Sept. 25, 1951 F. V. KUZMITZ ET AL 2,569,010

GUN SIGHT

Filed Jan. 2, 1943 6 Sheets-Sheet 1

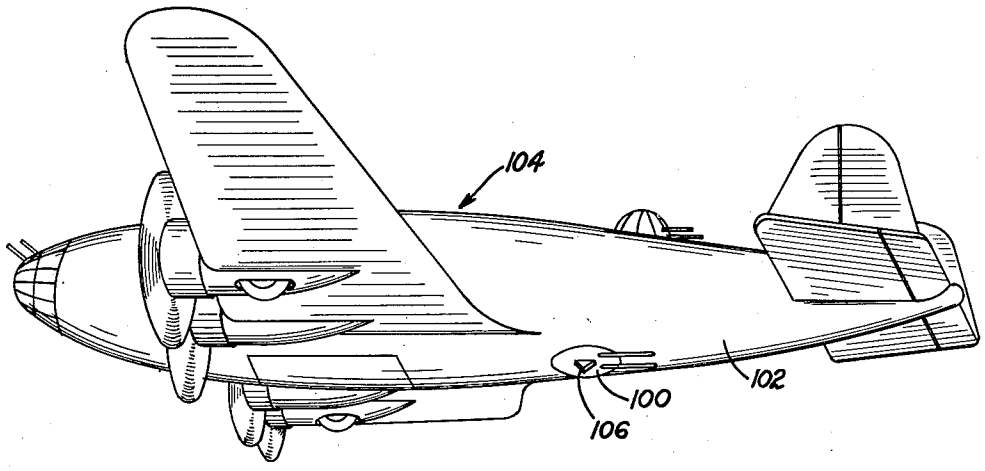

FIG. 1

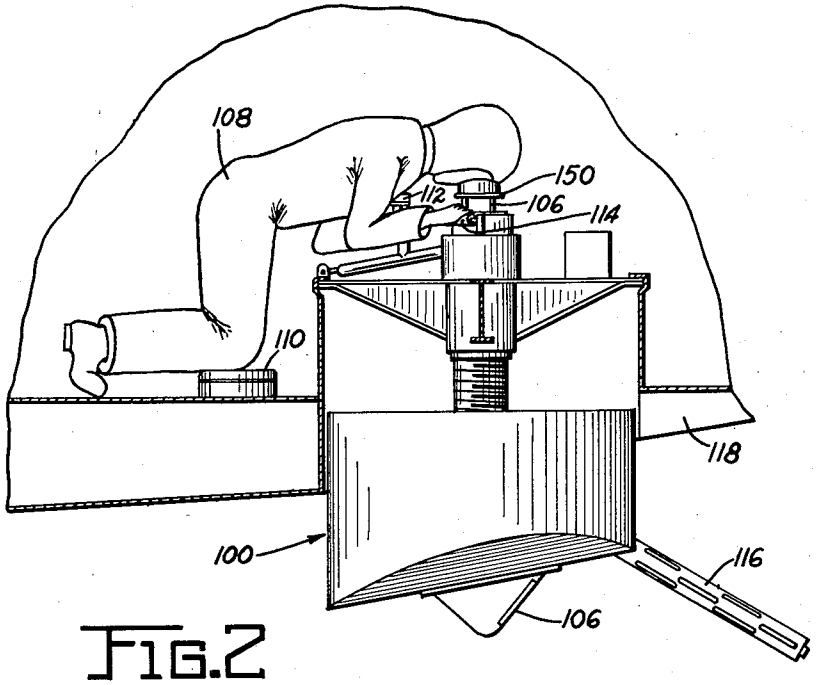

FIG. 2

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GUN SIGHT

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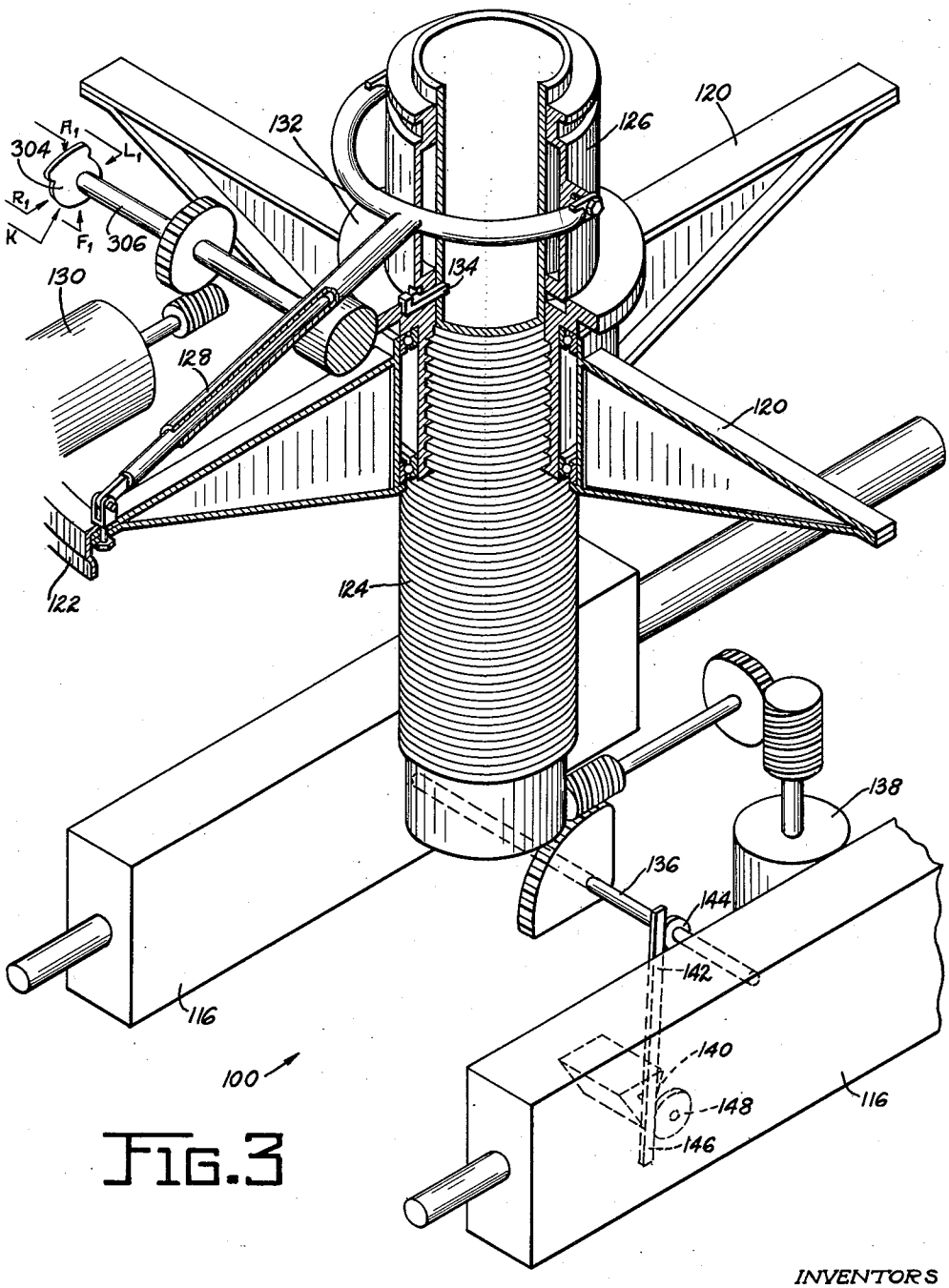

FIG. 3

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GUN SIGHT

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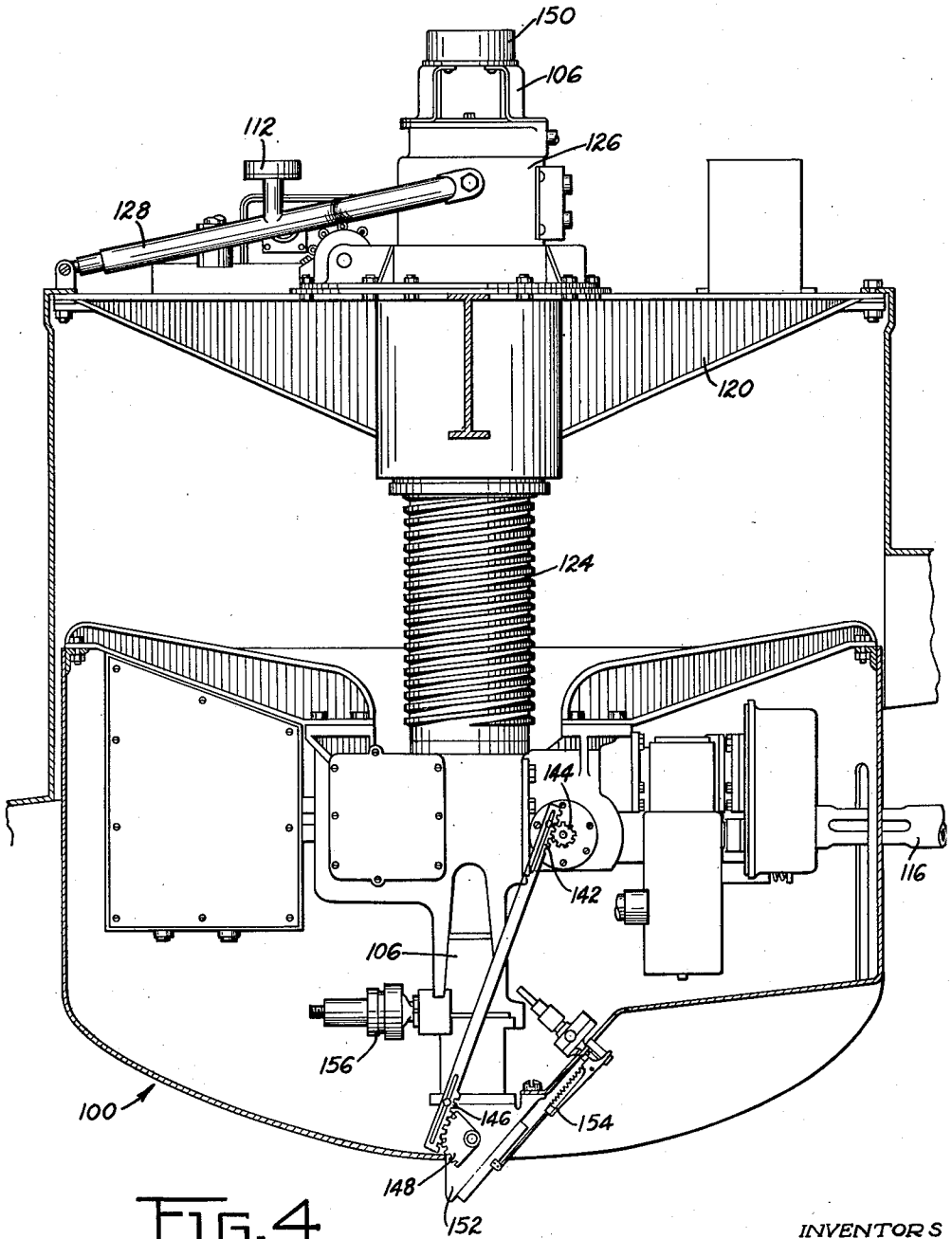

FIG. 4

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GUN SIGHT

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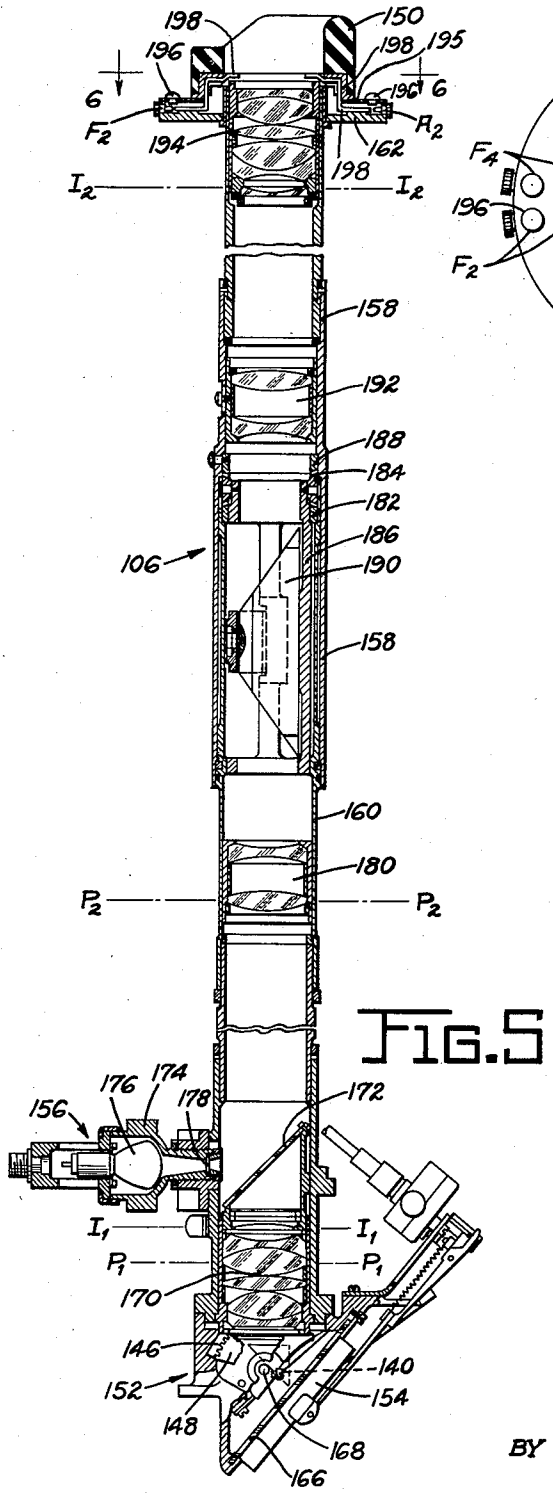

FIG. 5

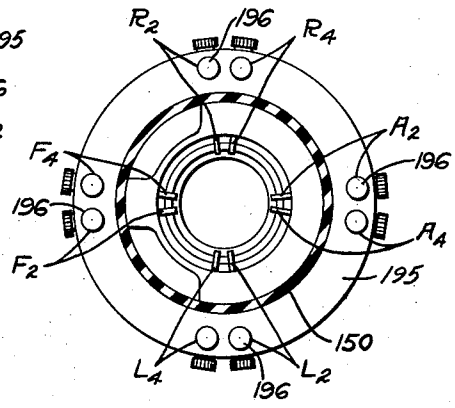

FIG. 6

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GUN SIGHT

Filed Jan. 2, 1943 6 Sheets-Sheet 5

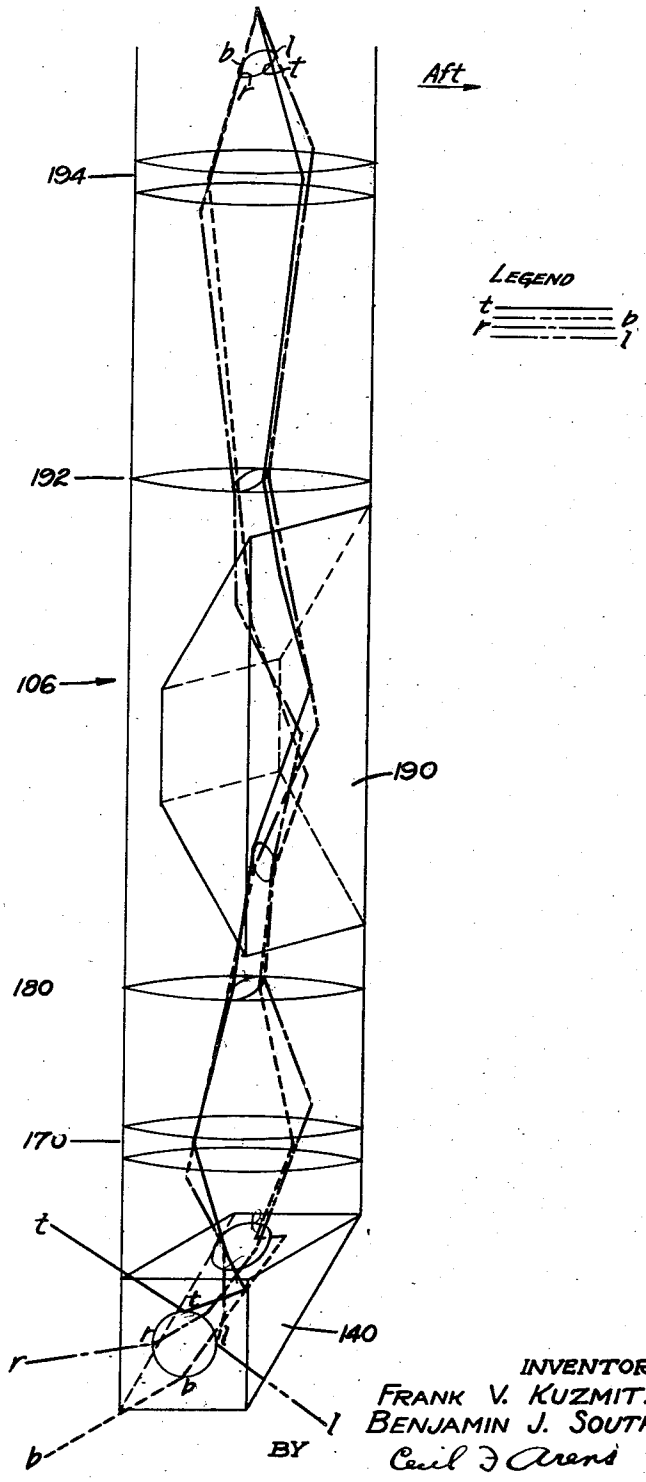

FIG. 7

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GUN SIGHT

Filed Jan. 2, 1943 6 Sheets-Sheet 6

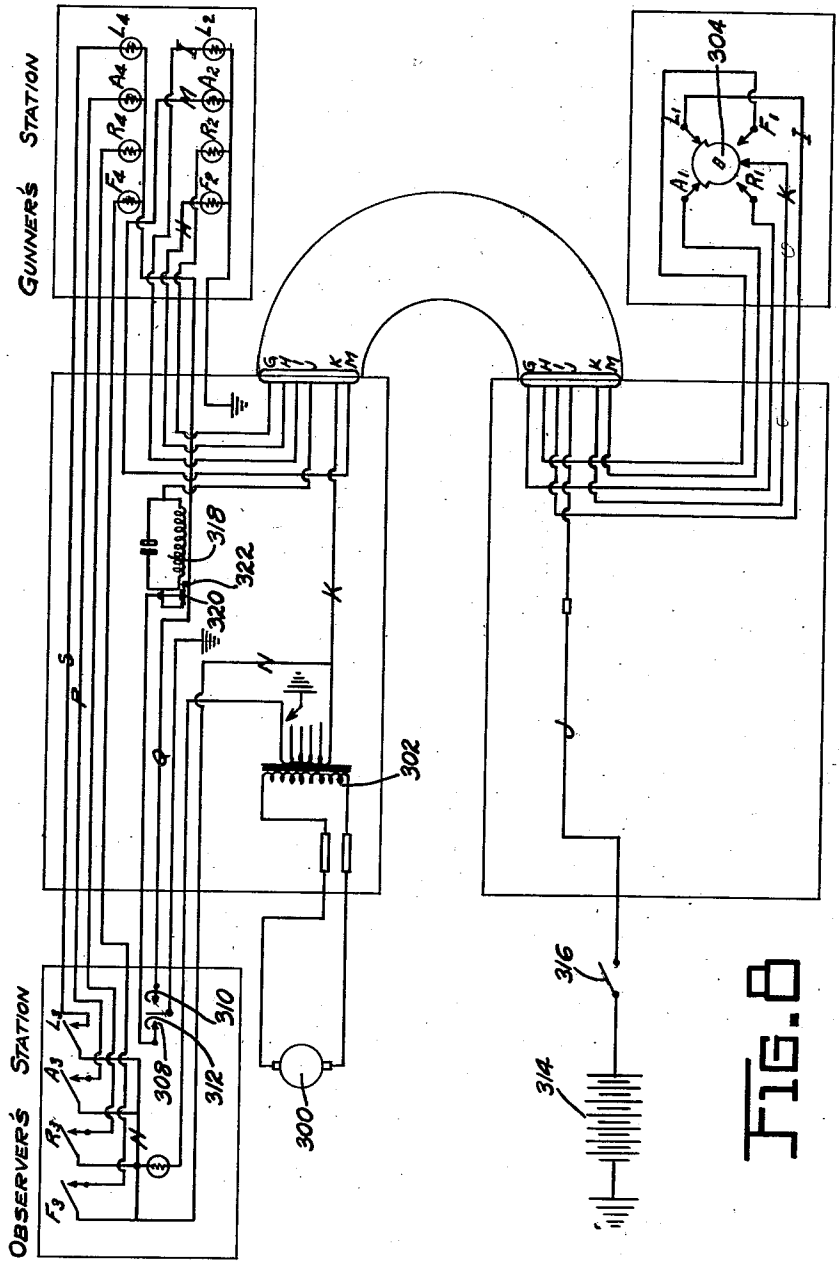

FIG. 8

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2,569,010

UNITED STATES PATENT OFFICE

2,569,010

GUN SIGHT

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Application January 2, 1943, Serial No. 471,124

4 Claims. (Cl. 33—49)

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This invention relates to gun turrets and particularly to turrets of the type which may be used in aircraft. More particularly, the invention relates to improvements in sighting means for turrets of the type where the gunner occupies a fixed station with respect to the aircraft, and sights upon a target by means of a sight which moves with the guns in all positions of elevation and azimuth.

It is an object of this invention to provide a turret having therein novel sighting means which will produce an erect image to the gunner for all positions of the turret in azimuth.

Another object is to provide a sighting mechanism for a turret which will be synchronized with the movement of the guns of said turret for all positions in azimuth and elevation.

A still further object comprehends the provision of novel means for indicating to the gunner the position of the guns of said turret in azimuth.

Yet another object of the invention includes a novel signaling arrangement for indicating to the turret gunner the position of enemy targets both in azimuth and elevation.

A further object comprehends the provision of novel means both for indicating the position in azimuth of the turret guns and for indicating the position in azimuth of an enemy target.

The foregoing and other objects of the invention will be apparent from the drawings and the description hereinafter following, which form a part of this specification. It is to be understood, however, that the embodiment described is merely a preferred one, other embodiments made according to designer's choice falling within the spirit of the invention being distinctly reserved, the scope of the invention being determined only by the claims which are hereto subjoined.

In the drawings forming a part of this specification:

Figure 1 is a substantially side view of an aircraft carrying a bottom, retractable turret having incorporated therein the improvements forming a part of this invention;

Figure 2 is an enlarged sectional view of the aircraft shown in Figure 1 in the vicinity of the turret, showing the turret in an extended or working position, and being under the control of a gunner;

Figure 3 is an isometric, diagrammatic view of the turret in an extended position, showing the power means for controlling the movements thereof in both azimuth and elevation;

Figure 4 is a substantially side view of the turret in a plane normal to the axis of elevation

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rotation of the guns shown in Figure 3, showing in some detail certain of the parts thereof, and showing certain details of the sight forming a part of this invention;

Figure 5 is a detailed longitudinal section of the sight shown in Figures 1, 2, and 4;

Figure 6 is transverse section of the sight shown in Figure 5 taken along the lines 6—6;

Figure 7 is a schematic, isometric, view of the sight shown in Figure 5, the parts thereof being arranged according to the position they occupy when the turret has rotated to 90° azimuth position; and

Figure 8 is a wiring diagram showing the circuit for controlling the indicator system shown in Figures 5 and 6.

Referring now to Figure 1 of the drawings, the new and improved turret forming a part of this invention is shown as a bottom, retractable type turret 100 mounted in such a manner that it is substantially flush with a fuselage 102 of an aircraft 104, thereby imposing very little drag on the aircraft 104 when in the retracted or non-operating position. A novel sight 106, forming a part of this invention, is shown with its objective end protruding but slightly from the bottom surface of the turret 100.

Reference is made to Figure 2 to show the turret 100 in an extended or working position, wherein a gunner 108 kneels on a cushion 110, his chest being supported on a rest 112 attached to the turret 100. As shown, the gunner 108 is peering through the eyepiece 150 of the sight 106, and is also controlling the movement of the turret 100 and the guns thereof in azimuth and elevation by manipulating with his right hand a single control 114. In Pontius et al. application Serial No. 438,602, filed April 11, 1942, now Patent No. 2,404,090 granted July 16, 1946 there is described and claimed a suitable form gun turret power control, although other forms may also be used if desired.

Guns 116 are mounted in the turret 100, and for providing a recess for the guns 116 when the turret 100 is retracted a pair of gun wells 118 are provided in the fuselage 102.

The mechanical and electrical parts relating to the turret 100 are shown diagrammatically in Figure 3, and as shown, the turret 100 is supported on a four arm spider 120 which is secured to structural members such as at 122 of the aircraft 100, and which has rotatably mounted at the center thereof a column 124 adapted to move axially with respect to the spider 120 for retracting and extending movement of the turret

100, and adapted also to rotate with respect thereto for azimuth movement of the turret 100.

A head unit 126 mounted on the upper end of the column 124 is adapted to rotate with respect to the column 124 and to move longitudinally therewith according to the retracting or extending movement of the turret 100. However, head unit 126 is restrained from rotative movement with respect to the spider 120 by a telescoping yoke member 128 secured at its inner end to the head unit 126 and at its outer end to an extreme end of the spider 120. Head unit 126 is also adapted to hold against rotative movement the eyepiece 150 of the sight 106, which is not shown in Figure 3.

For moving the guns 116 in azimuth and for retracting the turret 100 a single power source 130 is provided which acts through an appropriate gearing system as shown to rotate a ring gear 132 which has an internally threaded portion for cooperating with the threaded portion of the column 124. Movement in azimuth of the guns 116 is effected by means of a key 134 which engages both the ring gear 132 and the column 124, as is described and claimed with particularity in Pontius et al. application Serial No. 407,468, filed August 19, 1941, now Patent No. 2,389,997 granted November 27, 1945.

For effecting the movement in elevation of the guns 116 there is mounted at the lower end of the column 124 a rotatable shaft 136 which has secured at each end thereof gun 116. The power means for moving the guns in elevation includes a motor 138, which operates through the gear train shown.

For gathering in the field of view of the sight 106 shown in Figures 1, 2, 4, 5, 6 and 7, a field scanning piece or prism 140 is provided which is synchronized in its movements with the movements of the guns in elevation by means of a rack 142 engaging a pinion 144 secured to the shaft 136 and a second rack 146 engaging a second pinion 148 secured to the prism 140. Thus, for any movement of the guns in elevation there is a corresponding movement of the prism 140 to scan the target field, and since the prism 140 is immovable with respect to the guns as they move in azimuth, it will be seen that the field scanning piece is correctly positioned for any position of the guns in elevation and azimuth.

Referring now to Figure 4, there is shown with more detail the placement of the sight 106 with respect to the center column 124 of the turret 100. The sight extends above the head piece 126 and terminates at its upper end in the rest 150 made of sponge rubber or the like for the gunner 108. The sight 106 extends below and beyond the lower end of the column 124, and is provided at the lower end thereof with a housing 152 for the field scanning piece 140 and for an objective lens system (not shown in Figure 4). The objective face of the housing 152 is provided with a glass window 166 (shown in Figure 5) which can be kept free of ice or rain by an automatic wiper arrangement 154 driven by appropriate means.

Means are provided for giving an illuminated reference pattern for sighting purposes to the gunner. As shown generally at 156 in Figure 4, the means includes a lamp housing having a lamp therein whose rays impinge against a reticle to give a desired light pattern. Reference will be had to Figure 5 for the details of construction of the reference pattern illuminating means 156.

The details of the optical system of the improved sight forming a part of this invention is shown in Figure 5. The sight 106 comprises two cylindrical tube portions 158 and 160 which are coaxial with the axis of the center column 124 and which are adapted to rotate with respect to each other. The upper portion 158 is held against rotation by an integral flange 162 extending therefrom which is secured to the head piece 126. The lower cylindrical portion 160 is adapted to rotate with the guns 116 as they sweep in azimuth.

The lower or objective end of the sight 106 is supported by the lower cylindrical tube portion 160, which also carries at its lower end the housing 152 for enclosing the field scanning piece or prism 140. The glass window 166 forms a sighting or objective face for the sight 106, and it is kept free from moisture and ice by the wiper 154.

The field scanning piece 140 is journalled as at 168 in the housing 152, and is adapted to be rotated as the guns 116 move in elevation by means of the rack 146 and the pinion 148. It may be noted that for a given angle of change in elevation position of the guns 116, the angle of rotation of scanning prism 140 is one-half because the angle through which the reflected ray is moved must equal the angle of elevation movement of the guns.

An objective lens system 170 is provided for focusing the light received from the field of view upon an image plane I_1—I_1 from the principal plane P_1—P_1 of the objective system 170. The image formed on the image plane I_1—I_1 is then transmitted upwardly past a fractionally illuminized mirror 172 disposed at 45° to the axis of the sight 106. The fractionally illuminized mirror 172 is of the type which can reflect an image formed on its upper surface, and which can transmit substantially unchanged and through itself any light which impinges upon its under side.

For transmitting to the eye of the gunner 108 a reference or aiming point, a lamp housing 174 of the illuminating reference means 156 is provided which supports a lamp 176 mounted therein whose rays pass a reticle 178, forming a light pattern of any desired shape which is reflected from the mirror 172, upwardly to a principal plane P_2—P_2 of the objective side of an erecting system comprising lenses 180, a dove or double-right prism 190, and a similar group of lenses 192.

A second aiming pattern may be provided in the upper flat surface of the uppermost lens of the objective lens system 170, and may be in the form of a circle or a cross etched or ground into said lens.

As has been explained above, when the guns are moved in azimuth the ordinary periscope, or sight, which would give an erect image for the straight aft or 0° azimuth position to the gunner, whose position is fixed with respect to the airplane, would give images which are no longer erect as viewed by the gunner for positions other than 0° azimuth, that is, when the guns are pointed other than straight aft. Accordingly, to provide means to give an erect image to the gunner for whatever position in azimuth his guns happen to be pointed would facilitate his ability to train the guns on the target.

Referring once more to Figure 5 the dove prism 190, which is positioned between the double group of lenses 180 and 192, is adapted to move to the half angle position in azimuth for whatever

angle in azimuth to which the guns 116 are turned, and with the double group of lenses 180 and 192 always erects the target image so that it always appears vertical and so that right and left are properly oriented to the gunner.

For moving the dove prism 190 to the half angle position there is provided on the upper end of the cylindrical portion 160 a beveled ring gear 182 which engages a plurality of pinions 184 which are carried in a mounting 186, which also supports the dove prism 190. Carried by the upper cylindrical portion 158, which, as has been explained before, is secured against rotation by being fastened to the head unit 126 by means of the flange 162, is a second beveled ring gear 188 which similarly engages the pinions 184. Since the lower cylindrical portion rotates with the turret in azimuth, and as the upper cylindrical member 158 is held against rotation, by a suitable selected gear ratio, the prism 190 will rotate at one-half the angular speed of the guns 116.

The image formed on the image plane I_1—I_1 is thus transmitted through the erecting system, comprising lens group 180, dove prism 190 and lens group 192, and is then passed on, where it once more forms on an eyepiece image plane I_2—I_2 properly oriented for all positions of the guns 116 in azimuth. Thence the rays forming the image on image plane I_2—I_2 is viewed by a suitable eyepiece lens system 194.

Secured in a housing 195 which lies intermediate the eyepiece or rest 150 and the flange 162 are a plurality of indicator lamps, F_2 and A_2 of which are shown in Figure 5. Referring to Figure 6, which is a section taken along the lines 6—6 in Figure 5, there is shown all of the indicator lamps for signalling to the gunner both the position of the guns 116 in azimuth and the direction in both azimuth and elevation of an enemy target. Lamps A_2, L_2, F_2, and R_2 may be white in color and are adapted to light bull's-eyes 196 and are adapted also to transmit light rays to the inner ends of radially disposed plastic members 198, so that regardless of whether the gunner has his eye at the eyerest 150 or not, he is always apprised of the octant position of the guns 116. The circuit for controlling the lighting of the gun position indicator lamps A_2, L_2, F_2, and R_2 will be described later with reference to Figures 3 and 8.

Also secured in the housing 194 is a similar set of indicator lamps A_4, L_4, F_4, and R_4 which may be colored red to indicate the direction in both azimuth and elevation of an enemy target and which are adapted to light the bull's-eyes 196 attendant upon each of the lamps. Similarly, plastic rods, bent to the proper shape, carry the light rays furnished by the indicator lamps to the interior of the sight 106. Thus it will be seen that the gunner may know of the position of an enemy target when his eye is fixed to the eyepiece 150, and also when he is at rest. The circuit for controlling the lighting of signal lamps A_4, L_4, F_4, and R_4 will be described with respect to Figure 8.

Referring now to Figure 7, there is shown a schematic partly isometric view of the sight 106 shown in Figure 5, the parts of the optical system of the sight 106 being arranged according to the position they occupy when the turret has rotated to the 90° azimuth position.

For the sake of clarity part of the boundary rays only forming the image transmitted by the sight 106 are shown and are labelled *t*, *b*, *l* and *r*, indicating respectively the top, bottom, left and right boundary rays of the image.

As shown in Figure 7, the field scanning piece 140 has moved to the 90° azimuth position, and the dove prism 190 has moved to the half-angle position, or through 45°. The rest of the optical system has not changed position, except insofar as the objective system 170 and the pair of lenses 180 has rotated with the lower end of the sight through 90° azimuth.

The path taken by the top ray, *t*, will now be described to show how the sight 106 will keep erect the image seen by the gunner even though the turret has moved in azimuth. Similarly, the erection of the image for other positions in azimuth could be shown, the 90° azimuth position of the turret being selected only for simplifying the discussion of the erecting function of the sight 106.

Top ray *t* enters the field gathering piece or prism 140 at its objective face whence it is refracted and then reflected from the oblique face of the prism 140 to the upper surface of said prism. There ray *t* is once more refracted to enter the objective lens system 170 and to pass therethrough. Ray *t* similarly passes through the lowest part of the erecting system 180, 190, and 192 until it is refracted at the lower oblique face of the dove prism 190, being reflected from the back vertical face of said prism to the upper oblique surface of prism 190. Ray *t* is refracted once more at the upper oblique face and passes through the uppermost part 192 of the erecting system 180, 190, and 192, whence it is passed through the eyepiece lens system 194, emerging to be seen as the top part of the image seen by the gunner 108, who, as has been explained, occupies a fixed position with respect to the aircraft 104. Similarly, the left of the image will always appear to be in its proper position as viewed by the gunner; so, also, will be the right and the bottom of the image. Thus, it will be seen that the image of a sighted target will appear always to the gunner to be erect and properly oriented right and left.

The circuit for effecting the signalling to the gunner both the position of his guns in azimuth and the direction of an enemy target both in azimuth and elevation is shown with reference to Figure 8. The circuit shown consists of two parts, one of which is controlled by an observer, and the other of which is controlled by the position of the guns in azimuth.

A source of power for the circuit is furnished by an inverter 300 which supplies alternating current at a desired voltage and frequency which may be stepped down to a desired operating value by a transformer 302, the secondary of which may be tapped in the manner shown to obtain any desired voltage.

The gunner's station is indicated generally in Figure 8 and shows a lower bank of lights F_2, R_2, A_2, and L_2 which light according to the position of a wafer switch 304 mounted on an extension 306 of the azimuth drive shaft of the turret shown in Figure 3. The designations A, F, L and R represent the aft, forward, left and right positions respectively of the guns or target with respect to the observer. As shown in Figure 3 the wafer switch 304 is closed on switch point A_1, since the guns 116 are pointing in the straight aft or 0° azimuth position. However, in Figure 8 the guns 116 of Figure 3 are pointing to a position between straight aft and to the left, left being to the observer's left and not to the gun-

ner's left, since the gunner needs only to know the direction according to a signal, and not according to his orientation with the aircraft.

Current is supplied from the secondary of the transformer **302** through a lead K to the wafer switch **304** where the current is picked off at switch points A_1 and L_1 and passed through leads M and I respectively to illuminate signals A_2 and L_2 respectively, which, in Figure 8 are shown as signal lamps similar to those shown in Figures 5 and 6. Thus, since signal lamps A_2 and L_2 are lighted, indication is given to the gunner that his guns are pointed somewhere in the quadrant between 0° azimuth and 90° azimuth, or between the straight aft position as would be viewed by the gunner, and the straight left position as viewed by the observer.

Similarly, when the guns **116** rotate in azimuth, for example to the 180° azimuth position, or straight forward, the wafer switch **304** will contact a similar switch point F_1. At such time, current will be supplied by the lead K to the switch **304**; thence it is picked off at switch point F_1 and passed through lead H, thereby lighting lamp F_2. It may be noted, that as the wafer switch **304** revolves with the turret in azimuth the flow of current supplied by lead K is made and broken at switch points A_1, L_1, F_1, and R_1 to light and to extinguish the corresponding signal lamps A_2, L_2, F_2, and R_2.

For indicating to the gunner the position of an enemy target in azimuth, a series of switches located at the observer's station is connected into the circuit shown in Figure 8. As was the case in supplying energy to the signalling system for indicating the position of the guns in azimuth to the gunner, the transformer **302** through its secondary supplies current to a similar lead N. At the observer's station there is located a series of switches F_3, R_3, A_3, L_3. According to the position of the enemy target, that is whether it is straight aft as viewed by the observer or straight ahead, the observer will close switch A_3 or switch F_3. Similarly, if the target is to the right of the aircraft, the observer will close switch R_3, and if to the left of the aircraft as viewed by the observer, he will close switch L_3. Provision is made also for signalling to the gunner the position of an enemy target when it occupies intermediate positions, as for example, midway between the straight aft position and the straight left position, or as related to the orientation of the turret **100**, between 0° azimuth position and the 90° azimuth position. At such time the observer will close switches A_3 and L_3 thereby lighting the proper signal lamps.

The circuits for accomplishing the signalling to the gunner the direction in azimuth of an enemy target is as follows: Assuming that the target occupies a position between 90° elevation and 135° elevation, the observer will close a switch **308** to a right hand switch point **310**. Assuming also that the target is coming from the straight aft position he will close switch A_3. Current will then flow from the lead N, through the switch A_3, and thence through a lead P to light signal lamp A_4. The current passes through signal lamp A_4, and thence through a common lead Q to ground through the right hand switch point **310** of the switch **308**.

Assuming now for example, that the target aircraft is approaching the ship from some direction between 0° azimuth and 90° azimuth, the observer will close switches A_3 and L_3, and if the enemy target is approaching from some position between 90° zenith and 135° elevation the switch **308** will be kept closed upon the switch point **310**. At such time, current will be passed from the lead N through the switch A_3 and switch L_3, to pass current respectively through leads P and S to signal lamps A_4 and L_4. It will be apparent, therefore, that for other positions in azimuth of the enemy target the observer can close an appropriate switch, or an appropriate pair of switches and through the medium of signal lamps F_4, R_4, A_4, L_4, give the approximate position in azimuth and zenith of an oncoming target ship to the gunner.

For indicating to the gunner that the target which is approaching from a direction below the 135° elevation angle, the observer can close a left hand switch point **312** of the switch **308**. By so doing an auxiliary source of control current is brought into use to effect an intermittent lighting of the signal lamps F_4, R_4, A_4, L_4, to indicate the approximate direction in both elevation and azimuth of the target ship. The circuit for controlling an intermittent energization of the signal lamps comprises a source of power **314** which is connected through a switch **316** to a lead J, which supplies current to a slow release relay **318**, which when energized serves to attract an armature **320** to the right to close on point **322** which forms part of a circuit in parallel with the circuit for lighting the lamps F_4, etc. Thus, when switch **308** is closed upon the left hand switch point **312**, the current supplying any one or a pair of lamps F_4, R_4, A_4, L_4 will be intermittent in character; so, when slow release relay **318** is energized the armature **320** will be attracted to the right, thereby supplying a ground for the return lead Q through the switch **322** to the left hand switch point **312** of switch **308**. But, when the armature **320** is attracted to the right the circuit for energizing the relay **318** will be opened, thereby causing the condenser of the relay **318** to unload its charge into the winding of the relay **318**, and when the flux is dissipated in the winding of relay **318**, the armature **320** will no longer be attracted to the right. At such time, the current for the return lead Q will be broken, since it is no longer made at the switch point **322** of the armature **320**. It will be seen, therefore, that the lamps will glow intermittently according to the energization and deenergization of the relay **318**, and will indicate to the gunner the direction in azimuth and elevation below the 135° zenith of a target ship.

The operation of the improved turret and sight will be readily understood from the foregoing description. The gunner **108** occupies the position shown in Figure 2 which shows the turret **100** extended to the working position, and with his right hand grasps the control handle **114**, which when rotated away from the gunner causes the guns **116** to rotate about shaft **136** downwardly, the power being furnished by elevation drive motor **138** shown in Figure 3 which is controlled by control **114**. By rotating the handle toward himself the gunner moves the guns upwardly in elevation. The same control **114** effects, through the azimuth drive motor **130** shown in Figure 3, the azimuth movement of the guns **116**. By moving the control handle **114** about its vertical axis away from himself the guns **116** are moved to the right in azimuth, and conversely, by moving the handle **114** about its vertical axis towards himself the guns are moved to the left in azimuth.

As has been explained with reference to Fig-

ures 5, 6, and 7, when the guns are moved in azimuth and elevation, the sight **106** is also correlated with said movements, so that the aiming point of the guns **116** will be seen by the gunner **108** through the sight **106**, and the image of the aiming point will always appear erect and properly oriented right and left.

When the observer sees an enemy target he can signal to the gunner **108** its direction in azimuth and elevation so that the gunner may immediately train his guns on the target. According to the position of the target ship he closes switches F_3, R_3, A_3, L_3, and switch **312** shown in Figure 8 to light the corresponding signal lamps mounted near the eyepiece **150** of the sight **106** shown in Figures 5 and 6. The gunner, being always apprised of the position of his guns in azimuth by the signal lamps F_2, R_2, A_2, and L_2 can then immediately move the guns **116** to the position to keep within the field of view of sight **106** the enemy target.

The operation just described is accomplished with a minimum of delay, a factor quite important in present-day aerial warfare. An aircraft, particularly a bomber, equipped with the new and improved turret described hereinbefore is thus made more completely protected against enemy aircraft, and is thus able to carry on a mission without the necessity for a fighter escort, a very desirable advantage, since bombing missions are carried on over distances far beyond the range of fighter planes.

While the present invention has been described with reference to its use in a modern bomber-type aircraft, its use is not limited to aircraft alone, other uses, for example, in tanks being possible. The invention, then, is not limited to the embodiment shown, nor otherwise than by the appended claims.

We claim:

1. In combination with a gun turret mounting guns movable in unison in azimuth and elevation, a sighting mechanism carried by said turret and including a stationary eye piece and a view piece movable simultaneously with the guns and having a field of view embracing the field of fire of said guns for viewing a target on which the guns are laid, means for indicating to a gunner peering into the eye piece the position of said guns in azimuth with respect to said gunner comprising an electrical system including signal devices located in the eye piece housing, and a switch in said electrical system constructed and arranged to be actuated as the guns move in azimuth to control said signal devices.

2. In combination with a gun turret mounting guns movable in unison in azimuth and elevation, a sighting mechanism carried by said turret and including an eye piece fixed relative to the turret and a view piece movable simultaneously with the guns and having a field of view embracing the field of fire of said guns for viewing a target on which the guns are laid, means for indicating to a gunner peering into the eye piece the position of said guns in azimuth with respect to said gunner comprising an electrical system including signal devices located in the eye piece housing, a switch in said electrical system constructed and arranged to be actuated as the guns move in azimuth to control said signal devices, and means for visibly determining the position of the target with respect to the gunner comprising a device positioned in the eye piece housing, whereby to obtain position relationship between the gun and target.

3. In combination with a gun turret mounting guns movable in azimuth, a sighting mechanism including an eye piece housing having an eye piece therein and a view piece for viewing a target, said view piece being movable with respect to the eye piece and constructed and arranged to follow the movement of the guns, a set of signal lights in the eye piece housing for indicating to a gunner peering into the eye piece the position of the guns in azimuth with respect to said gunner, and means including a switch constituted to be actuated by movement of the guns in azimuth to control said signal lights.

4. In combination with a gun turret mounting guns movable in azimuth and elevation, a sighting mechanism including an eye piece housing having an eye piece therein and a view piece for viewing a target, said view piece being movable with respect to the eye piece and constructed and arranged to follow the movement of the guns, a set of signal lights in the eye piece housing for indicating to a gunner peering into the eye piece the position of the guns in azimuth with respect to said gunner, means including a switch constituted to be actuated by movement of the guns in azimuth to control said signal lights, a set of signal lights in the eye piece housing for indicating to said gunner peering into the eye piece the position of the target in azimuth and elevation with respect to said gunner, whereby the relative position between the gun and target is shown by the signal lights, and means including operator operated switches to be actuated by an operator to control said last-named set of signal lights.

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