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APPARATUS FOR FIRE CONTROL

Filed Aug. 21, 1934

2 Sheets-Sheet 1

Fig. 1.

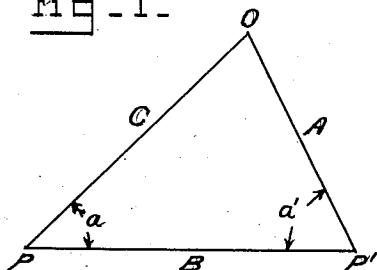


Fig. 2.

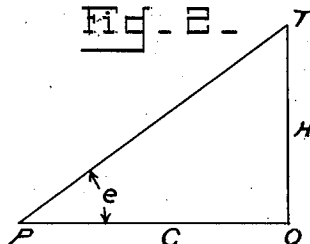


Fig. 3.

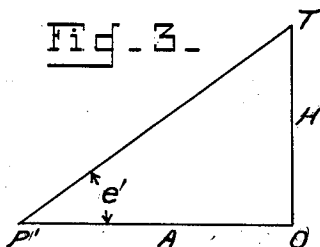
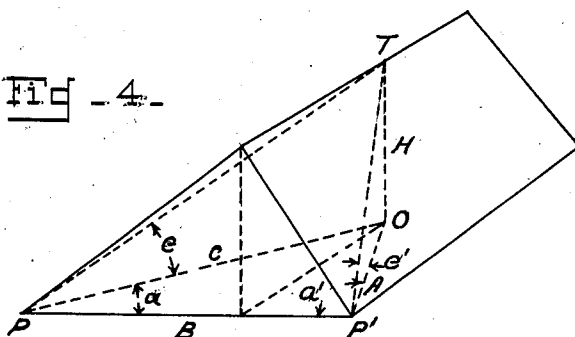


Fig. 4.



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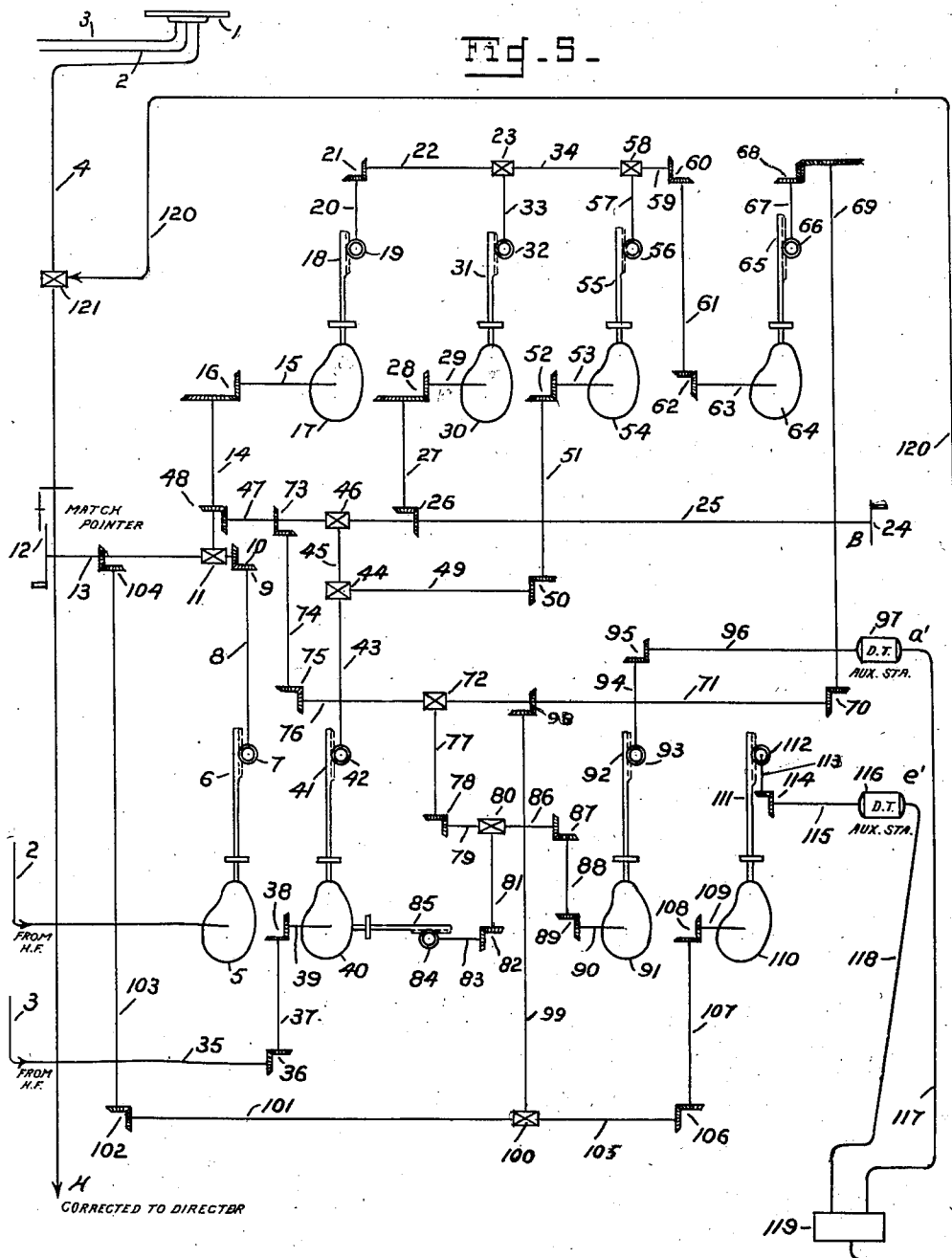
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APPARATUS FOR FIRE CONTROL

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Application August 21, 1934, Serial No. 740,803

2 Claims. (Cl. 235—61.5)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

5 The subject of this invention is apparatus for fire control.

The main objects of the invention are to provide a mechanism for correcting the height furnished by a self-contained base height finder through the use of one or more auxiliary stations at the extremities of known base lines; to provide a system in which corrected values of height are supplied for final computation of data.

The system is so designed that; should an auxiliary station become inoperative a switch may be made to another auxiliary station and the system continues to function; should the computing mechanism become inoperative, the system still functions by directing the height determined by the self-contained base height finder directly into the director.

With these and such other objects as may hereinafter more fully appear the invention consists in the novel system and structure herein-after described and claimed it being understood however, that changes in the precise embodiment of the invention herein disclosed may be made within the scope of what is claimed without departing from the spirit of the invention.

30 In the drawings illustrative of the invention: Figs. 1, 2 and 3 are extracts from the altimetric roof shown in Fig. 4 to make more clear the calculations involved;

Fig. 4 is a view of the altimetric roof, showing a location of a target T, a primary station P, and one of the auxiliary stations P';

Fig. 5 is a schematic view showing the arrangement of the stations and a form of calculating device.

40 Referring to the drawings by characters of reference:

From Fig. 4, which shows a primary station P and one of the auxiliary stations P', we have the relation

$$45 \quad A^2 = B^2 + C^2 - 2BC \cos a$$

where B is a known base length, e the elevation angle at the primary station, H the measured or estimated height of the target T, a the azimuth angle at the primary station, and A the horizontal distance from the auxiliary station P' to the ground projection O of the target T.

Again referring to Figs. 1, 2, 3 and 4, the following relations are evident:

$$55 \quad e' = \tan^{-1} \frac{H}{A}$$

$$\sin a' = \frac{C}{A} \sin a$$

60 where e' represents the elevation angle at the

auxiliary station and a' the azimuth angle at the auxiliary station.

Having previously determined the values of C, H, A and a, the values of e' and a' for the auxiliary station are computed and transmitted to the auxiliary station. If the optical axis of the telescope at the auxiliary station is not accurately upon the target when the values of a' and e' are inserted, it is due to error in the value of H, as the other factors entering the computation are either known or accurately measured. Accordingly a differential correction for H is set in at the auxiliary station and transmitted back to the primary station and through the computing mechanism. In this manner new values of e' and a' are automatically and continuously generated, the operator at the auxiliary station merely keeping the optical axis of the telescope at that station on the target by inserting the required differential value for H. The differential value of H is added to the original estimated or measured value and furnishes the corrected value of H which is transmitted to the guns or to a director for determination of firing data.

While this system may be carried out in various ways, as through calculations worked out by personnel or by the use of any well known transmitting and calculating devices, there has been shown herein one preferred form of calculator which is incorporated in the system.

At the primary station P is provided a height finding telemeter 1 of well known design, the elevation angle of which is transmitted to the calculator through the line 2, and the azimuth angle a of which is likewise transmitted to the calculator through the line 3. The height, as determined by the height finder 1, is transmitted to the calculator through the line 4.

The means of transmitting such data is old and well known and forms no part of the present invention.

The value of the elevation angle is set into the calculator through rotation of a cam 5 designed to produce a lift proportional to $\log \cot e$ in a follower 6 formed with a rack meshing with a pinion 7 on one end of a shaft 8 on the other end of which shaft is a pinion 9 meshing with a pinion 10 rotatable with one element of a differential 11. The movement proportional to $\log \cot e$ is combined in differential 11 with a movement proportional to $\log H$ through means of the follow the pointer hand operated mechanism 12 and shaft 13 and the resultant movement, $\log C$ or $\log H + \log \cot e$, is imparted to shaft 14 and from it to shaft 15 through the medium of gearing 16 which has a 2 to 1 ratio.

Shaft 14 moves proportional to $\log C$ while shaft 15 moves proportional to $\log C^2$. The shaft 15 has mounted thereon a cam 17 designed to lift its follower 18 proportional to C^2 . The fol-

lower 18 is provided with a rack meshing with a pinion 19 on a shaft 20, and the shaft 20 is connected through gearing 21 with a shaft 22 which drives one side of a differential 23 imparting thereto a movement proportional to C^2 .

The value $\log B$ is set into the instrument through the medium of a hand wheel 24 on a shaft 25 which shaft drives, through gearing 26, shaft 27 which, through gearing 28 having a 2 to 1 ratio, drives shaft 29 on which is a cam 30 designed to impart a lift to its follower 31 proportional to B^2 .

The follower 31 is provided with a rack meshing with a pinion 32 on a shaft 33 which shaft drives the planetary gears of differential 23 so that the resultant movement from the differential is proportional to $B^2 + C^2$ and this movement is imparted to a shaft 34 connected to one side of the differential.

The value a is introduced into the instrument through a shaft 35 which, through gearing 36, drives a shaft 37, and this shaft in turn, through gearing 38, drives a shaft 39 on which is a cam 40 designed to impart a lift to its follower 41 proportional to $\log \cos a$. The follower 41 is provided with a rack meshing with a pinion 42 on one end of a shaft 43 the other end of which has a driving connection with one side of a differential 44. The other side of this differential 44 is connected through a shaft 45 with a differential 46 one side of which is driven through the shaft 25 and the other side of which is driven through a shaft 47 connected through gearing 48 with the shaft 14. The resultant movement of differential 46, $\log BC$, is imported through differential 44 to shaft 49 which, through gearing 50, drives a shaft 51 with movement $\log BC \cos a$, driving through gearing 52 a shaft 53 on which is mounted a cam 54 designed to impart a lift to its follower 55 proportional to $2 BC \cos a$. The follower 55 is provided with a rack meshing with a pinion 56 on one end of a shaft 57 the other end of which has a driving connection with the planetary gears of a differential 58, one side of which is driven by the shaft 34 and the other side of which drives a shaft 59, of movement A^2 or $B^2 + C^2 - 2 BC \cos a$, which, through gearing 60, imparts motion to shaft 61 and this shaft in turn, through gearing 62, drives shaft 63.

Mounted on the shaft 63 is a cam 64 designed to impart to its follower 65 a lift proportional to $\log A^2$. The follower 65 is provided with a rack meshing with a pinion 66 on a shaft 67 which, through the 1 to 2 reduction gearing 68, drives shaft 69 proportional to $\log A$. The shaft 69, through gearing 70, drives shaft 71, which shaft is connected to and drives one side of differential 72, the other side of which is driven through gearing 73, shaft 74, gearing 75 and shaft 76 giving a resultant movement proportional to $\log$

$$\frac{C}{A}$$

This resultant movement is imparted to shaft 77 and, through gearing 78, to shaft 79 connected to one side of differential 80. The planetary gearing of differential 80 receives movement, $\log \sin a$, from shaft 81 which is driven through gearing 82 by a shaft 83 which shaft is rotated through a pinion 84 fast thereon and engaged by a rack formed on the follower 85 of cam 40. The other side of differential 80 drives shaft 86 which, through gearing 87, drives shaft 88

and the rotation of shaft 88, through gearing 89, imparts rotation to shaft 90,

$$\log \sin a' = \log \sin a + \log \frac{C}{A},$$

and cam 91 mounted thereon. The cam 91 is designed to impart a lift to its follower 92 proportional to a' and the lift of the follower, through its rack, rotates pinion 93 and shaft 94 which, through gearing 95, rotates shaft 96 connected to a data transmitter 97.

Shaft 71, through gearing 98, drives shaft 99 imparting movement, $\log A$, to the planetary gears of differential 100. One side of the differential 100 is driven through shaft 101, gearing 102, shaft 103 and gearing 104 which connects shaft 103, $\log H$, with shaft 13. The other side of the differential,

$$\log \frac{H}{A} = \log \tan e'$$

drives shaft 105, gearing 106, shaft 107, gearing 108, shaft 109 and its cam 110. The cam 110 is designed to impart a lift to its follower 111 proportional to e' . The follower, through its rack, rotates pinion 112, shaft 113, gearing 114 and shaft 115 connected to a data transmitter 116 through which the value of e' is transmitted to the auxiliary station.

The value a' is transmitted to the auxiliary station through line 117 and the value of e' is transmitted through line 118. The transmitters and receivers are any of the old and well known devices now in use for such purposes. The telemeter or telescopes, as the case may be, at the auxiliary station, indicated by the numeral 119, is elevated and traversed in accordance with the received values, which, if the value of H was correct would place the optical axis of the instrument on the target. If the target does not appear on the cross lines of the instrument then the instrument must be moved to place the cross lines squarely on the target. This movement imparted to the instrument is transmitted through line 120 back to the primary station where it is incorporated through differential 121 into the setting of the instrument at the primary station, and also into the calculating device, or director.

I claim.

1. In a system for gun fire control, a height finder, an auxiliary sighting instrument at a predetermined distance therefrom, a calculator, means for transmitting data from the height finder to the calculator, means for transmitting resulting data from the calculator to the auxiliary instrument, and means for transmitting corrections in height necessary to place the auxiliary instrument on the target back to the calculator.

2. In a system of gun fire control, means by which height of a target may be measured, an auxiliary sighting instrument at a predetermined distance therefrom, means connected to and operated from the height finding station for calculating necessary data, means for transmitting such data to the auxiliary sighting instrument, means for transmitting corrections in height necessary to place the sighting instrument on the target back to the calculator, and means for transmitting the resulting height to a fire control instrument.

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