July 22, 1947. F. P. SHERMAN 2,424,257

TELESCOPIC DIVE BOMBSIGHT

Filed June 20, 1936 3 Sheets-Sheet 1

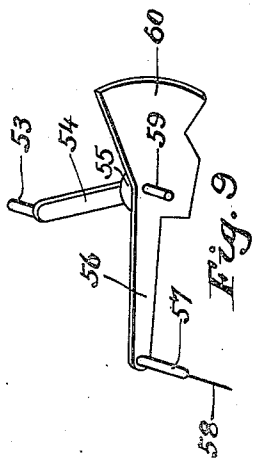

Fig. 9

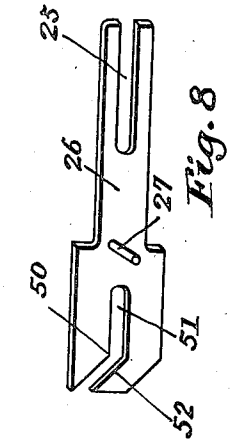

Fig. 8

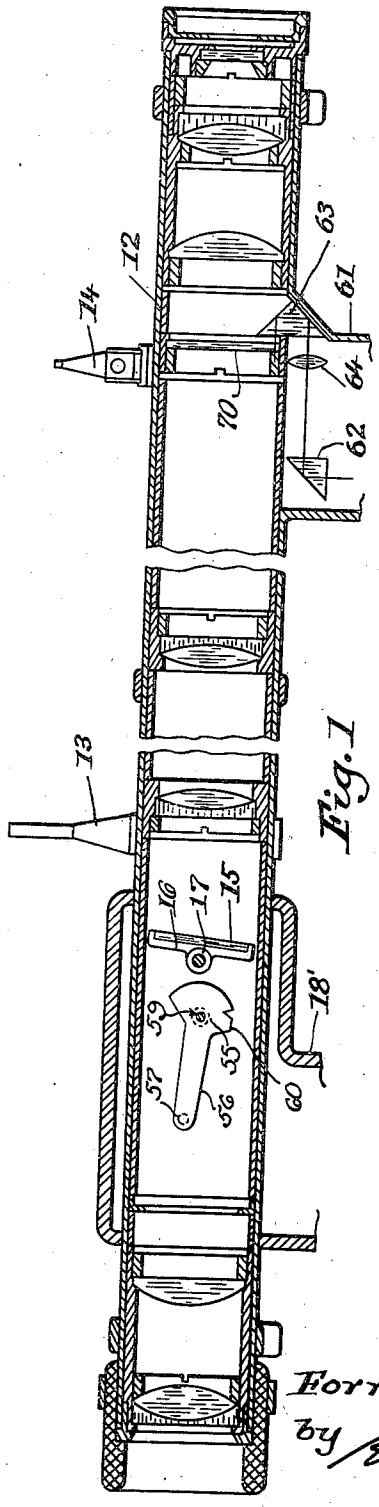

Fig. 1

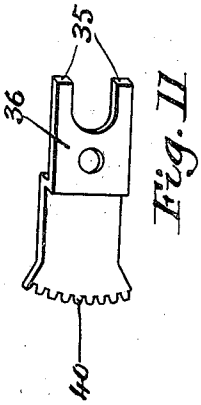

Fig. 11

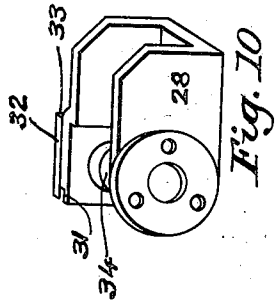

Fig. 10

Inventor:
Forrest P. Sherman
by Robert A. Lavender
Attorney

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TELESCOPIC DIVE BOMBSIGHT

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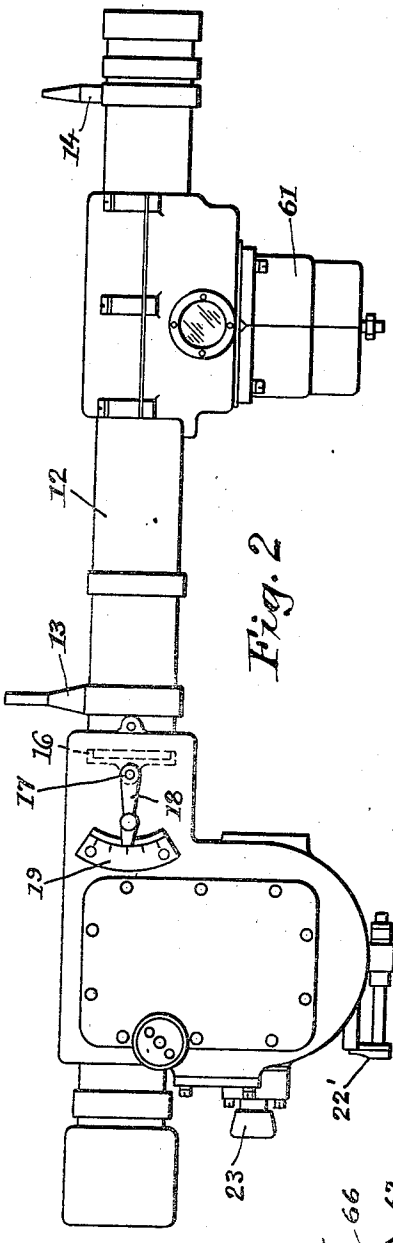

Fig. 2

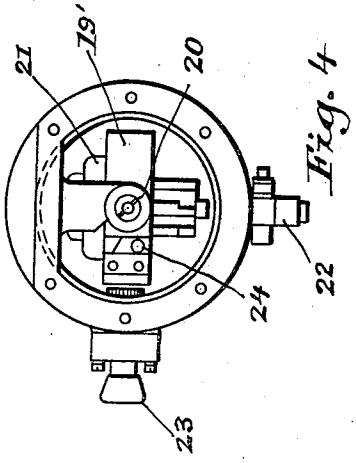

Fig. 4

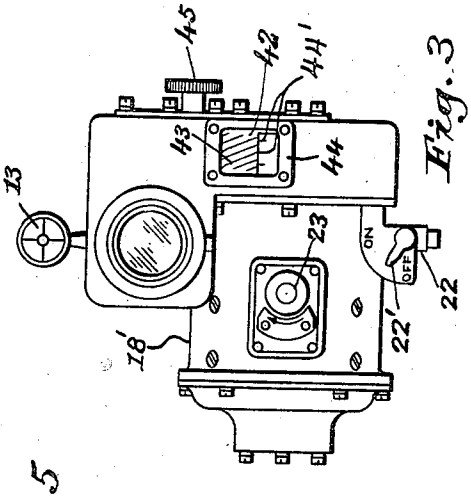

Fig. 3

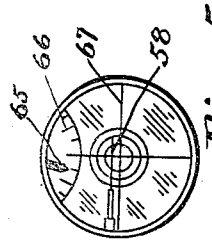

Fig. 5

Inventor:
Forrest P. Sherman
by Robert A. Lavender
Attorney

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TELESCOPIC DIVE BOMBSIGHT

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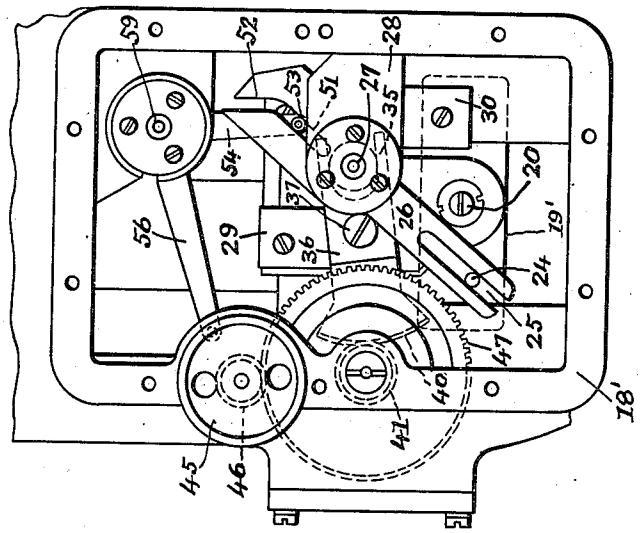

Fig. 6

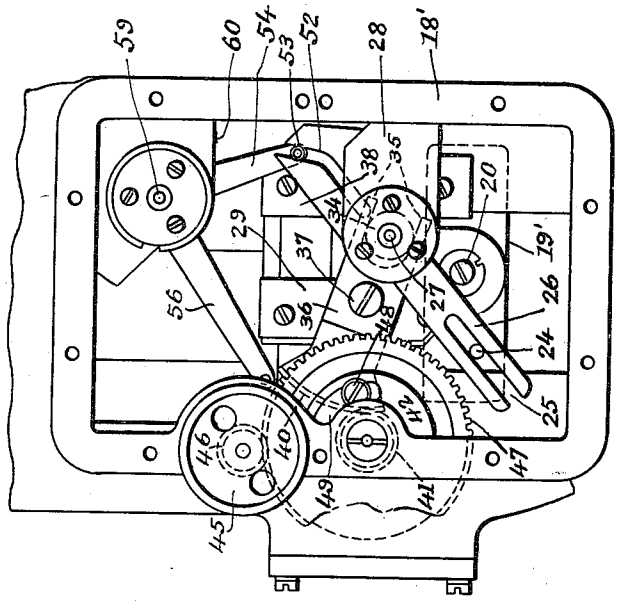

Fig. 7

Inventor:
Forrest P. Sherman
by Robert A. Saunders
Attorney

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TELESCOPIC DIVE BOMBSIGHT

Forrest P. Sherman, United States Navy

Application June 20, 1936, Serial No. 86,316

12 Claims. (Cl. 88—2.4)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to a sight for use on an aircraft when engaged in dive bombing and has among its objects to provide mechanism to cooperate with a telescope sight of well known type to generate continuously the correct sighting angle to direct the craft to insure striking the target when the bombs are released at a known air speed and altitude, which mechanism is adjustable to correct for the lift angle of the aircraft.

In the drawings:

Fig. 1 is a longitudinal section of the telescope sight illustrating certain additions thereto for the purpose of the present invention;

Fig. 2 is a side elevation of the present invention;

Fig. 3 is an end elevation thereof looking at the eye-piece end;

Fig. 4 is a detail view of the gyroscope as mounted;

Fig. 5 illustrates the appearance of the field in the telescope;

Figs. 6 and 7 illustrate the mechanism for generating the correct sighting angle;

Fig. 8 is a side elevation of the double forked lever for transmitting movement from the gyro to the movable reference element in the field of the sight;

Fig. 9 is a perspective view of the movable reference element and the motion transmitting arm connected therewith;

Fig. 10 is a perspective view of the slide upon which the lever of Fig. 8 is carried;

Fig. 11 is a perspective view of the gear sector lever that transmits movement from the altitude and speed adjustment to the slide shown in Fig. 10.

It is well known to those skilled in the art of dive bombing that the longitudinal axis of an airplane in a dive does not coincide with the flight path, the angle between the two lines defining the said axis and said path being dependent upon the lift angle of the craft when diving at any particular angle. Also, the line of sight from the craft to the target does not coincide with either of the above mentioned lines but is more steeply inclined than either. Thus it is necessary that the line of sight be inclined at a certain angle to the axis of the plane. It is the function of the present invention to generate this angle correctly for any given set of conditions of speed, altitude, and dive angle.

It can be shown that sufficient accuracy of aiming is attained when the angles between the line of sight, the axis of the plane, and the flight

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path are applied according to a simple relation although in reality the functions involved are very complex. Owing to the fact that the angle between the flight path and the horizontal is less than the angle between the axis of the craft and the horizontal, it is necessary that an initial adjustment be made to set the parts of the sight to allow for the lift angle. It is further necessary that some means be provided for maintaining a fixed relation with the horizontal, and in the present instance this is done by means of a gyroscope.

In Fig. 1 the telescope sight 12 is of more or less conventional design, having an optical system of well known type with a reticle 70 bearing vertical and horizontal cross lines and has mounted on its tube the rear open sight 13 and the front open sight 14. Since the lift angle of any given airplane when diving at a predetermined angle is known, it is possible to make the necessary adjustment to allow for the lift angle before the dive is begun. In the present invention this is accomplished by a plate 15 of glass having plane parallel faces mounted to be in the path of light passing through the telescope 12. The plate 15 is securely fixed at one end in a frame 16 carried by a pin 17 that is rotatably mounted in the tube of the telescope and has fixed to it an index 18 that cooperates with a scale 19 indicating various angles of lift. It is apparent that when the plate 15 is at right angles to the light passing through telescope 12 there will be no angular relation between the light emerging from plate 15 and that entering the plate, but when the plate 15 is tilted to some angle other than a right angle with respect to the light the emergent beam will be parallel to but vertically offset from the incident beam due to the refraction of the glass and, therefore, when the plate 15 is so tilted the position of the image of the horizontal cross line of the reticle will be displaced sufficiently to allow for the lift angle.

A housing 18' is secured to the telescope 12, and mounted therein in a gimbal 19' having horizontal trunnion 20 is a gyroscope 21 with its spin axis vertical. While any means of driving the gyro may be used, in the present instance, it is shown as being of the air driven type, the connection to the source of compressed air being through fitting 22 controlled by an arm 22'. A knob 23 operates the means for locking the gyro caging.

On gimbal 19' is a pin 24 that is disposed in slot 25 formed in one end of the lever 26, this lever being rotatably mounted on a pin 27 journaled

in the slide block 28. The slide block 28 is mounted in guides 29 and 30. As is shown in Fig. 10, the slide block 28 is channel shaped and has a rabbet 31 formed in one edge to receive the guide 29 and has secured to it a plate 32 that engages the inner face of guide 29 to hold the slide in the rabbet 31, the edge 33 of plate 32 riding along the edge of the guide 30. The cylindrical cross member 34 in the slide block is engaged by the forks 35 of the gear sector lever 36 which is pivoted at 37 on the slide 29 and has at its other end gear teeth 40 that mesh with a gear 41 fixed to the altitude and air speed drum 42. The drum 42 has on its periphery helical lines 43 indicating air speeds, any one of which may be set to coincide with the altitude graduations 44' on a scale 44 and when so set in coincidence the sight is adjusted for bombing at the speed and elevation indicated. Adjustment of the drum 42 is effected by turning knob 45 which is mounted on one end of a shaft that has on its other end a pinion 46 meshed with a gear 47 secured to drum 42 by means of a screw 48 that is threaded into one end of drum 42 and passes through an arcuate slot 49 in gear 47 to permit of minor angular adjustments between gear 47 and the drum. It is apparent that when the drum 42 is rotated, the lever 36 will turn about its pivot 37 and the slide 28 will be moved longitudinally of the guides 29 and 30.

In the end of lever 26 opposite the slot 25 is a slot 50 having a portion 51 parallel to the longitudinal axis of the lever and a portion 52 inclined thereto. Disposed in the slot 50 is a pin 53 that extends laterally from an arm 54 fixed to the sleeve 55 that has also secured to it an arm 56 bearing the laterally extending pin 57 to which is fixed the movable reference element 58 that extends into the field of the telescope. The inclined portion 52 of slot 51 is to facilitate positioning pin 53 in slot 51. Sleeve 55 is secured to a pin 59 mounted in brackets 60 that is carried by the housing 18. A counter-balance 60 is provided to offset the torques due to the arms 54 and 56 to cause the assembly of the arms 54 and 56 and sleeve 55 to rotate pin 59 in its bearings with a minimum of effort. It is apparent that shifting slide 28 will change the relative distances between pivot 27 and pin 24 on the one hand and pivot 27 and pin 53 on the other, thereby altering the extent of angular movement imparted to arm 54 by a given tilting of the gyroscope with respect to the axis of the telescope, the change in the ratio of the two distances being a function of the air speed and altitude for which drum 42 is set.

It is readily seen that when the airplane upon which the sight is mounted goes into a dive the gyroscope 21 will continue to spin about a vertical axis, which will cause a rotation of the gimbal 19 about its horizontal axis 20 with respect to housing 18' and this relative rotation will be transmitted by pin 24 to lever 26 and will result in the turning of the lever about its pivot 27. Such turning of the lever 26 will apply to the arm 54 a force that will rotate arm 54 and, consequently, arm 56, about pivot 59 and will change the position of movable reference element 58 in the telescope field, such change in position being a function of the angle of dive and of the position of slide 28 in the guides 29 and 30.

In the housing 61 there is disposed an altimeter (not shown) with the scale thereof so positioned that the altitude at which bombs are to be released is visible in the field of the telescope by reflection thereof in the prisms 62 and 63, the lens 64 being provided to restrict the cross sectional area of the beam in the prism 63 and give it an enlarged area in the field of the sight. The appearance of the field of the telescope is shown in Fig. 5 wherein the hand of the altimeter is designated by 65, the altimeter scale by 66, and the horizontal cross line of the reticle by 67, the movable reference member 58 appearing therein offset from the horizontal cross line 67.

The operation of my novel sight is as follows: It having been determined from what altitude and at what air speed the bombs are to be released, the drum 42 is set to bring the line representing the selected air speed into coincidence with the proper altitude mark on scale 44 and the plate 15 is adjusted to allow for the lift at the chosen angle of dive. As above set forth, the tilting of plate 15 causes the image of the horizontal cross line to be offset by a quantity that will compensate for the lift angle and when the airplane has maneuvered into position for beginning a dive the pilot so directs the craft that the image of the point of aim will coincide with the intersection of the fixed vertical cross line and the moving cross line 58. When the predetermined release altitude is reached the point of aim for a fixed target in still air is the target itself. When bombing a moving target or when the airplane and its bomb are influenced by wind an offset point of aim may be used to correct for wind and target motion.

This invention may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. The combination with a telescope sight having a reticle with horizontal and vertical fixed reference lines, of adjustable means in said telescope to displace proportionately to a known angle the light from said reticle to the eyepiece of the telescope, means for establishing a stable horizontal, a slide mounted adjacent the last mentioned means to be linearly movable, means including a drum and a forked lever associated therewith to move said slide in accordance with two known factors, a lever pivoted intermediate its ends to said slide, said pivoted lever having an elongated longitudinal slot in each end, a pin on said stable vertical means slidable in one slot in said pivoted lever, a rotatably mounted shaft, an arm at each end of said shaft, the said arms being angularly offset, a pin on one of said arms slidable in the other slot in said pivoted lever, and a horizontal reference element on the other of said arms extending into the field of said telescope, the position of said reference element in the field being varied by said pivoted lever in response to changes in the relative position of said telescope with respect to said stable horizontal means.

2. The combination with a telescope sight having a reticle with a horizontal fixed reference line, of a plate of transparent light-refractive material between the objective portion and the ocular portion of the optical system in said telescope lying transversely of the axis of the telescope, means to adjust the angular position of said plate with respect to said axis proportionately to a known angle, means for establishing a stable horizontal, a slide mounted adjacent said means to be linearly movable, means to position said slide in accordance with two known factors, a lever pivoted intermediate its ends to said slide, said lever having an elongated longitudinal slot in each end, a pin on said stable horizontal means slidable in a

rotatably mounted shaft, an arm at each end of said shaft, said arms being angularly offset, a pin on one of said arms slidable in the other slot in said lever, and a horizontal reference element on the other of said arms extending into the field of said telescope, the position of said element in said field being varied by said lever in response to changes in the relative position of said telescope with respect to said stable horizontal means.

3. The combination with a telescope sight having a reticle with a horizontal fixed reference line, of a plate of transparent light-refractive material between the objective portion and the ocular portion of the optical system in said telescope lying transversely of the axis of the telescope, means to adjust the angular position of said plate with respect to said axis proportionately to a known angle, gyroscope means including a cardan associated with said telescope, a slide mounted adjacen said gyroscope means to be movable transversely of said axis, means to position said slide in accordance with two known factors, a lever pivoted intermediate its ends to said slide, said lever having an elongated longitudinal slot in each end, a pin on said cardan slidable in one of said slots, a rotatably mounted shaft, an arm at each end of said shaft, said arms being angularly offset, a pin on one of said arms slidable in the other slot in said lever, and a horizontal reference element on the other of said arms extending into the field of said telescope, the position of said element in said field being varied by said lever in response to changes in the relative position of said telescope with respect to the spin axis of said gyroscope.

4. The combination with a telescope sight having a reticle with a horizontal fixed reference line, of a plate of transparent light-refractive material between the objective portion and the ocular portion of the optical system in said telescope lying transversely of the axis of the telescope, means to adjust the angular position of said plate with respect to said axis proportionately to a known angle, gyroscope means including a cardan associated with said telescope, a slide mounted adjacent said gyroscope means to be movable transversely of said axis, means to position said slide in accordance with two known factors, a rotatably mounted shaft, an arm at each end of said shaft, said arms being angularly offset, a horizontal reference element on one of said arms extending into the field of said telescope, and means carried by said slide connecting the other of said arms to said cardan, whereby the position of said element in said field is changed in response to variations of the relative position of said axis with respect to said gyroscope means.

5. The combination with a telescope sight having a reticle with a horizontal fixed reference line, of a plate of transparent light-refractive material between the objective portion and the ocular portion of the optical system in said telescope lying transversely of the axis of the telescope, means to adjust the angular position of said plate with respect to said axis proportionately to a known angle, gyroscope means including a cardan associated with said telescope, a rotatably mounted shaft, an arm on said shaft, a horizontal reference element on said arm extending into the field of said telescope, and means operatively connecting said shaft to said cardan, said means including a member settable in accordance with two known factors, whereby said shaft is rotated to change the position of said element in said field in response to variations of the relative position of said axis with respect to said gyroscope means.

6. The combination with a telescope sight having a reticle with a fixed horizontal reference line, of light refracting means in the path of light through said telescope, means to adjust said refracting means to vary the displacement of light thereby proportionately to a known quantity, a rotatable drum bearing speed indicia, a scale associated therewith bearing altitude indicia with which said speed indicia may be brought into coincidence, a gear fixed to said drum, a lever pivoted intermediate its ends having at one end a gear sector meshed with said gear and a fork at its other end, a slide with which said fork is engaged, a lever pivoted intermediate its ends to said slide, a stable horizontal device operatively connected to one end of the last mentioned lever, and a movable reference element projecting horizontally into the field of said telescope operatively connected to the other end of the last mentioned lever, whereby the position of said element in said field is varied in response to changes in the relative position of the axis of said telescope with respect to said stable horizontal device.

7. The combination with a telescope sight having a reticle with a fixed horizontal reference line, of means to vary the apparent position of said line in the field of said telescope proportionately to a known quantity, a rotatable drum bearing speed indicia, a scale associated therewith bearing altitude indicia with which said speed indicia may be brought into coincidence, a gear fixed to said drum, a lever pivoted intermediate its ends having at one end a gear sector meshed with said gear and a fork at its other end, a slide with which said fork is engaged, a lever pivoted intermediate its ends to said slide, a stable horizontal device operatively connected to one end of the last mentioned lever, and a movable reference element projecting horizontally into the field of said telescope operatively connected to the other end of the last mentioned lever, whereby the position of said element in said field is varied in response to changes in the relative position of the axis of said telescope with respect to said stable horizontal device.

8. The combination with a telescope sight, having a reticle with a fixed horizontal reference line, of a rotatable arm, a reference member carried by said arm to extend into the field of said telescope, a second arm connected to and concentric with the said arm, a lever mounted to be movable transversely of its length and also rotatable, said lever having in one end a slot with a portion extending longitudinally of the lever and a portion extending at an angle to the first mentioned portion, and in the other end a longitudinally extending slot, a pin on said second arm slidable in the first mentioned slot, means to vary the position of the pivot of said lever proportionately to two known quantities, and means to rotate said lever about its pivot through an angle that is a function of the inclination of the axis of the telescope from the horizontal.

9. The combination with a telescope sight having a reticle with a fixed horizontal reference line, of means to vary the position of the image of said line in the field of the telescope, a movable reference member extending horizontally into said field, means to maintain a stable horizontal, means operatively connecting said movable reference member to said stable horizontal means whereby the position of said movable reference member in the field is changed by movement of the telescope with respect to the horizontal, and means to vary the extent of move-

ment of said movable member in response to a given magnitude of movement of the telescope with respect to the horizon.

10. The combination with a telescope sight having a reticle with a fixed horizontal reference line, of means settable to vary the position of the image of said line in the field of the telescope proportionately to the lift angle of an aircraft upon which the sight is mounted, a movable reference member extending horizontally into the field of the telescope, means to set the position of said member initially in accordance with an altitude and a speed, and means acted upon by the last mentioned means to vary the position of said member in accordance with the inclination of said telescope to the horizontal, the degree of variation in the position of said member by a given change in said inclination being controlled by the action of the said last mentioned means.

11. The combination with a telescope sight having a reticle with a fixed horizontal reference line, of means settable to vary the position of the image of said line in the field of the telescope proportionately to the lift angle of an aircraft upon which the sight is mounted, a movable reference member extending horizontally into the field of the telescope, means to set the position of said member initially in accordance with an altitude and a speed, means acted upon by the last mentioned means to vary the position of said member in accordance with the inclination of

said telescope to the horizontal, the degree of variation in the position of said member by a given change in said inclination being controlled by the action of the said last mentioned means, and means to project into said field the reading of an indicating instrument.

12. The combination with a telescope sight having a reticle with a fixed horizontal reference line, of a member settable to vary the position of the image of said line in the field of the telescope proportionately to the lift angle of an aircraft upon which the sight is mounted, a movable reference member extending horizontally into the field of the telescope, and means to bring said member into alignment with said image under predetermined conditions.

FORREST P. SHERMAN.

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