable position.

In testimony whereof we have affixed our signatures in the presence of two witnesses.

EMANUEL SAQUI.
STEPHEN A. FARRELL.

Witnesses:
A. S. HONIGSBERG,
NATHALIE THOMPSON.