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GUN CONTROL COMPENSATING MECHANISM

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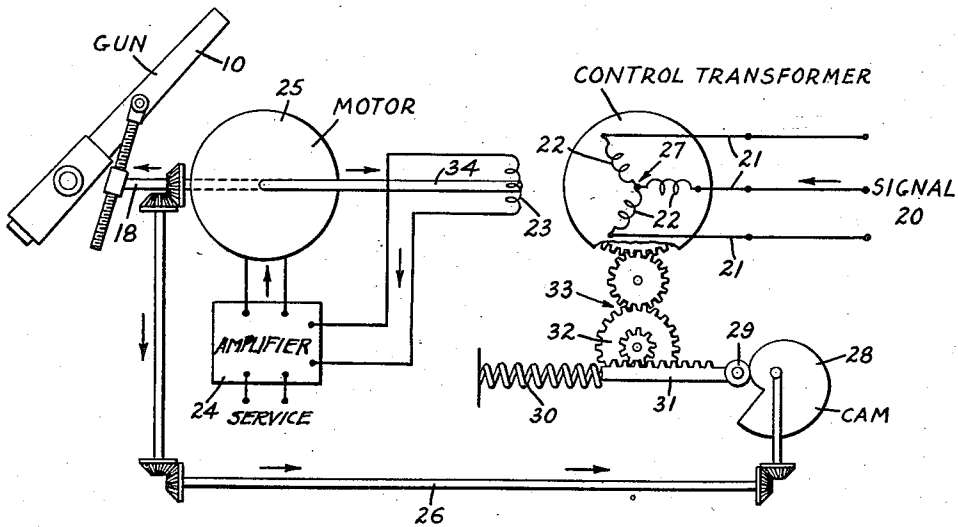
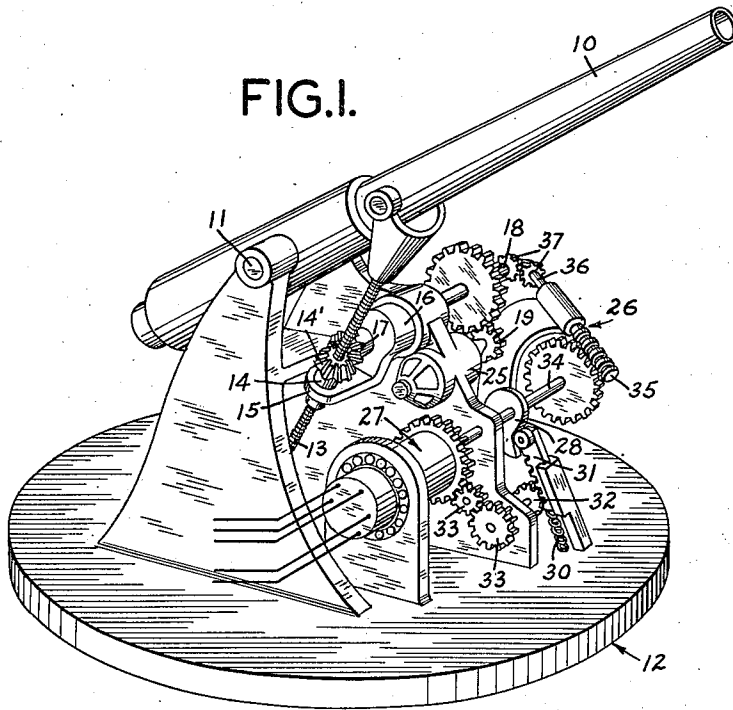


FIG. 2.

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GUN CONTROL COMPENSATING
MECHANISM

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2 Claims. (Cl. 89-41)

1

This invention relates to gun control mechanism, and has particular reference to mechanism for correcting the movement of guns, although the invention is not limited to that use.

Guns of the class having the nut and screw type of elevating mechanism, which includes many guns of such large size and weight as to require it, have a non-linear elevation characteristic due to the change in the effective crank arm with change of the elevation angle and the accompanying distortion of the gear drive. As the result, the gun elevating motor linearly follows the elevation of a director or calculator dummy gun, for example, but the gun itself does not, and consequently serious errors in gun elevation occur.

In accordance with the present invention, a correcting mechanism is provided for automatically compensating for the change in the effective crank arm and accompanying gear drive distortion of the nut and screw type of elevating mechanism, so that the desired linear elevation characteristics of the gun are obtained and accurate elevation angle follow-up results.

The preferred embodiment of the invention includes a cam shaped to correct the non-linear error and actuated in accordance with the elevation movements of the gun for correspondingly adjusting the angular relation between the stator and the rotor of an elevation angle signal-receiving control transformer, whose corrected rotor secondary winding voltages are amplified and impressed on the gun elevating motor, which drives the gun through the proper transmitted elevation angle and then deenergizes itself by rotating the transformer rotor to non-inductive or "null" position.

It will be seen that the operation characteristic of a nut and screw type gun elevation mechanism is rendered linear and therefore accurate in a simple and reliable manner with the control correcting mechanism of this invention, further details of which will be apparent upon examination of the accompanying drawings, in which:

Figure 1 is a perspective view of a gun provided with a corrected nut and screw type elevating mechanism in accordance with the present invention; and

Fig. 2 is a schematic and wiring diagram of the control mechanism thereof.

Referring to Fig. 1 of the drawings, numeral 10 designates a gun mounted for angular motion in elevation about trunnions 11 on a mount 12 supported on the deck of a ship, for example. Gun 10 is elevated by the common nut and screw mechanism, including the screw 13 non-rotatably

2

pivoted at its upper end on the barrel of the gun 10 and passing through a nut 14. Nut 14 is rotatably mounted on a thrust bearing 15 carried by a yoke 16 pivoted on the mount 12 for oscillation about the axis of drive bevel gear 17 meshing with bevel gear 14' on nut 14. Elevation drive bevel gear 17 is mounted on elevation shaft 18 journaled on the mount 12 and driven by elevation motor 25 through spur bearing 19, as shown. Referring particularly to Fig. 2, the elevation angle signal from the director or calculator is impressed on terminals 20 and supplied through flexible leads 21 to the three-phase windings 22 of the stator 27 of a self-synchronous control transformer or receiver so as to produce a rotating field therein, as is well known. Located within this field is the single winding rotor 23 whose induced current is amplified in a conventional electronic amplifier 24 which feeds gun elevating motor 25, connected by gears 19, shaft 18 and bevel gears 17 and 14' to elevating nut 14 which accordingly advances or retracts screw 13 to raise or lower gun 10 in elevation.

The gun elevation shaft 18, so driven by motor 25, is connected to rotor 23 and by shafting 26 to a cam 28 whose follower 29 is held in contact therewith by spring 30. As follower 29 is actuated by cam 28 it advances or retracts a rack 31 to rotate pinion 32, which is connected by gearing 33 to the stator 27 of the control transformer so that the angular relation between the stator winding 22 and rotor winding 23 is adjusted. The adjustment of stator 27 is such as to correct the non-rectilinear characteristics of the nut and screw elevating mechanism, and cam 28 is shaped accordingly.

In the preferred embodiment shown in Fig. 1, the cam 28 is mounted directly on the shaft 34 carrying the rotor winding 23 and this shaft is connected by worm and wheel combination 35, shaft 36 and bevel gears 37 to elevation shaft 18, so that the cam 28 is actuated directly in accordance with the movements of gun 10 in elevation.

In operation of the nut and screw gun elevating mechanism shown in Fig. 1, elevation of the gun 10 causes screw 13 to swing counter-clockwise, which in turn causes yoke 16 to swing in the same direction about the axis of elevation shaft 18, thus changing the relation between the motion of elevation shaft 18 and the motion of gun 10. The same but reverse incorrect movement results when the gun 10 is depressed. The exact amount of in correction can be readily determined for every degree of elevation of the gun 10 and these in corrections plotted to serve as a basis for laying

out the contour of cam 28. Although cam 28 is rotated angularly in step with the angular movement of the gun 10, the cam rotates slightly less than one complete revolution during the full elevation and depression movement range of the gun.

As cam 28 rotates, its follower 29 displaces rack 31, which, through meshing pinion 32 and gears 33, rotates stator 27 of the receiver or control transformer to accordingly distort the signal impressed on winding 22, so that the motor-driving voltage induced in rotor 23 causes the motor 25 to elevate gun 10 more or less in the prescribed correction range than the original signal required, thus compensating for the non-linear gun elevation characteristic of the nut and screw mechanism 13, 14. This greater or less elevation rotation of elevator motor 25 is directly dependent upon the angle through which rotor coil 23 is driven by motor 25 the non-inductive null or motor deenergizing position. Thus if stator 27 is rotated by cam 28 in one direction, rotor coil 23 must be driven through a greater angle to null position, and vice versa.

It will be understood that the invention is also applicable to other driving mechanisms where the driven member is to follow a course or have a movement different than that dictated by the construction of the intervening gearing or other driving mechanism, and that cam 28 may be shaped to introduce other corrections simultaneously with or in addition to the aforementioned elevation corrections, such as corrections for gun erosion, parallax, and the like. Such corrections may be introduced by the present mechanism, even where the gun elevation mechanism has linear characteristics as in the case of a gear sector on the gun having its pitch center about the trunnion axes and driven by a pinion.

Although a preferred embodiment of the invention has been illustrated and described herein, the invention is not limited thereby, but is susceptible of changes in form and detail within the scope of the appended claims.

I claim:

1. In combination with a motor-driven nut and screw mechanism for driving a member about a pivot, means for correcting the inherent non-linear characteristics of said mechanism including a cam having a contour conforming to the difference between the inherent non-linear drive pattern of said mechanism and the desired linear pattern, driving connections between said mechanism and said cam, a control transformer having a rotatable rotor and a rotatable stator,

a source of signal voltage for energizing said mechanism, electrical connections between said source and said stator, electrical connections between said rotor and said motor, driving connections between said motor and said rotor for rotating the latter to non-inductive angular relation with said stator, and driving connections between said cam and said stator for rotating the latter to thereby change the angle through which the rotor is driven by said motor for accordingly correcting the movement of said member.

2. In combination with a motor-driven nut and screw mechanism for elevating a gun, means for correcting the inherent non-linear characteristics of said mechanism including a cam having a contour conforming to the difference between the inherent non-linear drive pattern of said mechanism and the desired linear pattern, driving connections between said motor and said cam, a control transformer having a rotatable rotor and a rotatable stator, a source of varying elevation angle signal voltage for energizing said mechanism, electrical connections between said source and said stator, electrical connections between said rotor and said motor for energizing said motor in accordance with the signal voltage induced in said rotor, an amplifier in said connections between said rotor and said motor, driving connections between said motor and said rotor for rotating the latter to non-inductive angular relation with said stator, and driving connections between said cam and said stator for rotating the latter to thereby change the angle through which the rotor is driven by said motor for accordingly correcting the movement of said gun to conform to the elevation angle signal.

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