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CROSS REFERENCE

Sept. 29, 1942. A. BARONI 2,297,448

BOMBSIGHT AND PILOT DIRECTOR

Filed Sept. 18, 1940 3 Sheets-Sheet 1

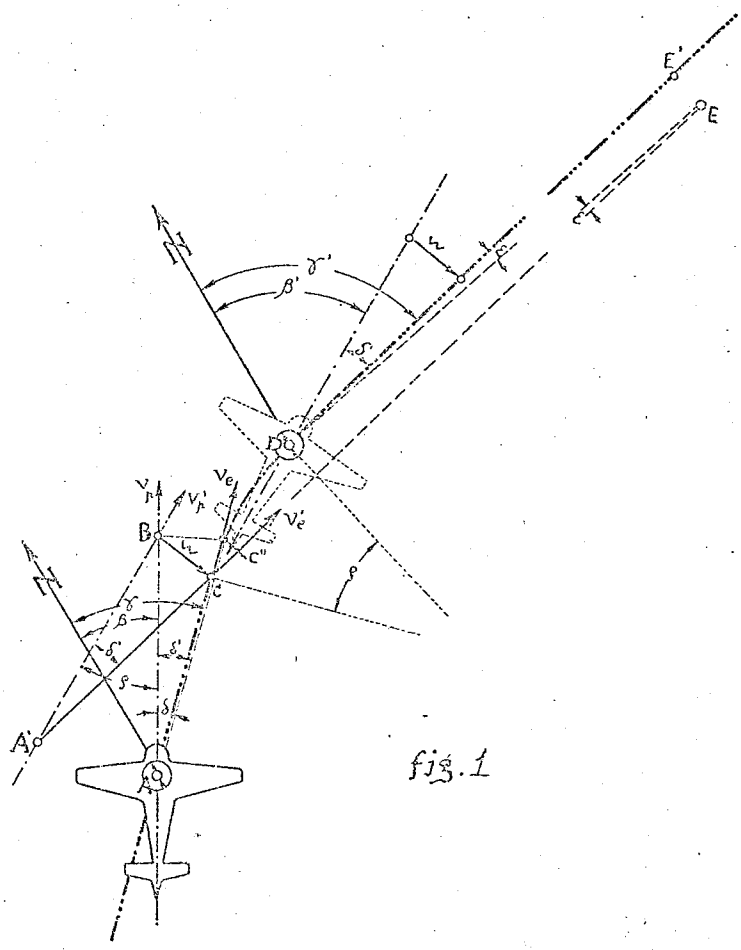


fig. 1

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Fig. 3

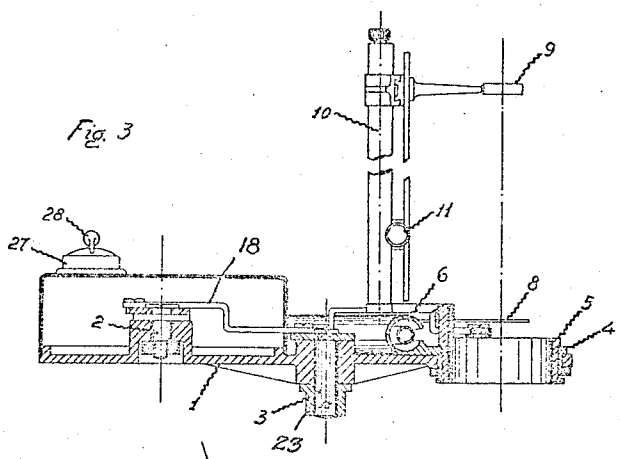


Fig. 3a

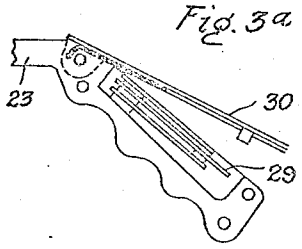


Fig. 2

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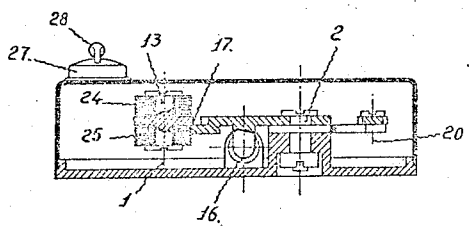


Fig 4

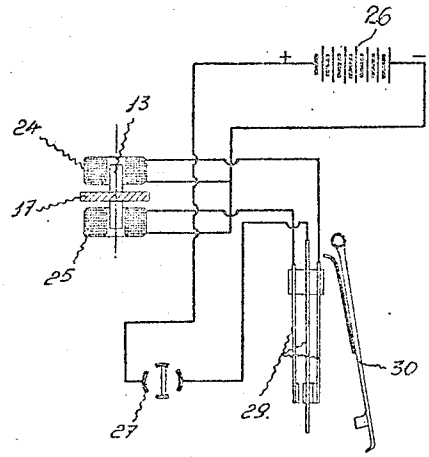


Fig 5

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UNITED STATES PATENT OFFICE

2,297,448

BOMB SIGHT AND PILOT DIRECTOR

Augusto Bareni, Rome, Italy; vested in the Alien Property Custodian

Application September 18, 1940, Serial No. 357,310
In Italy March 5, 1938

1 Claim. (Cl. 33—46.5)

The present case is in the nature of a continuation-in-part application of my copending application Serial No. 258,506, filed February 25, 1939.

This invention relates to aiming and checking devices intended to be used in conjunction with bomb sights for aircraft and dirigible craft and is based on the use of the vector triangle of velocities, of which the elements may be introduced therein by any known means by simply aiming the bomb sight at the target, while the aircraft follows a straight course, and thereby finding the compass course in relation to the true course passing through the target, and then immediately transmitting said compass course to the pilot resulting from the deformation of the triangle occurring subsequently to and simultaneously with the sighting operation.

An object of my invention is to have the air speed bar of the device mounted so as to be rotatable about a vertical axis so as to represent the vectoral side of the air speed and the actual speed of the aircraft after a turn equal to the angle through which the air speed bar is displaced with respect to the longitudinal axis of said aircraft.

Another object is thus to make it possible to deform the triangle relatively to the actual trim of flight into a triangle representing a future trim, and during such deformation to maintain the wind bar parallel and unvaried while the air speed bar rotates and remains unaltered in length.

A further object is to cause during such deformation, the length of the ground speed bar to change its length in relation to the ground speed the direction of which is the same as that of the sighting line on the target.

It is thus an object to reduce the finding of the direction of attack to a simple sighting operation to determine instantly the necessary approach so that an accurate order of operation may be transmitted to the pilot.

Other objects of this class and the various advantages of my invention and its practical application will appear more fully as this specification proceeds.

In the accompanying drawings:

Fig. 1 is a diagram illustrating schematically the fundamental principle of the invention.

Fig. 2 shows in plan a form of realization of the device applied on a free viewing sight.

Fig. 3 shows in elevation the device of Fig. 2, partly in section along the line A—A, of Fig. 2.

Figure 3*a* is a plan view of a switch and control lever forming a part of the invention.

Fig. 4 is a section of the same device through line B—B of Fig. 2, and

Fig. 5 shows a scheme of the electric connections of the electromagnets comprised in the form of realization of the device herein described.

With reference to the drawings, the aircraft A (Fig. 1) flies initially with a compass course β and a drift angle δ, following a true course having γ azimuth. The corresponding vector triangle ABC, the side AB, of which parallel to the longitudinal axis of the aircraft, represents in size (constant at the flight altitude considered) and the actual direction of the airspeed Vp, the side BC represents the wind W, which is supposed to be constant both in intensity and in direction, and the side AC represents therefore the ground speed resulting from the two vectors Vp and W. If now said triangle is deformed so that when the aircraft has reached the point C, the side AC has assumed the position A'C in alignment with the stationary target E, the side BC has remained stationary and unvaried, and the side AB has rotated without varying its length, until it has reached the position shown in A'B, the triangle A'BC so deformed, shows both in value and in spatial orientation the trim of flight corresponding to a future actual course CE having γ' azimuth, and for the actual change to this latter from the initial course having γ azimuth, it is necessary to effect a turn φ, equal to the angle ABA' the side of which representing the airspeed bar, has rotated through the deformation above mentioned, i. e., has passed from the compass course β to the compass course β', which is equal to $\beta+\varphi$.

After transmitting immediately to the pilot the order to effect the turn φ, the aircraft, at the end of the manoeuvre, will no longer be in C, but having described a certain portion of a curved trajectory, will reach the point D, thereby realising the new actual course DE' parallel to CE. This inevitable displacement, produces a directional error ϵ, which, however, as already mentioned, does not involve the substantial value of the device according to the invention.

In the meantime, in order that the triangle A'BC at the end of the turn, may resume its correct position in space, will have to rotate through the angle $-\varphi$, without undergoing further deformations, so that the side A'B may be returned to its initial position AB, parallel to the longitudinal axis of the aircraft, and the sides BC and A'C may assume in the aircraft the positions BC'' and AC'' respectively, which, owing to the change of the course, will result respectively in

the direction of the wind and in the direction of the new actual course.

As the final trim is represented on the aircraft by the triangle ABC'', it would appear superfluous at first sight the passage through the intermediate triangle A'BC equal to the preceding one, and to state that is sufficient for the purpose to transform the initial triangle ABC into the triangle ABC'', leaving unchanged the side AB in its normal position, and by simply rotating the wind side BC through the angle $-\varphi$, for causing it to assume the position BC''. There is nothing against this procedure from a geometrical point of view; however it is to be remembered that the extent of turn which is necessary for obtaining the wanted direction of attack, is precisely the unknown factor of the practical problem; which is highly necessary to ascertain at the same moment in which the target is sighted, so that the result aimed at may be reached with the maximum possible accuracy.

It is precisely with the formation of the triangle A'BC that the device of the invention attains this end in the simplest and most rapid way, while this cannot be stated with regard to known sights provided with a triangle of velocities which operates essentially as a calculating device and which are not provided with means for realizing simultaneously the operations of sighting the target and of measuring the relative turn, which, in addition to obvious inconvenience during operation, give rise to errors which are totally inadmissible with the present speeds of aircrafts. Also the idea of finding the direction by successive approximations, by rotating the wind vector without any objective reference to the target to be hit, cannot be justified in any way, as it is obvious that such use of the triangle of velocities represents only a useless complication, and is not a solution of the technical problem here considered.

The principle above disclosed may evidently be applied to any type of bomb sight for dropping bombs from aircrafts.

Hereinunder is described, with reference to the accompanying drawings, the application of the device to a free viewing sight, the description of the sight itself being however confined to those portions which are necessary for a complete understanding of the structure and of the operation of the device embodying the present invention.

The horizontal plate 1 (Figs. 2, 3 and 4) forming the general support or base of the apparatus, is mounted on the aircraft in such a way that its axis B—B (Fig. 2) is parallel to the horizontal projection of the longitudinal axis of the aircraft itself when the latter is set in the horizontal trim, said plate serving to support two vertical rods 2, 3 and two hollow coaxial rods 4, 5; the three axes of these four rods lying in the vertical plane passing through the line A—A (Fig. 2) normal to the line B—B.

The sight itself is formed by the bar 6, provided with two end cross pieces 7, 7', holding the horizontal cross hair line comprising three parallel threads, the central one 8 of which, is the lubber line, in cooperation with the ocular bead 9 supported adjustably in height on the column 10, fixed on plate 1, with a device for registering the retardation controlled by the button 11, interposed therewith. The sight is completed by an objective sight bead 12 supported by the bar 6, along which it may be displaced with means not shown in the figure.

The sight plane is determined by the objective sight bead 9 and by the thread 8; the sight bead 12 co-operates in determining the range angle. The bar 6 is integral with the hollow pivot 4, while column 10 is integral with the hollow pivot 5, co-axial with pivot 4.

In the theoretical case of no retardation, the ocular sight bead 9 should be placed on the vertical axis of the pivots 4 and 5; the forward displacement in the direction of the longitudinal axis of the aircraft shown in Fig. 2, having been regulated by rotation of the button 11, in order to take into account the retardation effect in relation due to the speed of the aircraft and to the shape of the bomb.

The vector triangle is instrumentally obtained by the three rods 13—2, 14—13, and 14—2, connected one to another by the pivot 2, fixed to the base plate, 1, by the pivot 13 fixed with respect to the rods 13—2 and 13—14, and by the pivot 14, connecting together two sleeves 15, 15' (Fig. 2), into which may slide respectively the two rods last mentioned. The rod 13—2 having an invariable length, representing the air speed, is normally maintained in the direction B—B of the longitudinal axis of the aircraft, by the pressure exerted by two opposite small pistons 16, 16' provided with inner cylindrical springs; the rods 14—13 and 14—2 represent, in the same scale as the air speed rod 13—2, respectively the wind vector and the ground speed. A pressure screw (not shown in the figure) operated by means of a button, which may be co-axial with pivot 14, serves to fix rod 14—13 with the sleeve 15, thus preventing any variation of length of the rod representing the wind vector. The triangle 13—2—14, remains however deformable, and hereinafter the means will be described by which said triangle may be caused to be non-deformable when desired, or subjected to a given deformation.

In normal conditions, that is to say, when the rod 13—2 represents both in size and in direction the air speed of the aircraft, the two sides 13—2 and 14—2 of the vector triangle 13—2—14, must be parallel respectively to the vertical plane passing through the sight bead 9, and through the axis of the pivot 4 and 5 and to the thread 8. Consequently, two horizontal connecting rods 17, and 18 are provided, both parallel to the vertical plane containing the axes of pivots 2, 3 and 4, 5, the first of which connects the pivot 13 to the vertical pivot 19, carried by an extension integral with the base of column 10, the second connecting rod connecting a pivot 20 on an extension of rod 14—2, with the pivot 21 carried by a rib integral with the bar 6 and consequently with the line, both said connecting rods having lengths equal to the distance between the axes of pivots 2 and 4—5. To the connecting rod 18 is also connected a rod pivoted at one end in the stationary pivot 3, and at the other end with the pivot 22 carried by the connecting rod, the distance between the pivots 20 and 22, being equal to the distance between the pivots 2 and 3. Below the base plate and on the rod 22—3, is keyed a knob 23, which in Fig. 3a is shown partly broken and turned with respect to Fig. 3, for the purpose of showing the details partly indicated in the scheme of Fig. 5.

Figures 4 and 5 show the pivot 13 carried at the end of connecting rod 17, while the ends of the rods 13—2 and 14—13, pivoted one above the other below said pivot, are provided with two electromagnets 24 and 25, fed with current from

a battery or cell 26 through a circuit in which is inserted the general contact breaker 27, controlled by hand by means of a small lever 28 (Fig. 4), and the switch 29 controlled by a lever 30, which is normally in the lifted position indicated in Fig. 3*a*; in such case, if the contact breaker is closed, only the electromagnet 24 is energized, while by gripping with the hand the knob 23, lever 30 is lowered, and switch 29 is actuated so that the electromagnet 24 becomes inactive, and the electromagnet 25 is energized. It is evident that in the first case the wind bar is integral with the air speed bar, and the triangle 13—2—14 becomes indeformable; in the second case the wind bar becomes integral with the connecting rod 17, and consequently said triangle may be deformed, the wind bar remaining always parallel to itself. On opening the contact breaker 27, as the rod 13—2 is maintained in place by the system of springs 16—16', it will be possible to operate the sight by means of the knob 23, and to measure, for example, the ground speed, recording it on to the respective rod by sliding thereon the sleeve 15' and thereby determining the wind vector, the length of which will be maintained unvaried by fixing sleeve 15 by means of its own pressure screw. After this preliminary operation has been completed, it is sufficient to close the switch 27 before leaving hold of the knob 23, in order that the sight may be ready to function according to the present invention, provided of course, that both during the setting of the vector triangle and in the phase preceding the manoeuvre of attack, the pilot maintains unvaried a straight and horizontal course of his aircraft.

When the bomber sees the target lying away from its course, he gets hold of the knob 23, and brings the projection of the thread 8 of the hair lines, observed through the sight 9, to pass on the target, in such a way, for example, that the thread 8 is brought in the direction indicated with 8' in Fig. 2. Owing to the connecting rod 18, the rod 14—2—20 will rotate to the position 14'—2, parallel to 8''. On the other hand, by gripping the knob 23, owing to the energization of the electromagnet 24, the wind rod 14—13 is prevented to modify its own angle with respect to the connecting rod 17, and consequently can move only with the latter, and keeping always parallel to itself, and as the distance 14—13 cannot be varied owing to the pressure screw above mentioned, the rotation of rod 14—2—20 produces the rotation of rod 13—2 round 2, against the action of the springs 16, 16', until this latter rod reaches the position 13'—2, while the distance 2—14 changed to the distance 2—14' owing to the sliding of said rod inside the sleeve 15'. Thus, following the simple sighting operation above described, the vector triangle 13'—2—14' is automatically formed, which represents in advance the trim of flight which must be realized for attacking the target; and in particular, the angle 13—2—13' provides both in amplitude and in direction, the turn to be effected to operate the attack, apart from the approximation mentioned above in connection with the statement of the invention.

After letting hold of the knob 23, as soon as the sighting operation has been effected in the way above described, owing to the interchangeable action of the electromagnets, the wind vector, in the position 14'—13' becomes freed from the connecting rod 17, and becomes connected with the air speed bar in the position 13'—2, thus causing the vector triangle to become indeformable.

After the manoeuvre of the bomber on the knob has ceased, the system of the springs 16, 16', produces the return of the air speed bar, and consequently also the return of the ocular sight, to their normal position, drawing with them the triangle 13'—2—14' without deforming it, and disposing it in the position 13—2—14'', and consequently also the thread 8' of the hair line in the direction 8'' with respect to the aircraft. On its return movement, the air speed bar follows in the opposite direction the angle of turn which is to be transmitted to the pilot automatically by using any known angle repeating device connected to an instrument indicating the direction of the course.

Excepting the particular of construction which may be changed in different cases, and which may differ from those above described with reference to the form of embodiment illustrated in the drawing, the device herein disclosed may be applied to any aiming sight both optical or free viewing for bomb dropping from aircrafts, and outside the field of military uses, it may be included in an instrument for aeronavigation.

What I claim is:

A correction device for bomb sights of the type comprising a deformable triangle of mechanical members representing to scale the air-wind-ground-speed triangle, having the ground speed member rotatable about a vertical axis, a base, a vertical column rotatably supported on said base, an ocular sight bead adjustable along said column, a sleeve integral with the base, a shaft carried by said sleeve for rotation about a vertical axis, a horizontal bar fixed to said shaft, cross pieces projecting laterally from said bar, three parallel sight wires stretched between said cross pieces the center one of which is a lubber line intersecting the axis of said vertical shaft, an objective sight bead adjustable along said lubber line, said beads coacting to determine a line of sight, and a link connecting said bar and ground speed member to maintain them parallel.

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