O. R. VON EBERHARD.

SIGHTING DEVICE.

APPLICATION FILED DEC. 17, 1913.

1,157,468. Patented Oct. 19, 1915.

Fig. 1.

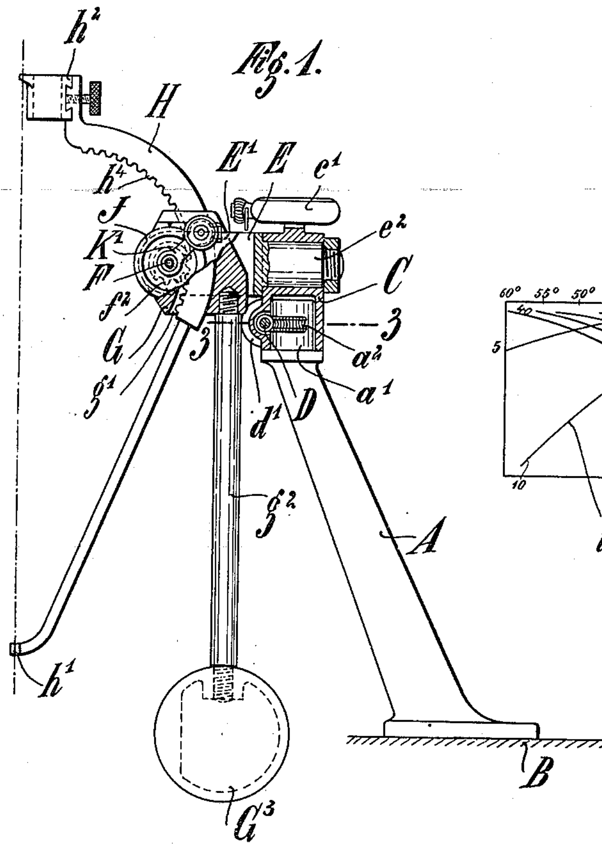


Fig. 5.

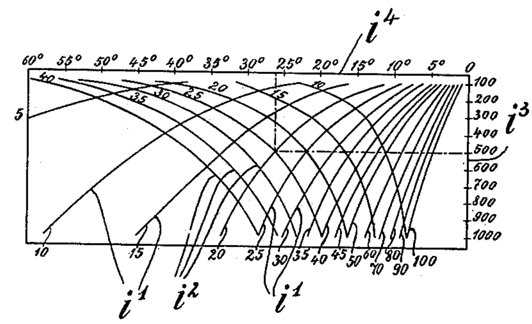


Fig. 4.

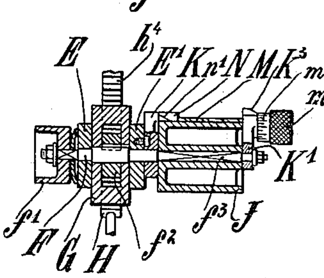


Fig. 2.

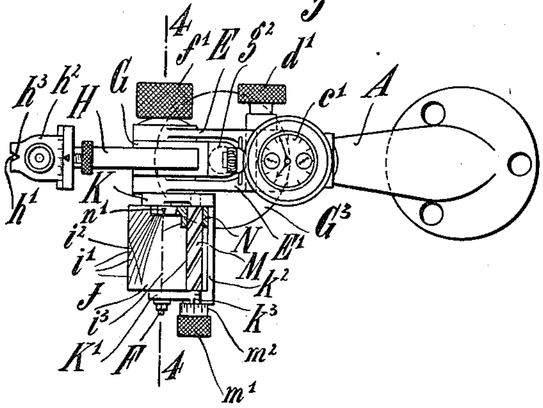
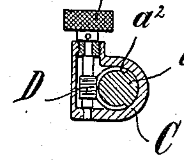


Fig. 3.



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SIGHTING DEVICE.

1,157,468. Specification of Letters Patent. **Patented Oct. 19, 1915.**

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To all whom it may concern:

Be it known that I, OTTO RITTER VON EBERHARD, residing at Bredeney, near Essen-on-the-Ruhr, Germany, a subject of the Emperor of Germany, have invented a certain new and useful Improvement in Sighting Devices, of which the following is a specification.

The present invention relates to sighting devices and position finders for projectile ejectors used on air vehicles, especially on flying machines, by means of which it will be possible, to adjust the angle of ejection corresponding to the air ship's height above ground, when this height is known and after deciding the time necessary for traversing the horizontal distance, proportionate to the height, but without previously having to ascertain the speed of flight based on measuring the time by computation or by tables. The expression "angle of ejection" is then understood to mean, the angle formed between the line of sight and a horizontally or vertically adjustable straight line, which is kept rigid on the sighting device, so that a projectile, which has been thrown at the moment the target passed through the line of sight, will hit the target. Sighting devices of the prior art have the disadvantage that the time which is required to traverse a horizontal distance proportionate to the altitude of flight, has again to be found out for every change of altitude of flight.

The object of the present invention is now to provide a sighting device of this kind, which is without this disadvantage.

In the accompanying drawings is illustrated one embodiment of the invention, and Figure 1 shows a side view of the device partly in section; Fig. 2 a top plan view of Fig. 1; Fig. 3 a section along line 3—3 of Fig. 1, seen from above; Fig. 4 a section along line 4—4 of Fig. 2, seen from the left and on larger scale; and Fig. 5 a development of the cylindrical surface of a detail of cylindrical shape.

A bracket A, for carrying the sighting device is rigidly connected with a part B of the air ship. On the bracket A is provided a vertical trunnion a^1, upon which is journaled a hood C, with a stop-watch c^1. Between the hood C and the trunnion a^1 is inserted a self-locking worm gear, the worm D of which with a hand-wheel d^1 runs in bearings in the hood C and meshes with worm teeth a^2 of the trunnion a^1, see Figs. 1 and 3. A fork having two prongs E and E^1, is loosely mounted to oscillate on the hood C, by means of a journal e^2, the axis of which intersects the axis of the trunnion a^1 at right angles. A shaft F provided with a small hand-wheel f^1 and arranged at right angles to the journal e^2 is mounted in bearings in the fork prongs E and E^1, between which a sleeve G is revolubly mounted on the shaft F. The sleeve G has a circular cut g^1, see Fig. 1, the axis of its curvature being parallel with the axis of the shaft F. In this cut is guided a sight bar H, which is correspondingly curved along a portion of its length, and provided with a point h^1 and a notch h^3 in a transversely adjustable slide h^2. The circularly curved portion of the sight bar has teeth h^4 which are in mesh with a pinion f^2 rigidly secured on the shaft F. A counterpoise G^3 is suspended from the sleeve G by means of a rod g^2, which is rigidly connected therewith, and this counterpoise is able to retain the sleeve G, independent of the adjustment given the sight bar H by the gearing f^1 F f^2 h^4 during the swaying of the flying machine, in such a position, that the axis of the rod g^2 stands vertical.

A drum J, having two sets of curve lines i^1 and i^2 scribed on its cylindrical surface is pushed over a portion f^3 having square cross section, of the shaft F, extending beyond the fork-arm E^1. The drum is at its end faces held by two arms K and K^1, mounted on the shaft F connected by a cross piece k^2, of which arms the one K is rigidly connected with the prong E^1. On the arms K and K^1 relative to which the shaft F may be freely turned, is revolubly mounted a screw-spindle M provided with a small hand-wheel m^1 and by means of which a slide N may be axially displaced along the cross piece k^2. On the slide N is arranged an index n^1 for the curve lines i^1 and i^2. To read the axial adjustment of the index n^1, corresponding to the altitude of flight of the air ship at the moment, serves a graduation m^2 on the hand-wheel m^1, embracing a height of flight of from 0 to 1000 meters, and an index k^3 therefor is provided on the arm K^1.

In what manner the above named curve lines i^1 and i^2 are determined will now be explained with the assistance of the developed cylindrical surface of the drum J, see Fig. 5. It will then first be supposed, in order to determine the speed of flight during constant altitude of flight, that the stop watch c^1 in known manner is started at the moment, when the line of sight, which has previously been adjusted to a certain angle against the perpendicular, is directed against a certain point on the ground; and that, on following the point on the ground with the sight line, the stop watch is stopped at the instant, the line of sight becomes vertical. The distance which the flying machine has covered during the time indicated by the stop watch, the so called "stop-time", is therefore the same as the altitude of flight multiplied by the trigonometrical tangent of the originally set angle between the line of sight and the perpendicular; and by dividing this distance by the "stop-time", the speed of flight is obtained. For the sake of simplicity we will suppose that the originally set angle was 45°. The distance covered during the "stop-time" is in this case the same as the altitude of flight, and the speed of flight is the altitude of flight divided by the "stop-time".

It has furthermore been supposed that the angle formed by the line of sight with a vertically adjustable line, in this case the axis of the rod g^2, at the moment of ejection of the projectile, is considered as "ejecting angle". Not taking into account such secondary influences as wind, height of barometer, etc., the ejecting angle depends only on two magnitudes, namely the altitude and speed of flight. As now the speed is equal to the altitude of flight divided by the "stop-time", the ejecting angle may therefore also be considered as a function of the altitude of flight and the "stop-time".

The cylindrical surface of the drum J is thought bisected by that surface line i^3 see Fig. 5, which the index n^1 follows, when the axis of the rod g^2 stands perpendicular, and the sight line, determined by the notch h^3 and the point h^1, is so adjusted, by turning the shaft F and the drum J, which is rigidly secured thereon, that the sight line becomes parallel with the axis of the rod g^2. If the sight line is so adjusted, by turning shaft F, that the angle, which it forms with the axis of the rod g^2 is equal to a certain ejecting angle (not zero), then the distance which the surface line i^3 has been displaced relative to the index n^1, measured circumferentially on the cylindrical surface of the drum J, is proportionate with the ejecting angle, provided, that the rod g^2 retains its perpendicular position unaltered. From a fixed zero-point are now supposed to be laid out, in suitable scale on the surface line i^3, the altitude of flight; and on a line i^4, running through the zero-point of the surface line i^3 in circumferential direction, are the ejecting angles to be similarly laid out in such a scale, that, on turning the drum J, the angle between the sight line and the axis of the rod g^2 will be constantly equal to that ejecting angle, which is represented by the distance of the index n^1 from the surface line i^3, measured circumferentially. In Fig. 5 have been indicated along the surface line i^3, the altitudes of flight from 0 to 1000 meters at intervals of 100 meters; and along the circumferential line i^4, the ejecting angles from 0 to 60 degrees at intervals of 5 degrees. The relations between altitude of flight, the "stop-time" and the corresponding ejecting angle are now graphically illustrated in such a manner by the curves i^1 in the coördinate system formed by the two axes i^3 and i^4, intersecting each other at right angles, that to each curve corresponds a constant value of the "stop-time", and that the coördinates of each point on one of the curves represent the related values of the ejecting angle and the altitude of flight. If now the index n^1 is adjusted in axial direction to indicate a certain altitude of flight, and the drum J thereupon is turned until the mark n^1 points to a curve which corresponds to the "stop-time" found out at this height of flight, then the angle between the sight line and the axis of the rod g^2 will be equal to the ejecting angle, which corresponds to the set altitude of flight and the "stop-time".

Each point of any curve chart i^1 denotes a certain speed of flight. Supposing now, that all points of the curve chart i^1, which correspond to the same value of speed of flight, are connected by one curve, and that a great number of such curves of different values of speed of flight were scribed, a curve-chart i^2 will then result, which indicates the relations between the altitude of flight, the speed of flight and the ejecting angle in such a manner, that each curve represents a constant value of speed of flight and that the coördinates of each point of the same curve express the two related values of the altitude of flight and the ejecting angle. If now the drum J is so adjusted for a known speed of flight, that the mark n^1, already adjusted in axial direction to indicate a certain altitude of flight, will point to the curve corresponding to the speed of flight, the angle between the sight line and the axis of the rod g^2 is again equal to the corresponding ejecting angle.

In the curve chart i^1, see Fig. 5, the individual curves are scribed for a stop-time ranging from 5 to 100 seconds; with the individual curves following each other at distances corresponding to every 5 second of stop-time within the range of 5 to 50 seconds and of 10 seconds within the range of 50 to 100 seconds. The individual curves in the curve chart i^2 are drawn for a range of speed of flight of 10 to 40 meter-seconds, the individual curves following each other in distances corresponding to every 5 meter-seconds of speed of flight.

In describing the use of the present sighting device, the wind influence, which in known manner may be compensated for, will, for the sake of simplicity, not here be taken account of, and it will therefore be supposed that the wind is calm, so that the direction of flight coincides with the longitudinal direction of the flying machine and falls in a plane, which is laid perpendicular through the target. In order now, under these conditions, to determine the point from which the projectile should be thrown to hit a certain target, the index n^1 should first be displaced, by means of the hand wheel m^1, in the direction of the surface line i^3 until the division line indicating for instance 500 meters altitude of flight of the graduation m^2 registers with the index k^3, while the flying machine moves with uniform speed at constant altitude, which may be read off a barometer. For the purpose of determining the "stop-time", the sight line will now be so adjusted, by means of turning the shaft F, that it forms an angle of 45° with the perpendicularly situated axis of the rod g^2. At the moment a certain point on the ground is visible in the sight line, adjusted as above indicated, the stop watch c^1 is started and again stopped at that instant when the sight line, which has been kept directed against the target, arrives in vertical position. The time read off the stop watch might for instance be 20 seconds. The drum J will then be turned by means of the hand wheel f^1 until the index n^1 points to the curve of the curve chart i^1, which indicates a "stop-time" of 20 seconds. The sight line then receives, by means of the gearing f^2 h^4, such an inclination relative to the perpendicular axis of the rod g^2, that the angle of inclination will be equal to the ejecting angle, which corresponds to an altitude of flight of 500 meters and a "stop-time" of 20 seconds. If the flying machine, after the reading of the stop watch, retains the same altitude, the projectile must then be thrown in known manner from that point, from which the target is seen, when the sight line has been adjusted as now described.

Should the flying machine be compelled to change its altitude of flight, after the reading of the stop watch, the sight line must be adjusted for a different ejecting angle. It will, however, not be necessary to again determine the "stop-time", as long as the speed of flight remains the same, because simultaneously with the determining of the "stop-time" to 20 seconds at the original altitude of flight of 500 meters, the speed of flight was also determined and that consequently the adjustment of the sight line can take place by the use of the curve chart i^2. During the first adjustment of the sighting line the index n^1, as will at once be seen from Fig. 5, points to the curve of the curve chart i^2 which corresponds to the speed of flight of 25 meter-seconds. It will only be necessary to turn the drum J until the index n^1 again points to the curve of the curve chart i^2, which corresponds to the speed of flight of 25 meter-seconds, after having, by turning the hand wheel m^1, previously axially adjusted the index n^1 to correspond to the new altitude of flight. As soon as this has been done the sight line has been adjusted corresponding to the new altitude of flight.

It will now be evident, that the described sighting device possesses the advantage in its use, that it is neither necessary to compute the speed of flight from the altitude of flight and the "stop-time", nor to again determine the "stop-time" for a change of altitude of flight.

Without in any manner changing the object of the present invention, the curve chart i^1 might be exchanged for a curve chart, wherein each individual curve corresponds to a constant altitude of flight, and wherein one of the two coördinates of a curve point, measured in axial direction expresses the "stop-time" and the other coördinate, measured in circumferential direction expresses the ejection angle. In this case, the curves of the same speed of flight must naturally also be changed, so that also here the coördinates of each curve point express the "stop-time" and the ejecting angle.

I claim:

1. A sighting device for projectile-ejecting devices on air vehicles comprising a sight member, a reading-off means for indicating the "angles of ejection" of said projectile-ejecting device, said sight member being adjustable to correspond to the "angles of ejection," said means having a member provided with an index, a second member carrying two intersecting series of curves, one of said series of curves representing the relations between the height of flight, the time necessary for traversing a horizontal distance proportionate to the height of flight, and the angle of ejection in such a manner, that a constant value of the two first-named magnitudes corresponds to each curve and that the coördinates of each curve represent the angle of ejection and said third magnitude; the other of said series of curves comprising curves of equal speed of flight, the first-named member of the reading-off means and said second member being adjustable relative to each other in the direction of the two coördinates, a gear for adjusting the reading-off means to the coördinate representing the angle of ejec-

tion, said gear simultaneously adjusting the angle of ejection of said sight member.

2. A sighting device for projectile-ejecting devices on air vehicles comprising a bracket, a revoluble shaft carried by the bracket, a pendulum hanging freely from said shaft and being provided with a circular guide-way, the axis of which is parallel with said shaft axis, a sight bar having aiming members, said sight bar being mounted to run in said guideway, indicating means actuated by said shaft for showing the angular adjustment of said sight bar, and consisting of a movable member and an index therefor; and a setting member for said index for imparting transversal displacement of said index relative to the direction of movement of said movable member, the setting thus indicating altitude of flight.

3. A sighting device for projectile-ejecting devices on air vehicles comprising a bracket, a revoluble shaft carried by the bracket, a pendulum hanging freely from said shaft and being provided with a circular guideway, the axis of which is parallel with said shaft axis, a sight bar having aiming members, said sight bar being mounted to run in said guideway, a drum and a pinion rigidly secured on said shaft, teeth on said sight bar in mesh with said pinion, an index for said drum, said drum having a suitable scale for reading the angular movement of said drum and said sight bar, a screw spindle on which said index is seated, said spindle having stationary bearings relative to said bracket, said spindle having a scale for indicating the axial displacement of said index relative said drum, the longitudinal axes of said drum and said spindle being parallel.

4. A sighting device for projectile-ejecting devices on air vehicles comprising a bracket, a revoluble shaft carried by the bracket, a pendulum hanging freely from said shaft and being provided with a circular guideway, the axis of which is parallel with said shaft axis, a sight bar having aiming members, said sight bar being mounted to run in said guideway, a drum and a pinion rigidly secured on said shaft, teeth on said sight bar in mesh with said pinion, an index for said drum, said drum having a suitable scale for reading the angular movement of said drum and said sight bar, a screw spindle on which said index is seated, said spindle having stationary bearings relative to said bracket, said spindle having a scale for indicating the axial displacement of said index relative said drum, the longitudinal axes of said drum and said spindle being parallel, said drum also being provided with a curve chart, each individual curve denoting a constant but different speed from its neighbor.

5. A sighting device for projectile-ejecting devices on air vehicles comprising a bracket, a revoluble shaft carried by the bracket, a pendulum hanging freely from said shaft and being provided with a circular guideway, the axis of which is parallel with said shaft axis, a sight bar having aiming members, said sight bar being mounted to run in said guideway, a drum and a pinion rigidly secured on said shaft, teeth on said sight bar in mesh with said pinion, an index for said drum, said drum having a suitable scale for reading the angular bar movement of said drum and said sight bar, a screw spindle on which said index is seated, said spindle having stationary bearings relative to said bracket, said spindle having a scale for indicating the axial displacement of said index relative said drum, the longitudinal axes of said drum and said spindle being parallel; said drum also being provided with a curve chart, each individual curve denoting a constant but different "stop-time" from its neighbor.

6. A sighting device for projectile-ejecting devices on air vehicles comprising a bracket, a revoluble shaft carried by the bracket, a pendulum hanging freely from said shaft and being provided with a circular guideway, the axis of which is parallel with said shaft axis, a sight bar having aiming members, said sight bar being mounted to run in said guideway, a drum and a pinion rigidly secured on said shaft, teeth on said sight bar in mesh with said pinion, an index for said drum, said drum having a suitable scale for reading the angular movement of said sight bar, a screw spindle on which said index is seated, said spindle having stationary bearings relative to said bracket, said spindle having a scale for indicating the axial displacement of said index relative said drum, the longitudinal axes of said drum and said spindle being parallel, said drum being provided with a set of speed curves, each individual curve denoting a constant, but from its neighbor different speed, and a set of "stop-time" curves, each individual "stop-time" curve representing constant but from its neighbor different speed.

7. A sighting device for projectile-ejecting devices on air vehicles comprising a bracket, a revoluble shaft carried by the bracket, a pendulum hanging freely from said shaft and being provided with a circular guideway the axis of which is parallel with said shaft axis, a sight bar having aiming members, said sight bar being mounted to run in said guideway, a drum and a pinion rigidly secured on said shaft, teeth on said sight bar in mesh with said pinion, an index for said drum, said drum having a suitable scale for reading the angular movement of said sight bar, a screw spindle on which said index is seated, said

spindle having stationary bearings relative to said bracket, said spindle having a scale for indicating the axial displacement of said index relative said drum, the longitudinal axes of said drum and said spindle being parallel, said drum being provided with a set of speed curves, each individual curve denoting a constant, but from its neighbor different speed, and a set of "stop-time" curves, each individual "stop-time" curve representing constant but from its neighbor different speed; said angular scale representing the angular displacement between the sight line and a vertical line, and said displacement scale representing the altitude of flight.

The foregoing specification signed at Barmen, Germany, this 26th day of November, 1913.

OTTO RITTER VON EBERHARD. [L. S.]

In presence of—
ALBERT NUFER,
FRANCES NUFER.