

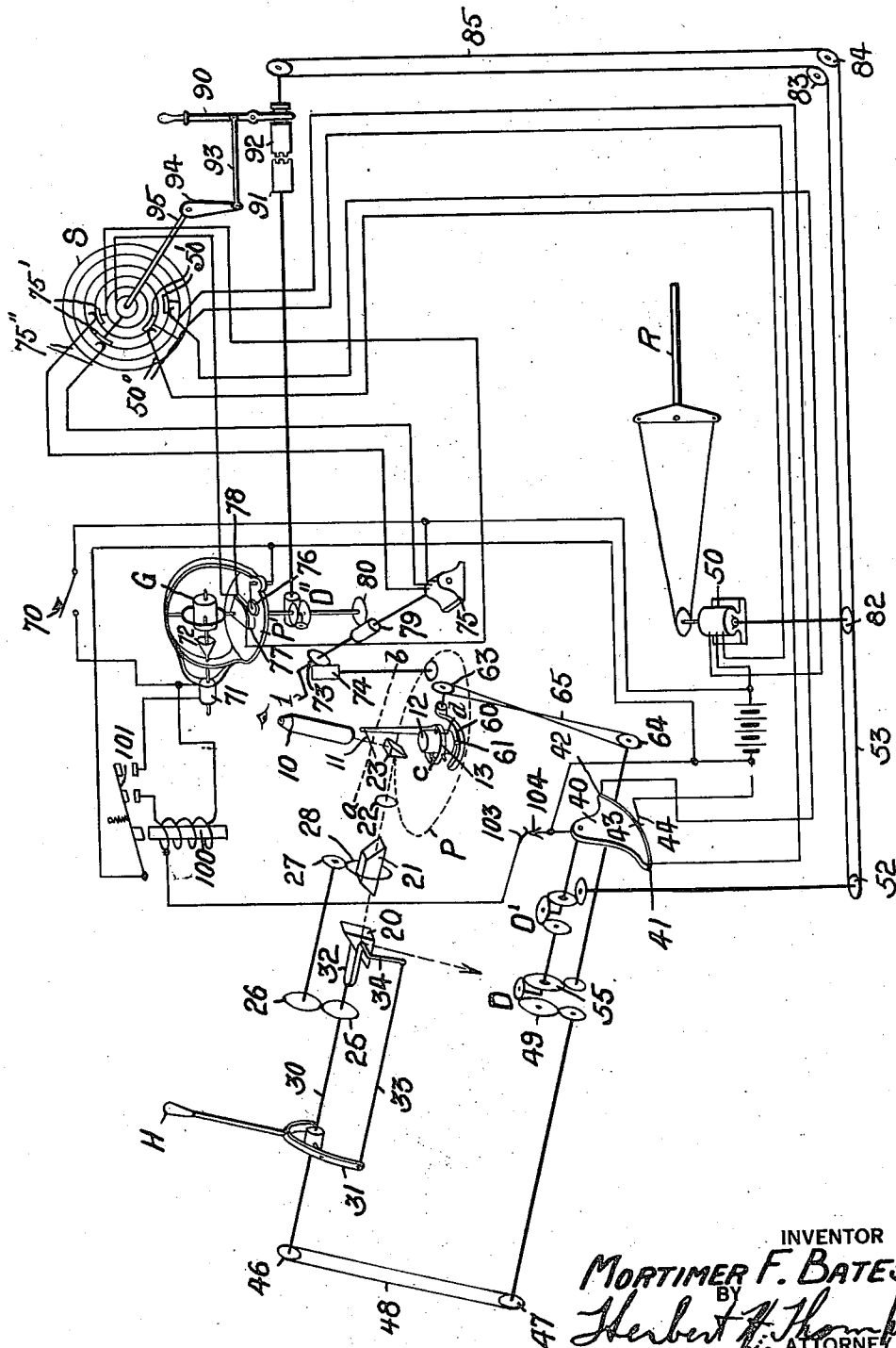
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BOMB SIGHT ALIGNMENT AND RUDDER CONTROL

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BOMB SIGHT ALIGNMENT AND RUDDER CONTROL

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This invention relates to bomb sights and aligning mechanism for dirigible aircraft, and has for one of its principal objects the provision of means whereby the steering of an aircraft may be directly under the control of the bomber at the bomb sight. More particularly it is an object of this invention to enable the bomber to steer the dirigible craft in the act of sighting upon a target. This distinguishes from all previous arrangements wherein the bomber operated an indicator near the pilot of the craft to indicate to the latter the desired direction, and the pilot then steered the craft accordingly. By this invention the pilot is relieved of the duty of steering the craft during the time of sighting and alignment on the target, and the alignment is accomplished more quickly and more effectively.

It is a further principal object of this invention to provide means whereby the direction of the craft may be aligned, i. e., changed to compensate for the drift angle, by the act of keeping the sight on the target or other objective.

A further principal object of this invention is the provision of means whereby the bomber can relieve himself of the duty of steering the craft when the latter is headed for the target by switching over the control of said steering to an automatic means such as a gyroscopically maintained baseline. It will thus be seen that at no time during the sighting operation is the steering of the craft under the control of the pilot, and by this invention direct or automatic steering by the bomber in the act of sighting is obtained.

A further object of the invention is to provide an automatic means for orienting the sight on the craft oppositely to the turning of the craft away from the target whereby the correct drift angle is set up and a straight ground track to the target arrived at. As soon as this point is reached the automatic steering means above described becomes effective

to maintain a straight ground track toward the target.

Further objects and advantages of this invention will become apparent in the following detailed description thereof, from which it will be apparent that certain aspects of the invention have application to the broad field of automatic flight of aircraft toward an objective as well as to bomb sights. However, such other applications of the invention are reserved for my copending application for bomb sight and pilot directors, filed July 18, 1931, Serial No. 551,654, which is a continuation in part of the present application.

The accompanying drawing is an assembly view, almost entirely diagrammatic, showing one preferred embodiment of my invention.

It should be understood that all computing mechanism has been suppressed and only those elements have been shown which have to do with the sighting and alignment operation.

Referring to said drawing there is disclosed a bomb sight which is adapted to be maintained on the target. Said sight may comprise the telescope 10, the stationary alignment wire $a-b$, and a wire 11 at right angles to said wire $a-b$ and adapted to be stabilized about an axis $c-d$ by means of a gyroscope 12, the said wire 11 being fixed to a gimbal ring 13 supported about said axis $c-d$. The inter-section of the said sighting wires $a-b$ and 11 is adapted to be maintained upon the target through the optical system which may comprise a reflecting prism 20, a dove prism 21, an objective lens 22, and a roof prism 23, the said optical system being designed to focus the ground image in the plane of the alignment wire $a-b$ and sighting wire 11, where it is viewed through telescope 10 in its natural relation to the eye of the observer. The said reflecting member 20 and dove prism 21 are mechanically mounted for rotation about a fore-and-aft axis, the said prism 21 being geared for a 2 to 90

1 ratio of movement with respect to reflecting member 20 through means such as gearing 25 to 28 inclusive, so that said prism 21 turns through one half the angle of movement around the fore-and-aft axis that the reflecting member 20 turns through and thus offsets the capsizing effect on the reflected image due to the said lateral tilt of the reflecting member 20. Such lateral movement around the fore-and-aft axis may be accomplished by means of handle H having a universal connection to the shaft 30 through a fork 31 pivotally connected to said shaft 30 for movement about a fore-and-aft axis. The reflecting member 20 may be mounted in a fork 32 carried by the shaft 30 so that said reflecting member may be tilted about an athwartship axis and movement about said axis may be accomplished by operating handle H in a fore-and-aft direction through the connection of fork 31 with reflecting member 20 through link 33 and arm 34. By rotating handle H laterally shaft 30 is rotated about its axis and reflecting member 20 is likewise rotated about said axis, while prism 21 is rotated about the same axis but through one half the angle. By this construction the target may be picked up by the bomber in the telescope 10, and held at the intersection of alignment wire *a-b* and sighting wire 11.

It will be appreciated that, in the embodiment of the invention shown it is the lateral movements of handle H which determine the direction of the target with respect to the craft and, therefore, I utilize such lateral movements of the handle as the signalling or controlling means whereby the steering of the craft may be governed so as to cause said craft to turn. For this purpose I may cause the handle to drive one member 40 of a contact system which includes live contact segments 41-42 separated by insulation 43 and cooperating with a contact 44. Such contacts may govern the steering either indirectly through signals to the human pilot or directly through an electromechanical servo motor. As shown, when contact 44 engages contact segment 41 or 42 it energizes a reversible motor 50 in one direction or the other to operate the rudder R in such direction as to cause the craft to turn so that its ground track will be a straight line toward the target. The handle H may be connected to member 40 through any suitable driving system, such as pulleys 46-47 and cable 48, operating through one side 49 of a differential D to actuate the said member 40. The motor 50 may operate a follow-back system comprising the pulleys 51-52, cable 53, and differential D' to the other side 55 of differential D, the planetary arm of the differential operating sector 40. As the craft heads toward the target, handle H will move toward the vertical, since the line of sight will also point toward the target, and when said handle H reaches the

vertical, contact 44 will engage insulation strip 43 to stop motor 50. Some slight movement of the line of sight in the other direction away from the target may take place which will cause handle H to be turned in the opposite direction to move the line of sight until it is again on the target and this will reverse the direction of rudder R to bring the craft again on a heading toward the target.

It will thus be seen that by the above arrangement I enable the bomber actually to perform the steering of the craft instead of merely signalling to a pilot for the desired direction of movement, as was the case heretofore.

If any rolling of the craft takes place it will be seen that the optical system will also roll with the craft and the line of sight will no longer be headed toward the target. Actuation of handle H laterally during such rolling movement to bring the line of sight back to the target would cause operation of rudder R to steer the craft unnecessarily into a different course. I, therefore, provide means whereby such lateral operation of handle H to compensate for rolling of the craft will not actuate the rudder R. For this purpose I cause the gyro 12 to stabilize in a fore-and-aft direction a channel member or loop 60 by means of a pin 61 on the gyro case engaging in said channel. Rolling of the craft will not affect the gyro and will, through the pin and channel connection, maintain channel member 60 in its original position. I cause this relative movement between the channel member and the rolling plane to introduce a correction which will nullify the tendency of handle H during such rolling movement to operate the rudder. For this purpose I may introduce through the other side 55 of differential D by any suitable drive, such as the pulleys 63-64 and cable 65, an equal and opposite movement to that introduced into the side 49 of differential D by the lateral movement of handle H to keep the line of sight on the target during such rolling movement. Therefore, member 40 will not be actuated and rudder R will not be operated.

Further, my invention contemplates not merely enabling the bomber to steer the craft but to provide automatic means for introducing the necessary correction for drift, which latter may be used either with or without fully automatic steering from the bomb-sight. At the instant that handle H is vertical and the craft is headed toward the target, I may close a switch 70 to energize an electro-magnet 71 which will attract a cage 72 normally engaging the axis of an azimuth gyro G so as to free said gyro which now maintains a fixed position in azimuth. Should the craft now drift sideways, due to cross wind, handle H will have to be operated laterally to cause turning of the craft until said craft is on a ground course toward the

target. Turning of the craft, however, will turn the line of sight off the target. It is, therefore, necessary to turn the optical system in a direction opposite to the direction through which the craft is turned for the drift correction, so that while the direction of the craft is changed to compensate for drift so that the fore-and-aft axis of the craft no longer points directly at the target, the line of sight will remain relatively fixed on the target. For this purpose it should be understood that the entire mechanism from handle H to telescope 10 is carried by a platform P, and I provide for rotating said platform P oppositely to the drift correction angle by utilizing the said free gyro G which maintains its position in azimuth. As the craft is turned to maintain a ground course toward the target, a motor 75 is energized to drive platform P in a direction opposite to the drift correction of the craft through any suitable driving means such as gearing 73—74. The said motor 75 is energized when the craft is given its drift correction by the fact that a trolley 76 movable with the craft engages one or the other of contacts 77—78 held fixed by gyro G. Engagement of trolley 76 with segment 77 or 78 energizes motor 75 in one direction or the other to operate platform P in the opposite direction to the direction of rotation of the craft for drift correction. Thus, in effect, as the heading of the craft is changed through a given angle to correct for drift, the sighting system is turned in the opposite direction and to an equal degree so that the alignment wire coincides with the ground course and intersects the target. A follow-up may be provided from motor 75 to the contact 76 through any suitable gearing such as 79—80, differential D' to the platform P' in which gyro G is pivotally mounted and which carries trolley 76.

I also may mount the free or directional gyro G and servo motor 75 on the same platform, utilizing a stationary azimuth gear concentric with platform P to engage with a pinion carried on the platform and driven by servo motor 75.

In order that the above-described mechanism for introducing the drift-correction may not be rendered effective until the craft is headed for the target, i. e. until the handle H is vertical, I provide means whereby energization of magnet 71 is prevented until such condition prevails. For this purpose I cause the circuit through magnet 71 to include not only switch 70 but also an electromagnet 100 normally de-energized and having its armature 101 disengaged, the circuit through said electromagnet 100 including a pair of contacts 103, 104. Contact 103 is fixed and contact 104 is carried by contact carrying sector 40, the said contacts being so positioned as to engage and close the circuit through elec-

tro-magnet 100 only when sector 40 is so positioned that contact 44 rests on insulation 43, i. e., when handle H is vertical and the craft is headed toward the target.

The drift correction will be ascertained and alignment secured after one or two approximations until the craft remains steady on its course with the handle H vertical and the target remains on the alignment wire. At this point I may provide means for shifting the burden of steering the aircraft to an automatic control, which in this instance is the azimuth gyro G. This is particularly desirable when flying at a great height when clouds are apt to intervene, obscuring the target at times. It has heretofore been pointed out that relative movement between the craft and the gyro G results in contact 76 engaging contact segments 77—78. I may utilize this set of contacts to control motor 50 to operate rudder R and keep the craft on the drift-corrected heading or correct ground course. For this purpose I provide a unitary control member in the form of a clutch handle 90 which may be shifted in a direction to cause clutch members 91 and 92 to engage so that motor 50 has a follow-up drive through pulleys 82—83—84, cable 85 and differential D' to the platform P' and trolley 76. At the same time that clutch 90 is operated to render the said follow-up motor 50 to trolley 76 effective, I may also cause the energization of motor 50 to be transferred from contacts 41—42 and 44 to contacts 76—77 and 78. I may accomplish this through means such as links 93 and 94 rotating shaft 95 carrying a switching disc S to break the circuit through motor 75 and contacts 77—78 by the movement of contacts 75' out of engagement with brushes 75'', and through motor 50 and contacts 41—42 by the movement of contacts 50' out of engagement with brushes 50'', while closing the circuit through contacts 77 and 78 and motor 50 through the engagement of contacts 75' with brushes 50''. All of these circuits are broken and made in the same operation with the clutching and unclutching of the clutch members 91—92.

It will be understood that the various control mechanisms for the rudder R described herein are in addition to the usual rudder-actuating means whereby the pilot may steer the craft when no sighting is being done.

Handle 1 may be provided for adjusting the position of platform P and of the sighting mechanism with respect to the craft. By this means a predetermined drift angle may be set up if desired, thus shortening the time required to bring the aircraft on the straight ground track.

In accordance with the provisions of the patent statutes, I have herein described the principle and operation of my invention, together with the apparatus which I now con-

sider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention extends to such use.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. In combination with a craft, a bomb sighting and aligning mechanism on said craft, automatic means for steering the craft, and means for automatically controlling said steering means from said mechanism.

2. In combination with a craft, a sighting and aligning mechanism on said craft, said mechanism including an operating member having universal movement, automatic means for steering the craft, and means for automatically controlling said steering means from said operating member.

3. In combination with a craft, a sighting and aligning mechanism on said craft, said mechanism including an operating member mounted for fore and aft and athwartship movements, automatic means for steering the craft, and means whereby the athwartship movements of said operating member controls said steering means.

4. In combination with a craft, a sighting and aligning mechanism on said craft, said mechanism including an operating member mounted for fore and aft and athwartship movements, means for steering the craft, means whereby the athwartship movements of said operating member controls said steering means, and means for preventing actuation of said steering means by the athwartship movements of said operating member in response to the rolling of the craft.

5. In combination with a craft, a sighting and aligning mechanism on said craft, said mechanism including an operating member mounted for moving the line of sight with respect to the ship to keep it on the target, and means whereby movements of said operating member govern steering of the craft, including a servo motor, a two-part controller therefor, and means for controlling one of said parts from said operating member.

6. In combination with a craft, a sighting and aligning mechanism on said craft, said mechanism including an operating member mounted for moving the line of sight with respect to the ship to keep it on the target, means for steering the craft, and means whereby movements of said operating member controls said steering means, including a

servo motor, a two-part controller therefor, means for controlling one of said parts from said operating member and a follow-back from said servo motor to the other of said parts.

7. In combination with a craft, a sighting and aligning mechanism on said craft, said mechanism including an operating member mounted for fore and aft and athwartship movements, means for steering the craft, means whereby the athwartship movements of said operating member controls said steering means including a servo motor and a two-part controller therefor, and means for preventing actuation of said steering means by the athwartship movements of said operating member in response to rolling of the craft including means responsive to rolling of the craft and means whereby said operating member and said responsive means differentially control one of the parts of said controller.

8. In combination with a craft, a sighting and aligning mechanism on said craft for sighting on a target, means for steering the craft, means actuated by the movements of said mechanism for controlling said steering means, and means whereby said mechanism introduces drift correction in the course of said craft while maintaining said mechanism on said target.

9. In combination with a craft, a sighting and aligning mechanism on said craft for sighting on a target, means for steering the craft, means whereby said mechanism controls said steering means, and means whereby said mechanism introduces drift correction in the course of said craft while maintaining said mechanism on said target, said last-named means including a base-line fixed in azimuth and means actuated thereby for fixing said sighting mechanism in azimuth.

10. In combination with a craft, a sighting and aligning mechanism on said craft for sighting on a target, means for steering the craft, means whereby said mechanism controls said steering means, and means whereby said mechanism introduces drift correction in the course of said craft while maintaining said mechanism on said target, said last-named means including a base-line fixed in azimuth and means whereby said baseline is rendered effective to fix the sight in azimuth when the craft is headed toward the target.

11. In combination with a craft, a sighting and aligning mechanism on said craft for sighting on a target, means for steering the craft, means whereby said mechanism controls said steering means, and means whereby said mechanism introduces drift correction in the course of said craft while maintaining said mechanism on said target, said last-named means including a baseline fixed in azimuth and means controlled by said base-

line for operating said mechanism through an angle equal and opposite to the angle of drift correction.

12. In combination with a craft, a sighting and aligning mechanism on said craft for sighting on a target, means whereby said mechanism introduces drift correction in the course of said craft while maintaining said mechanism on said target, said last-named means including a base-line fixed in azimuth, means whereby said baseline may be rendered effective when the craft is headed toward the target, and means including a servo motor and a two-part controller for said servo motor, one of said parts being controlled from said baseline and said motor being so connected to said mechanism that said mechanism is operated through an angle equal and opposite to the angle of drift correction.

13. In combination with a craft, a sighting and aligning mechanism on said craft, means for steering the craft, means in approaching a straight ground track toward the target whereby said mechanism may control said steering means, and automatic means for causing said steering means to maintain a straight course when said straight ground track is reached.

14. In combination with a craft, a sighting and aligning mechanism on said craft, means for steering the craft, means for controlling said steering means from said mechanism, and automatic means including a directional gyro for also controlling said steering means and means for transferring the control of the steering means from said sighting mechanism to said directional gyro when a straight ground track is reached.

15. In combination with a craft, a sighting and aligning mechanism on said craft, means for steering the craft, means whereby said mechanism may control said steering means, automatic means for controlling said steering means, and means whereby either of said steering means may be rendered effective and the other of said steering means ineffective.

16. In combination with a craft, a sighting and aligning mechanism on said craft for sighting on a target, means for governing the steering of said craft in accordance with the movements of said sighting mechanism, means whereby said mechanism introduces drift correction in the course of said craft in the act of maintaining said mechanism on said target, and means adapted to be rendered effective when said craft is on the drift corrected course for maintaining said craft on said course.

17. In combination with a craft, a sighting and aligning mechanism on said craft for sighting on a target, means for governing the steering of said craft in accordance with the movements of said sighting mechanism,

means for fixing said sighting mechanism in azimuth when the craft is headed toward the target and tilting said sight laterally to follow the target whereby said mechanism introduces drift correction in the course of said craft in the act of maintaining said mechanism on said target, automatic means for controlling said steering means, and means for rendering said mechanism ineffective and said automatic means effective to control said steering means when said craft is on the drift corrected course.

18. In combination with a craft, a sighting and aligning mechanism on said craft for sighting on a target, means for steering the craft, means whereby said mechanism controls said steering means, means whereby said mechanism introduces drift correction in the course of said craft in the act of maintaining said mechanism on said target, automatic means for controlling said steering means, and a single means for rendering said mechanism ineffective and said automatic means effective to control said steering means and for rendering ineffective said means whereby said mechanism introduces drift correction, when said craft is on the drift corrected course.

19. In a bombsight for aircraft, a sight directing means, means for mounting the same for orientation with respect to the craft, a directional gyroscope, and means actuated therefrom for turning the sight oppositely to turning of the craft.

20. In a bombsight for aircraft, a sight directing means, means for mounting the same for orientation with respect to the craft, a directional gyroscope, means actuated therefrom for turning the sight oppositely to turning of the craft through the drift angle, and means for maintaining a straight ground track toward the target when the correct drift angle is set up.

21. In a bombsight for aircraft, a sight directing means, means for mounting the same for orientation with respect to the craft, a directional gyroscope, means actuated therefrom for turning the sight oppositely to turning of the craft, and means also actuated from said gyroscope for steering the craft on a straight ground track toward the target.

22. In a sight directing means for aircraft, a bombsight, means for turning said sight whereby the same may be kept directed on the target, means whereby the steering of said craft may be governed in accordance with the movement of said means, means for setting up the correct drift angle and automatic means for maintaining a straight ground track toward the target when the craft is headed at the correct drift angle.

23. In a bombsight for aircraft, the combination with the movable optical system, and a common means for moving said system to maintain the sight on the target and for

simultaneously causing turning of the craft until a straight ground track is reached.

24. In a bombsight for aircraft, a target reflecting means, means for mounting the same for rotation in azimuth, for fore and aft tilting to follow the target and for lateral tilting to pick up the target and for causing said craft to line up with the target, means whereby turning of the craft is effected when said reflecting means is tilted laterally, a directional gyroscope, and means adapted to be brought into action when said reflecting means is laterally horizontal for orienting said reflecting means in azimuth from said gyroscope to set up the drift angle.

25. In a bombsight for aircraft, a target reflecting means, means for mounting the same for rotation in azimuth, for fore and aft tilting to follow the target and for lateral tilting to pick up the target and for causing said craft to line up with the target, means whereby turning of the craft is effected when said reflecting means is tilted laterally, a directional gyroscope, means adapted to be brought into action when said reflecting means is laterally horizontal for orienting said reflecting means in azimuth from said gyroscope to set up the drift angle, and means adapted to be brought into action when said correct drift angle and straight ground track is reached for automatically maintaining a straight course.

26. In combination with a craft, a sighting and aligning mechanism on said craft for sighting on a target, means whereby the steering of said craft is governed in accordance with said mechanism, means whereby said mechanism introduces drift correction in the course of said craft while maintaining said mechanism on said target, and means adapted to be rendered effective when said craft is on the drift corrected course for maintaining said craft on said course.

27. In a bombsight for aircraft, a target reflecting means, means for mounting the same for rotation in azimuth, for fore and aft tilting to follow the target and for lateral tilting to pick up the target and for causing said craft to line up with the target, means whereby turning of the craft is effected when said reflecting means is tilted laterally, a normally caged directional gyroscope, and means adapted to be brought into action when the craft is headed straight toward the target for releasing said gyroscope and for fixing said sight in azimuth therefrom.

28. In a bombsight for aircraft, a target reflecting means, means for mounting the same for rotation in azimuth, for fore and aft tilting to follow the target and for lateral tilting to pick up the target and for causing said craft to line up with the target, means whereby turning of the craft is effected when said reflecting means is tilted laterally, a normally caged directional gyroscope, means

adapted to be brought into action when the craft is headed straight toward the target for releasing said gyroscope and for fixing said sight in azimuth therefrom to set up the drift angle, and means adapted to be brought into action when the correct drift angle or straight ground track is reached for automatically steering the craft from said gyroscope on the determined course.

In testimony whereof I have affixed my signature.

MORTIMER F. BATES.

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