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OR 1,345,703

J. L. ROUTIN.

ANTI-AIRCRAFT GUNFIRE CONTROL APPARATUS.

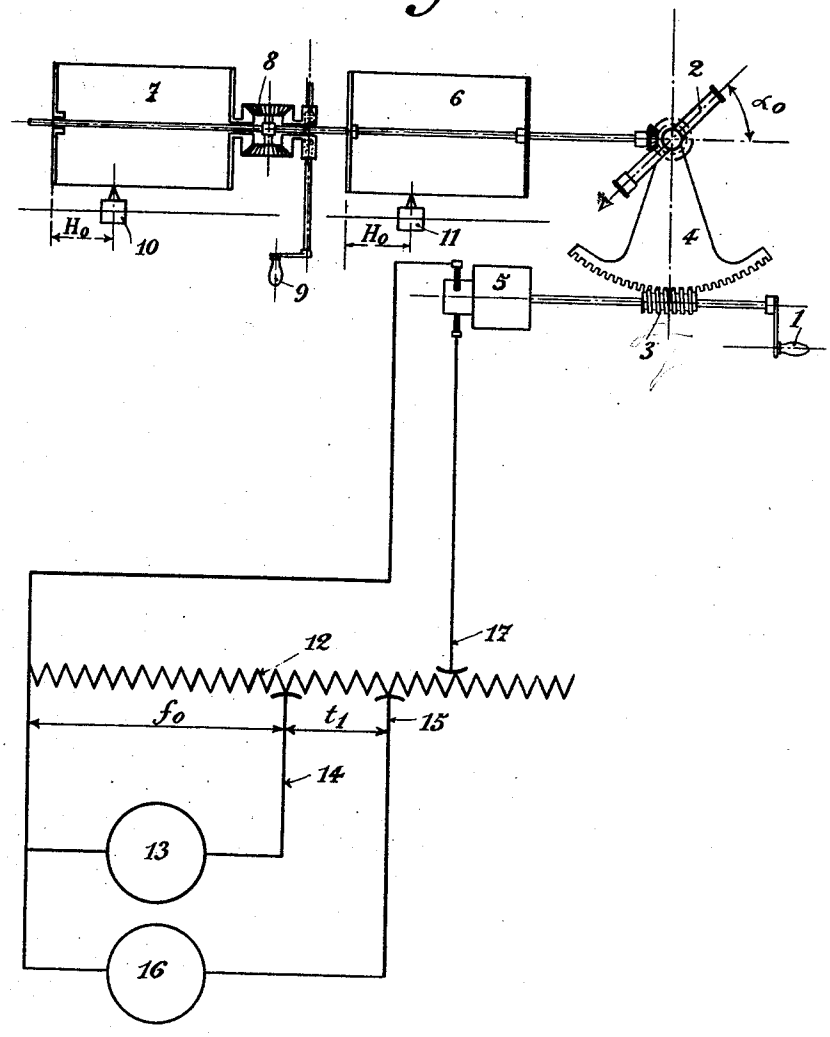
APPLICATION FILED SEPT. 8, 1917.

1,345,703.

Patented July 6, 1920.

3 SHEETS—SHEET 1.

Fig. 1.



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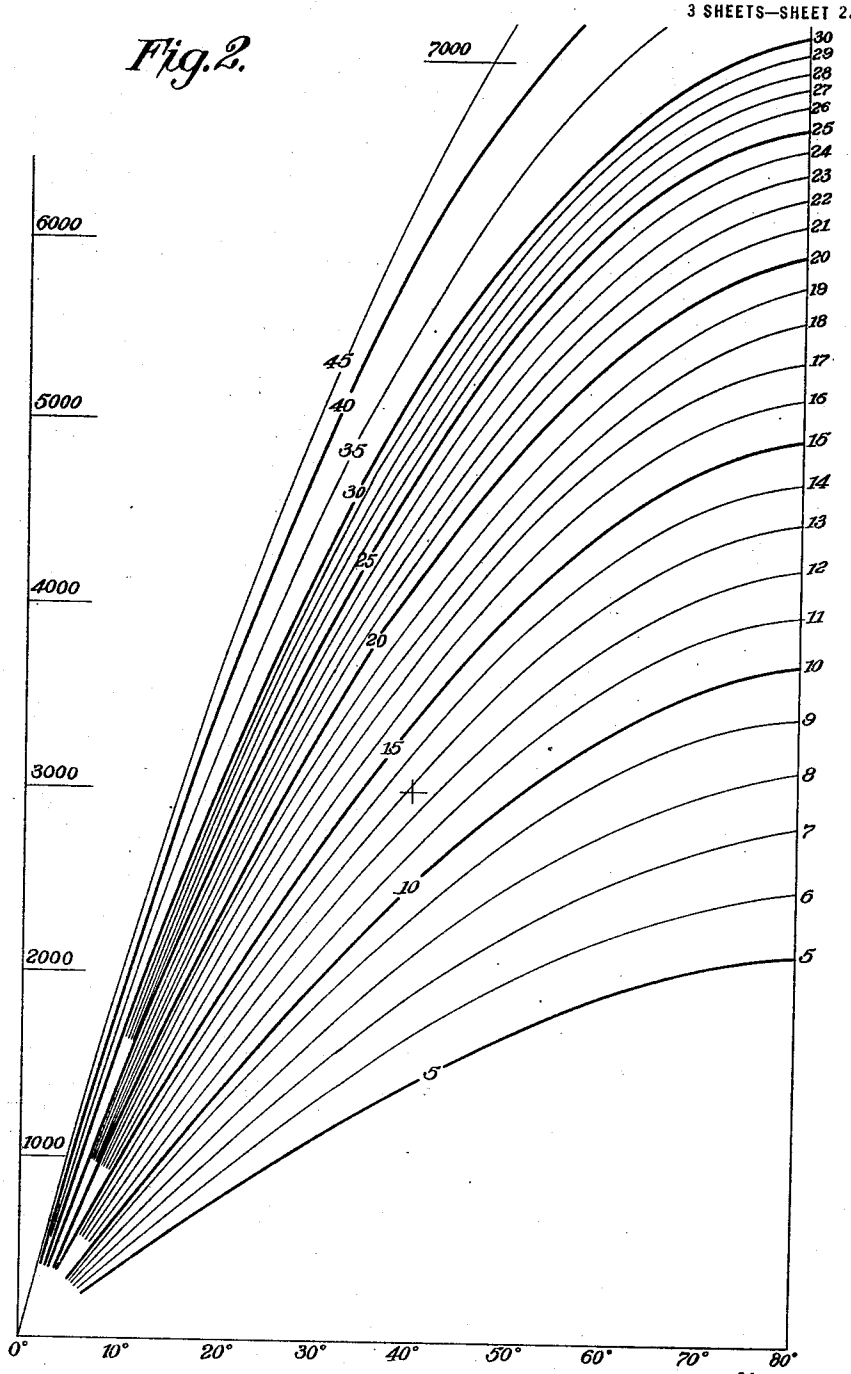
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3 SHEETS—SHEET 2.

Fig. 2.



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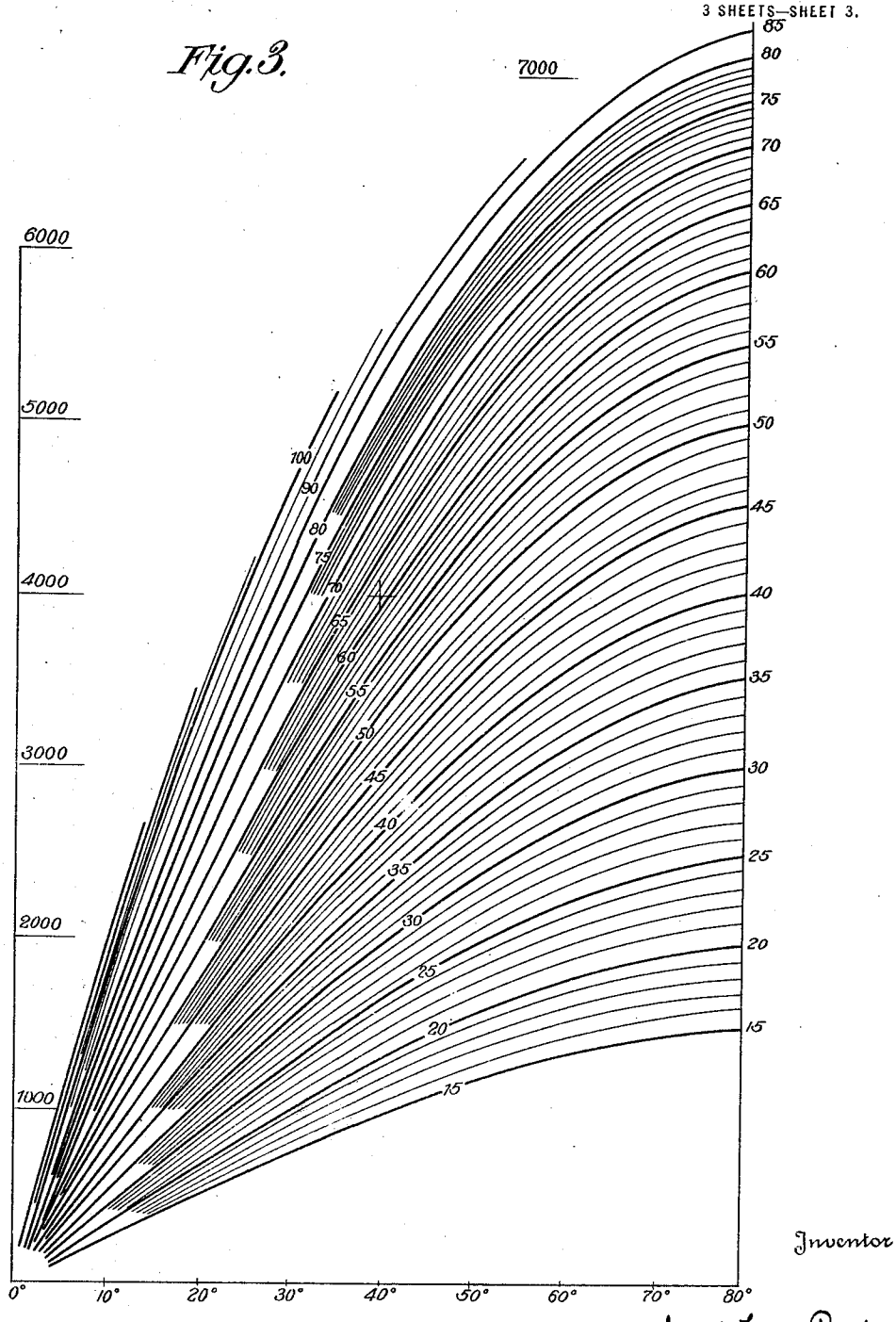
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3 SHEETS—SHEET 3.

Fig. 3.



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UNITED STATES PATENT OFFICE.

JOSEPH LOUIS ROUTIN, OF PARIS, FRANCE.

ANTI-AIRCRAFT GUNFIRE-CONTROL APPARATUS.

1,345,703. Specification of Letters Patent. Patented July 6, 1920.

Application filed September 8, 1917. Serial No. 190,337.

To all whom it may concern:

Be it known that I, JOSEPH LOUIS ROUTIN, a citizen of the French Republic, and a resident of 2 Rue Olchanski, Paris, France, have invented a new and useful Improvement in Anti-Aircraft Gunfire-Control Apparatus, which invention is fully set forth in the following specification.

The present invention relates to improvements in tachochronometrical apparatus such as described in my application for patent Serial No. 182,311, filed July 23, 1917, now Patent No. 1,345,697, dated July 6, 1920, and has for its object to provide a particular form of apparatus of the above kind which permits of the direct determination of the product of either the azimuthal or zenithal velocity of an aerial target by the time of flight of the projectile without making any calculations, it being assumed that the aerial target is moving at a constant altitude during the time of flight of the projectile.

In regulating the firing of anti-aircraft guns, it is necessary to apply a correction to the vertical and lateral directions of aim in order to compensate for the change of position of the aerial target during the time of flight of the projectile. This correction requires the determining of the angular zenithal and azimuthal velocities of the target and a knowledge of the time of flight of the projectile for an extrapolated or estimated distance of the target. Representing the zenithal angle by α, the azimuthal angle by ω, and by f_o the time of flight of the projectile corresponding to the range taken at t_o or the time of taking the readings for distance D_o to the aerial target, the zenithal and azimuthal velocities will be expressed by $\frac{d\alpha}{dt}$ and $\frac{d\omega}{dt}$ respectively.

Knowing at the time $t=o$ when the readings are made, the angle of sight α_o, the altitude H_o of the objective, its azimuthal angular speed $\frac{d\omega}{dt}$, and its zenithal angular speed $\frac{d\alpha}{dt}$, to determine the corrections to be made in the aim as well as in the observed distance or range D_o.

The duration of the flight corresponding to the time $t=o$ is completely defined when H_o and α_o are known. Designating the duration of flight by f_o, it is evident that the correction σ to be made in the vertical aim and the correction δ, the dihedral angle formed by the two planes of sight, to be made in the direction pointing, are given with sufficient approximation by the formulæ:—

$$\sigma = f_o\left(\frac{d\alpha}{dt}\right)_o; \text{ and } \delta = f_o\left(\frac{d\omega}{dt}\right)_o.$$

As the altitude varies rather slowly, it can, on the other hand, be assumed that the future distance D_2 is defined by the intersection with the horizontal plane, of altitude H_o with the line of aim making with the horizon an angle

$$\alpha_2 = \alpha_o + (f_o + t_1)\left(\frac{d\alpha}{dt}\right)_o$$

in which formula t_1 represents the time lost or required for reading the range D_o and angle of height α_o, fix the elevation, correct the adjustment of the telescope in relation to the axis of the gun and regulate the fuse and load the gun.

In order that the invention may be more readily understood, reference is had to the accompanying drawings, in which—

Figure 1 is a diagrammatic view showing how zenithal and azimuthal corrections σ and δ and the future distance D_2 may be obtained directly without making any calculation;

Fig. 2 is a view showing a scale of time of flight curves which give the values f_o for heights H_o and angles α_o and are determined by data from tables of firing; and

Fig. 3 is a view showing a scale of curves giving data for the fuse-setting known to French engineers as "distances debouchoir" or issuing distances in functions of altitude H_o and of the future sight

$$\alpha_2 = \alpha_o + (f_o + t_1)\left(\frac{d\alpha}{dt}\right)_o$$

Referring to Fig. 1 of the drawings, 1 is a handle which serves to move the vertical aiming telescope 2 by means of the screw 3 and the sector 4. This handle also operates the armature coil 5 of a small continuous current magneto, as well as two scale-carrying drums 6 and 7 so mounted as to make a complete revolution when the telescope is displaced through 90°. The drum 7 can also be displaced by means of the differential 8 by operating the handle 9 by hand. Any magneto or small continuous current generator, capable of impressing on a very large and practically constant resistance a

difference of potential proportional to the speed of rotation, is suitable for the purpose.

10 and 11 are two indexes which can be moved along two scales parallel to the axes of the drums. The position of the indexes is regulated according to the indication of the altitude. On drum 6 is placed the scale of curves representing the duration of flight f_0 shown in Fig. 2, and on drum 7 is placed the scale of curves representing future distances D_2 or the "distances debouchoir" shown in Fig. 3.

The duration of flight f_0 is read directly on the drum 6 opposite index 11.

12 is a resistance connected with the brushes of generator 5 and used as a potentiometer to enable the zenithal correction σ to be read on the voltmeter 13 when the movable contact 14 is placed in front of the graduation corresponding to f_0. The index-hand of the voltmeter 13 responds to the voltage across the brushes of the current generator and this voltage is proportional to the speed of its armature and in turn to the angular speed

$$\left(\frac{d\alpha}{dt}\right)_0$$

of the aerial object. The index-hand also responds to the fall of potential along the resistance 12 and this is made proportional to the time of flight f_0 as determined by the reading on drum 6. The resultant movement of the index-hand depends, therefore, jointly on the product

$$f_0\left(\frac{d\alpha}{dt}\right)_0$$

which may be directly read off on the voltmeter by aid of proper graduations.

The movable contact 15 being integral with sliding contact 14 and in advance of t_1 on the latter, the value of the angular correction

$$(f_0+t_1)\left(\frac{d\alpha}{dt}\right)_0$$

is indicated on the suitably graduated voltmeter 16.

This angle having been transmitted to the drum 7 by operating the handle 9, the future distance D_2 is read opposite the index 10. It is generally preferable to carry on the drum 7 not the values of the extrapolated or future distances D_2 but those of the issuing distances D^3 which are functions of H_0 and of future sight

$$\alpha_2=\alpha_0+(f_0+f_1)\left(\frac{d\alpha}{dt}\right)_0.$$

D_3 is really a graduation which is used in setting the time fuse and differs slightly in value from the future distance D_2.

The calibration of the voltmeters 13 and 16 to obtain, directly on the scale of the voltmeters, corrections in "milliemes" or mills is secured by operating the movable contact 17. It also enables restandardizing the voltmeters in case the intensity of the magnetic field of the generator should vary.

The whole of the device represented in Fig. 1 is involved in the movement transmitted to the direction aiming telescope as explained in the principal application above referred to. The value of the azimuthal correction δ is obtained by use of a similar apparatus to that above described, by setting on the graduation f_0 the movable contact of the potentiometer connected to the current generator of the direction aim.

The device described has further the great advantage of allowing the direct determination of the correction of the direction aim, even in the case (which is rather frequent) of the aiming devices mounted on the barrel only permitting this correction to be made by displacing the telescope in the plane of sight. The value of the correction is then given by the formula:

$$\delta_1=f_0\left(\frac{d\omega}{dt}\right)_0\cos\alpha_0.$$

It is consequently seen that it is sufficient to draw on the drum 6 a second series of curves (of different colors) giving directly

$$f^1{}_0=f_0\cos\alpha_0$$

to meet the case of the correction in direction in the horizontal plane.

The ballistic corrections are given by moving the indexes 10 and 11 in relation to the carriages which support them.

The apparatus is completed by a clockwork mechanism sounding a bell from t_1 to t_1 seconds and enabling one to regulate the time of the firing.

It is evident that without altering anything in the principle of the apparatus the scales could be arranged in any other way by using, for instance, disks in the place of the cylinders 6 and 7. As the movement to be given to the fingers of the potentiometer is only a function of angle of sight and of the altitude, the index 11 could be further connected mechanically to the contacts 14 and 15 and scales graduated in functions of altitude drawn on the drum or disk 6. This may be accomplished in the following manner: On the drum 6 are placed a set of equi-height curves $H_0=1$; $H_0=2$, etc., having for their coördinates angles of sight α_0 and times of flight f_0. It will suffice, then, to maintain the index 11 on the curve H_0 corresponding to the altitude announced. Contacts 14 and 15 having a suitable mechanical connection with index 11 will therefore be moved proportionally to the values of the terms of flight.

Finally the magnetos of the potentiom-

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eters and the voltmeters could be replaced by any tachometers, mechanical or magnetic, suitable for the purpose.

Where reference is made to the angle of sight, this refers to both the vertical and the horizontal angle and the claims are to be so interpreted.

What is claimed is:—

1. In apparatus of the character described, where the target is moving at a constant altitude during the time of flight of the projectile, the combination of a tachometer giving the angular speed of the target with two scales one giving the time of flight and the other the issuing distance in functions of the angle of sight and of the altitude (H_o).

2. A form of construction of the apparatus in claim 1 applicable when the sighting device is arranged so that the correction is given in the plane of sight characterized by the drum indicating the time of flight being provided with a series of curves indicating the duration of the fictitious time of flight which should be taken into consideration and which are given by the product of the duration of the actual time of flight (t_o) by the cosine of the angle of sight (α_o).

3. In apparatus for regulating the firing of anti-aircraft guns where the target is moving at a constant altitude during the time of flight of the projectile, the combination of two movable supports responsive to the angular movements of a sighting device, one of said supports being provided with a set of curves giving times of flight of the projectile and the other with a set of curves giving fuse-setting distances, height-indicating indices adjustable in relation to said curves, a tachometer adapted to respond to the angular speed of the target and to the time of flight of the projectile and to indicate the product of the two factors, and means for applying such product to the fuse-setting distances indicated by said fuse-setting curves.

4. In apparatus for regulating the firing of anti-aircraft guns where the target is moving at a constant altitude during the time of flight of the projectile, the combination of two movable supports responsive to the angular movements of a sighting device, one of said supports being provided with a set of curves giving times of flight of the projectile and the other with a set of curves giving fuse-setting distances, height-indicating indices adjustable in relation to said curves, a source of potential responsive to the speed of the target, a voltmeter in circuit therewith, and means for varying the voltage through the meter proportional to the time of flight of the projectile, and means for moving the support provided with fuse-setting curves in accordance with the indications by said voltmeter.

In testimony whereof I have signed this specification.

JOSEPH LOUIS ROUTIN. [L. S.]

Witnesses:
HENRI MONIN,
JOSEPH GEMENI.