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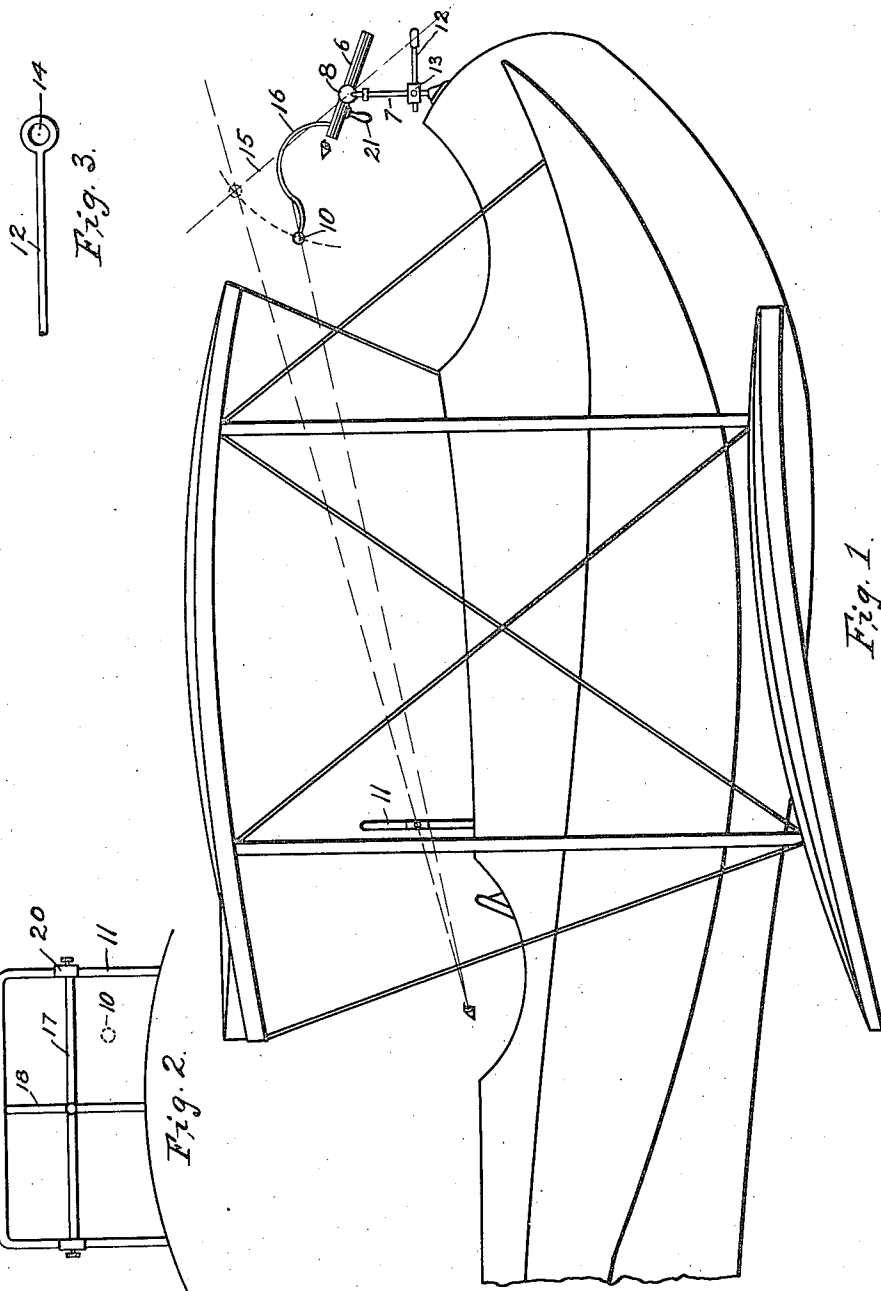
A. H. BOETTCHER

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PILOT DIRECTING INSTRUMENT AND BOMB DROPPING SIGHT FOR AIRCRAFT

Filed March 11, 1918

2 Sheets-Sheet 1



INVENTOR.

Arthur H. Boettcher

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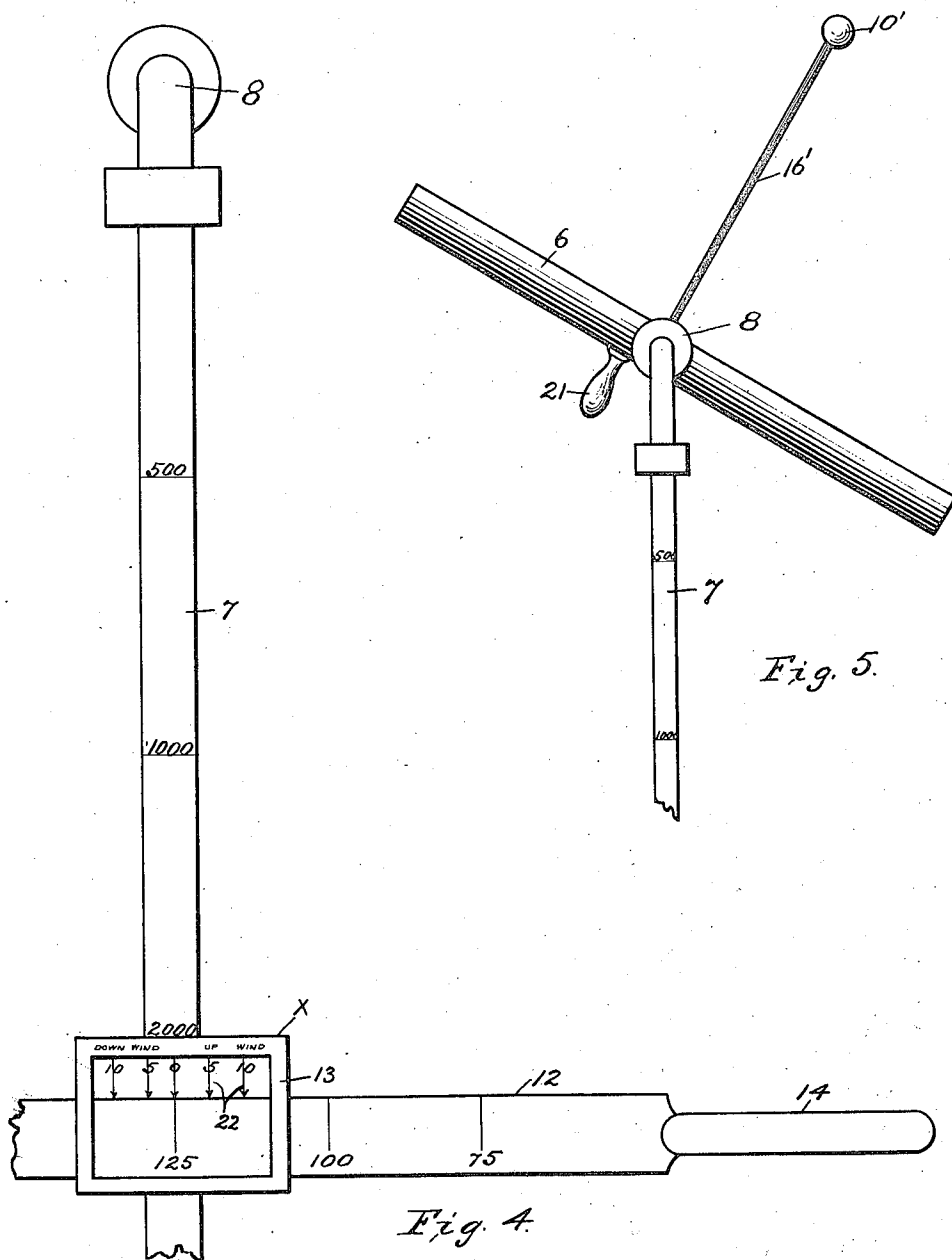
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INVENTOR

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UNITED STATES PATENT OFFICE.

ARTHUR H. BOETTCHER, OF CHICAGO, ILLINOIS.

PILOT-DIRECTING INSTRUMENT AND BOMB-DROPPING SIGHT FOR AIRCRAFT.

Application filed March 11, 1918. Serial No. 221,837.

To all whom it may concern:

Be it known that I, ARTHUR H. BOETTCHER, a citizen of the United States, residing at Chicago, Illinois, have invented new and useful Improvements in Pilot-Directing Instruments and Bomb-Dropping Sights for Aircraft, of which the following is a specification.

This invention relates to a pilot directing instrument and bomb dropping sight adapted to be carried by aircraft, and contemplates an arrangement whereby an observer at the nose of the machine may convey information to the pilot, whose view of an objective or target may be more or less obstructed, in order to enable the pilot more efficiently to maneuver the airplane accurately toward the objective and in bomb dropping toward the target for securing a hit on the release of the bomb.

The invention lies primarily in the pilot directing means which, per se, is useful in any case where accurate direction of flight toward an objective, particularly an objective below, as on the earth, and if need be over such objective, is required, as in bomb dropping, aerial photography, pursuit and navigation, as will be evident to those skilled in the art as this description proceeds; but the use which gave rise to its conception is that in connection with bomb dropping, in which the direction of flight is a fundamental factor, and consequently the invention goes beyond the pilot directing means, per se, and provides a bomb dropping sight in which the pilot directing means forms an inherent part and in which, in addition, certain improvements in bomb sights, specifically, are contemplated. This specification, therefore, dealing with the problems of bomb dropping and describing a novel bomb sight in detail, sets forth the pilot directing means in a most exacting use.

In order that a clearer perception of the present invention may be had, it may be stated that in dropping bombs from airplanes it is necessary for the pilot to steer his craft into proper position, relatively to the target, amply in advance of the time of dropping, so that the initial velocity of the bomb may lie accurately in the right direction. The pilot should also preferably be advised as to the time of dropping, having

regard to the trajectory of the bomb as determined by the speed and altitude of the machine, in order to secure a hit.

In the types of machines employed by the Navy, the pilot sitting down in his cabin is unable to see the water below and various expedients have been devised adapted to be actuated by the observer who is in a position to view the sea to assist the pilot in steering the craft into position. The best means thus far devised for this purpose, so far as known, comprises a series of three to five incandescent lights stationed before the eyes of the pilot and controlled by a corresponding number of electively operated switch buttons at the hand of the observer who, by actuating these buttons communicates to the pilot directions to steer more to the left or more to the right, still more to the left or still more to the right as the case may be. This method of communication like the hand waving signals which are also used is impractical and unsatisfactory, the chief difficulty being in the fact that it is more or less haphazard and indefinite, and the length of time to convey the intelligence is so great that it is frequently too late to use the information when the pilot receives it.

So far as the means for determining the line of sight for range is concerned, it may be made more or less elaborate according to the corrections which are to be taken into account. I propose a sight intended to correct only for speed and altitude and up and down windage, (that is, wind which decreases the speed over the earth and wind which increases the speed over the earth, respectively) although means for further corrections could also be included, and to associate with such a sight means for coordinating the efforts of the observer and the pilot, whereby the pilot, who is unable to see the target, may steer his craft effectively under the direction of the observer, who is able to see it.

To enable others skilled in the art so fully to comprehend the underlying features of the invention that they may embody the same into the numerous modifications in structure and relation contemplated by this invention, drawings depicting a preferred form have been annexed as a part of this disclosure, and in such drawings, like char-

acters of reference denote corresponding parts throughout all the views, of which:—

Fig. 1 is a side elevational view showing a portion of an airplane, more or less diagrammatically, with the device of my invention installed thereon.

Figs. 2, 3 and 4 are detail views of certain parts.

Fig. 5 is a fragmentary side elevation showing a slight modification.

One of the fundamental ideas is to provide a sighting means such as a tube or bar 6 mounted at 8 for universal movement on a suitable standard 7 at the forward part of the machine, which tube is to be kept by the observer directed at all times upon a discovered target. The pilot is kept advised of the movement of this tube or bar, and is thus enabled to steer his craft into position. With the use of the information thus transmitted to him by the observer, the machine may be readily directed so as to get on the line of the target and finally to assume a proper position relative to the target, at which instant the bomb is dropped by the act of either the observer or the pilot, preferably the former.

The means devised for keeping the pilot informed as to the position of the sight tube or bar thus trained upon the target includes an indicating means such as a semaphore ball 10 carried by the tube 6 and a cross-wire frame 11 mounted upon the machine in front of the pilot, through which the pilot can sight the semaphore ball. As shown more clearly in Fig. 1 of the drawing, the pilot is seated in his cabin while the observer sits or stands in the cockpit in the nose of the machine. The support 7 is directly in front of the observer's cockpit, on the center line of the machine and carries a second rod 12 at right angles thereto. This second rod is adjustable vertically upon the rod 7 and is also adjustable horizontally in a calibrated clamp 13. At the fore end of the rod 12 is a ring holding a disc of tinted glass 14, preferably orange, in order to provide a distinguishing sighting point. The joint 8 determines one of the points of the line of sight and the center of the ring 14 is the other determining point, the effective line of sight being indicated in the drawing by a dotted line 15. The vertically disposed rod 7 is calibrated according to the altitude, and the horizontally disposed rod 12 is calibrated according to the various speeds, (see Fig. 4) and it will therefore be clear that the ring 14 may be adjusted vertically and horizontally according to the altitude and speed to determine the proper range angle of the line of sight.

It has already been stated that the tube is universally mounted, and it will be clear that this tube may be brought into position with its axis co-incident with the ef-

fective line of sight, at which time the tinted glass of the ring will lie in front of the tube.

The tube 6 carries a rearward extension, or arm 16, having at the end thereof the semaphore ball or other indicating means 10, so disposed as to be in line with the center line of the tube. The arm 16 carrying this ball is preferably bent so that the observer may position his head, with his eye at the rear end of the tube.

Mounted upon the top of the fuselage or body, directly in front of the pilot's position, is the frame 11 of more or less rectangular shape in which are mounted vertical and horizontal cross-hairs 17 and 18, the horizontal wire 17 being mounted at 20 for vertical adjustment for use in a single point sight. Variations in the physical height of the pilot will cause certain inaccuracies to enter in. This fact may be overcome by varying the height of the seat of the pilot or by adjusting the wire 17. In other words, the pilot's eye should have a relatively fixed angular relation with respect to the cross-hairs at all times. The tube 6 is preferably provided with an operating handle 21 so that it can be conveniently maneuvered.

While it will be possible to set the calibrated sight while in flight, it is probable that the best plan is to set the sight for normal speed and altitude before going up. Whenever it is set, the cross-wire 17 will also be set as to height so that when the tube 6 is in effective sighting position the intersection of the cross-hairs will be in line with the semaphore ball as seen by the pilot.

It is also possible to provide compensation for up and down wind by having calibrations 22 on the clamping block 13 in which the horizontal rod 12 is mounted, with which the calibrations on this rod may be coordinated, the idea being to use the zero mark on the block for no wind, another mark for a head wind, and another mark for a rear wind, the marks being further augmented if desired by marks for different velocities.

As shown in detail view in Fig. 4, the calibrations on the vertical rod 7 are for altitude. For the purpose of illustration, three altitudes: 500, 1,000 and 2,000 feet, are shown. These calibrations can be determined mathematically, the distance from the origin to the points being proportionate to the squares of the altitudes which they represent, if it is assumed that the trajectory is a true parabola, but as a matter of fact it is not a true parabola, and the calibrations had better be determined by tests. The calibrations on the horizontal rod 12 are for speed, and the distances between the points are directly proportional to the values which

they represent. Since it is merely for illustration, but three speeds are given; 75, 100 and 125 M. P. H.

It will be clear that the block 13 can be raised or lowered on the vertical rod 7 and that the horizontal rod 12 may be moved longitudinally of itself in this block. The calibrations on the block are for coordination with the calibrations on the horizontal rod. If the plane is going down wind, then one of the right hand arrows is selected according to an approximation of its velocity, and if the plane is going up wind, then one of the left hand arrows is selected approximate to its velocity.

In operation it is intended that when the observer spots a target he will wave his arm, or otherwise signal to the pilot, to secure his attention upon the semaphore ball 10, and from that moment on it becomes the observer's duty to keep the sighting tube 6 trained upon the target at all times. Depending upon the position in which the pilot finds the semaphore ball in his sight field, he will steer his craft to bring the ball first to the vertical cross-wire and then up the vertical cross-wire to the horizontal cross-wire. It will be clear that with the sight tube always trained upon the target the ball will occupy the same relative position in the pilot's sighting field as the real target occupies relative to the machine in the real field, it being assumed, of course, that the machine is level both athwartships and fore and aft, or that proper allowance is made by the pilot for tilt and that drift is avoided or allowed for. Whether or not the craft is drifting may be determined by sighting down through the tube 6 along the member 12 upon any object upon the earth. When the object moves (relatively) parallel to the member 12, which is normally parallel to the keel as shown, there is no drift, the member 12 lying parallel to the actual line of flight of the aircraft over the earth. In the pilot's sighting field, the semaphore ball will occupy a position on the side of the vertical sight-wire opposite to that of the target. This is immaterial, but if desired it may be overcome, as for example my the modification shown in Fig. 5 hereinafter described.

Suppose, as indicated in Fig. 2, the pilot sights the semaphore ball 10 in the position there indicated, he will steer his craft towards the left, which action, as the observer keeps the sighting tube trained on the target, brings the ball over towards the vertical cross-wire. It will be clear how at every instant the pilot is kept advised as he is approaching the line of the target and when the ball finally reaches the vertical cross-wire, he knows that he has his target dead ahead. He then continues in that direction, and as the observer still follows the target with his sighting tube, the ball

will rise along the vertical cross-wire 18 until the horizontal cross-wire 17 is reached, at which instant the sighting tube will have assumed the effective line of sight, whereupon the observer or pilot will drop the bomb. The pilot is thus kept advised of the approach of the dropping point, so that he may flatten out and get ready to drop the bomb at the desired instant.

In the modification shown in Fig. 5, the tube or bar 6 is provided with a semaphore ball 10¹ carried by a rod 16¹ mounted upon the tube 6, but at right angles thereto, the idea being to keep the semaphore ball 10¹ on the same side of the target instead of the reverse side, as in the former sketch, as viewed by the pilot, and to bring the ball down in to the sight field rather than up as the craft approaches the target.

This invention is believed fully to solve the problem herein outlined in a highly efficient manner and accomplish, among others, all of the objects herein set forth.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can by applying current knowledge readily adapt it for various applications without omitting certain features that, from the standpoint of the prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention, and therefore such adaptations should and are intended to be comprehended within the meaning and range of equivalency of the following claims.

I claim as my invention:

1. In combination with an aircraft body having an observer's position and a pilot's position, a sighting member at the observer's position disposed in the direction of flight of the aircraft, a pivoted sighting member movably mounted at the observer's position, and indicating means visible to the pilot showing the movement of said sighting member relative to said first-named sighting member.

2. In combination with an aircraft body having a pilot's position and an observer's position, a sighting member at the observer's position disposed in the direction of flight of the aircraft, a movable sighting member at the observer's position, and an indicating device visible from the pilot's position, the location of said second sighting member relative to said first sighting member being a factor in the location of said indicating device.

3. In combination with an aircraft body having a pilot's position and an observer's position, a universally movable sighting member at the observer's position, and an indicating device visible from the pilot's position, the location of said indicating device being determined by the location of said sighting member.

4. In combination with an aircraft body having an observer's cockpit at the bow thereof and a pilot's cabin to the rear of said cockpit, a sighting member mounted for universal movement on the bow of said body, and means visible from said cabin for indicating the position of said sighting member.

5. In combination with an aircraft body having an observer's cockpit at the forward end thereof and a pilot's position to the rear of said cockpit, a sighting member mounted for universal movement at the observer's cockpit, a visual field at the pilot's position, and indicating means movable with said sighting member and visible to the pilot in said field.

6. In combination with an aircraft body having an observer's cockpit at the forward end thereof and a pilot's position to the rear of said cockpit, a sighting member mounted for universal movement at the observer's cockpit, and indicating means visible from the pilot's position, said indicating means being located according to the location of said sighting member and moved by the movement of said sighting member.

7. In combination with an aircraft body having an observer's cockpit at the forward end thereof and a pilot's position to the rear of said cockpit, a sighting member mounted for movement in azimuth at the observer's cockpit, a second sighting member at the observer's cockpit disposed in the direction of flight of the aircraft, a visual field at the pilot's position, and indicating means movable according to the movement of the first-named sighting member and visible to the pilot in said field.

8. In combination, two members adjustable relatively to each other and determining a sighting line, a sighting member movably mounted on one of said members and having line determining means, and indicating means the position of which is determined by the position of said sighting member, said sighting member being capable of assuming a position with its line determining means coincident with said sighting line.

9. In combination, two members adjustable relatively to each other and determining a sighting line, a sighting member movably mounted on one of said members and having line determining means, and means connected to said sighting member for indicating the position of said member to a distant point, said sighting member being capable of assuming a position with its line determining means coincident with said sighting line.

10. In combination, two members adjustable relatively to each other and determining a line of sight, a sighting member movably mounted on one of said members and having line determining means, said sighting member being capable of assuming a position

with its line determining means coincident with said sighting line, and means connected to said sighting member indicating the position of said sighting member and indicating when said line determining means is coincident with said line of sight.

11. In combination, two members adjustable relatively to each other and determining a sighting line, a sighting member universally movably mounted on one of said members and having line determining means, and indicating means connected to said sighting member, the position of said indicating means being determined by the position of said sighting member, said sighting member being capable of assuming a position with its line determining means coincident with said sighting line.

12. In combination, two members adjustable relatively to each other and determining a sighting line, a sighting member universally pivoted on one of said members, and indicating means, the position of which is determined by the position of said sighting member, said sighting member being capable of assuming a position with its line determining means coincident with said sighting line.

13. In combination with an aircraft body having an observer's position, and a pilot's position to the rear of the observer's position, a sighting member having line determining means mounted for universal movement at the observer's position, an indicator field visible from the pilot's position, a pair of members having parts associated with said sighting member and adjustable relatively to each other and determining a sighting line, said sighting member being capable of assuming a position with its line determining means coincident with said sighting line, and means in said field for indicating when said sighting line and said line determining means are coincident.

14. In combination with an aircraft body having an observer's position and a pilot's position to the rear of the observer's position, a sighting member having line determining means mounted for universal movement at the observer's position, an indicator field visible from the pilot's position, indicating means movable with said sighting member and visible in said field, a pair of members associated with said sighting member and adjustable relatively to each other and determining a sighting line, said sighting member being capable of assuming the position with its line determining means coincident with said sighting line, and cross wires in said field.

15. In combination with an aircraft body having an observer's position and a pilot's position to the rear of the observer's position, a sighting member having line determining means mounted for universal movement

ment at the observer's position, an indicator field visible from the pilot's position, indicating means moving with said sighting member and visible in said field, a pair of members associated with said sighting member and adjustable relatively to each other and determining a sighting line, said sighting member being capable of assuming a position with its line determining means co-incident with said sighting line, and adjustable cross wires in said field.

16. In a bomb dropping sight, a vertical member calibrated for altitudes, a horizontal member calibrated for speed, the relative positions of said members determining a sighting line, and a wind scale for adding to or subtracting from the calibrations on said horizontal member.

17. The combination, with an aircraft body having an observer's position and a pilot's position, of a sighting member universally movable at the observer's position and means visible to the pilot indicating any divergence between the vertical plane of the sighting member and the vertical plane of the axis of said body.

18. In combination with an aircraft body

having an observer's position and a pilot's position, of a sighting member universally movable at the observer's position and means visible to the pilot indicating divergence between the vertical plane of the sighting member and the vertical plane of the line of flight of the aircraft.

19. In combination with an aircraft body having an observer's position and a pilot's position, of a sighting member movable in azimuth at the observer's position, a sighting member set in the direction of flight of the aircraft and means visible to the pilot indicating any divergence between the vertical planes of said members.

20. In combination with an aircraft body having an observer's position and pilot's position, of a sighting member movably mounted at the observer's position, a sighting member set in the direction of flight of the aircraft, and means visible to the pilot indicating existing divergence between said members.

Signed at Washington, D. C., this 9th day of January, 1918.

ARTHUR H. BOETTCHER.