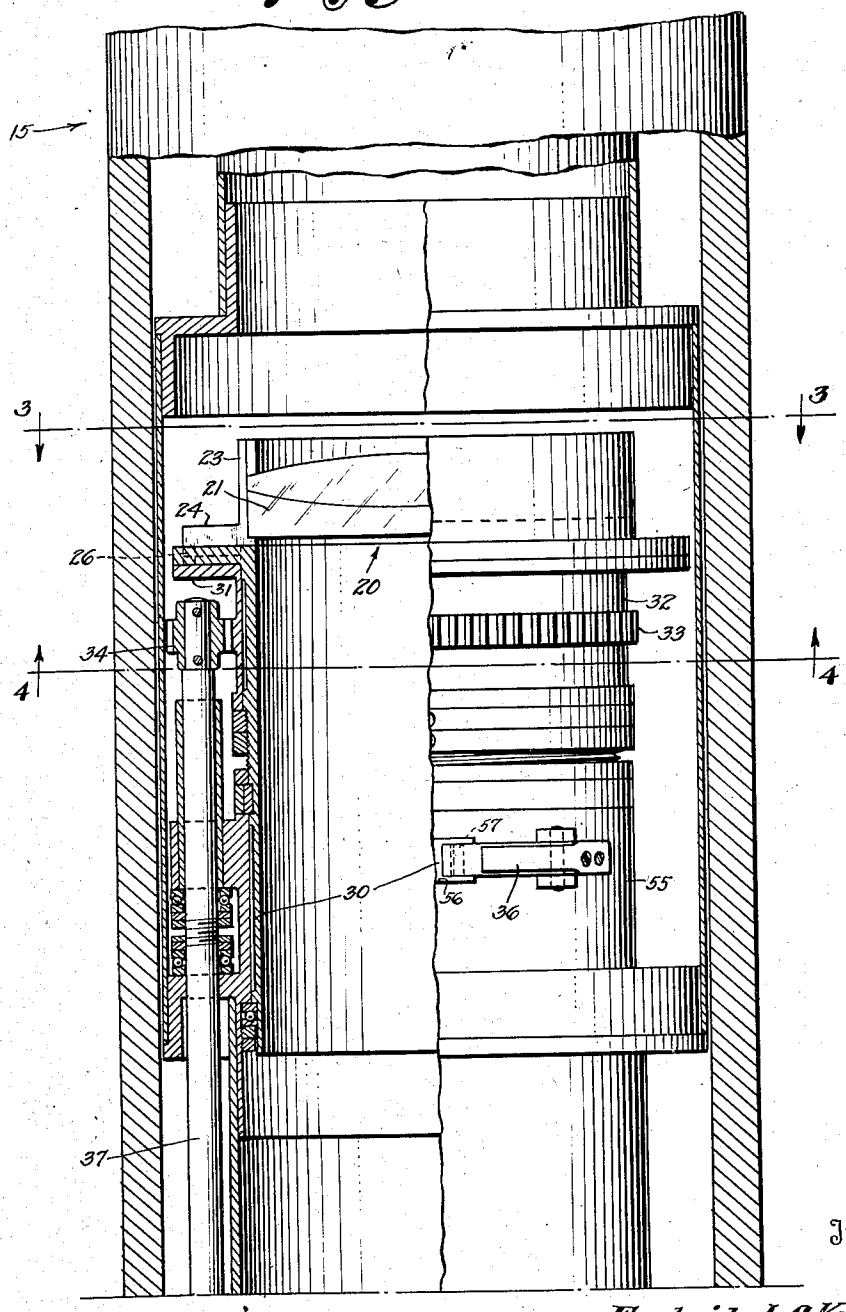
Jan. 1, 1935. F. L. G. KOLLMORGEN 1,986,731

COMBINATION PERISCOPE AND STADIMETER

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Fig. 1.



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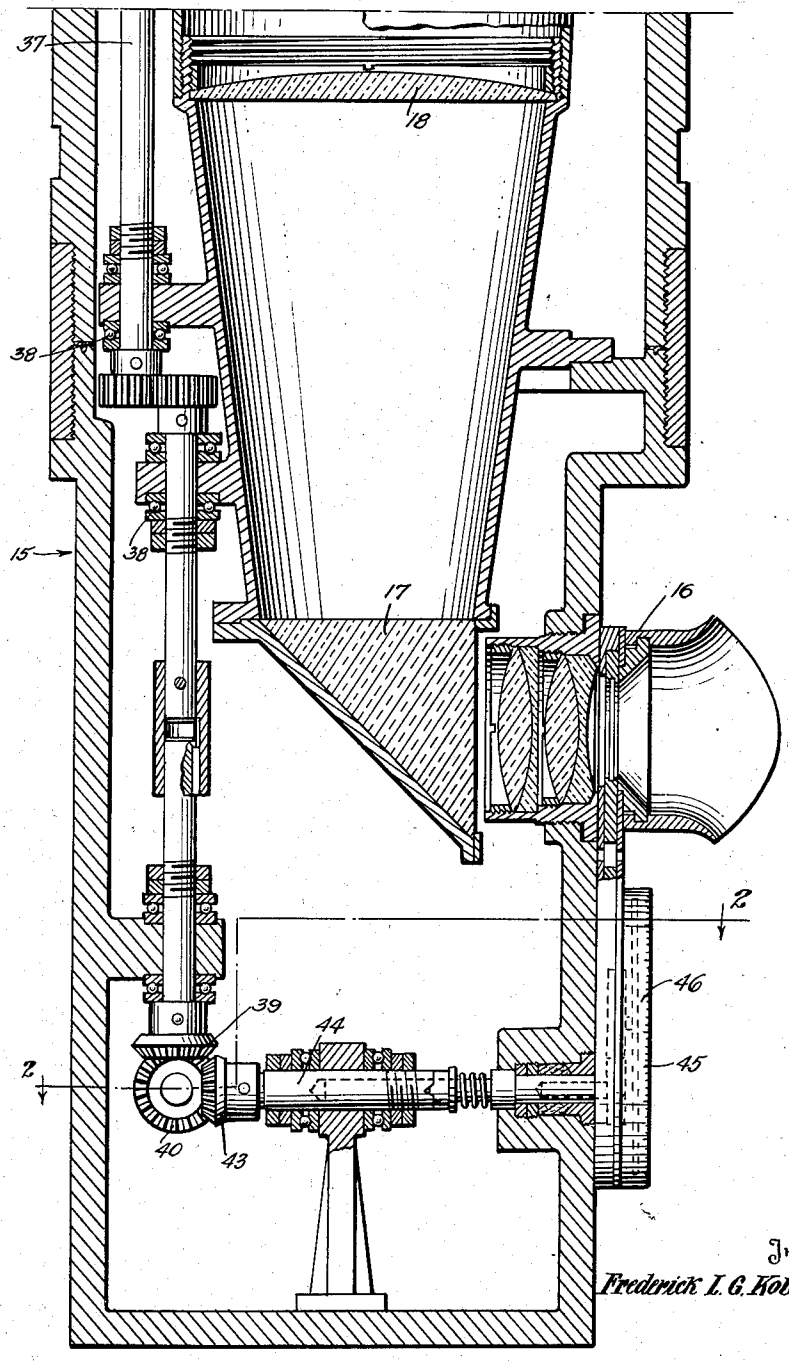
Attorneys

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COMBINATION PERISCOPE AND STADIMETER

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Fig. 1a.



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COMBINATION PERISCOPE AND STADIMETER

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Fig. 2.

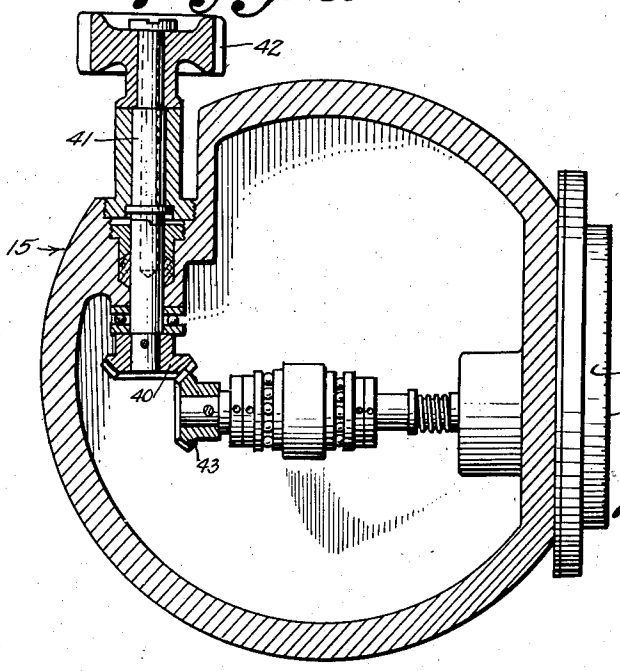


Fig. 5.

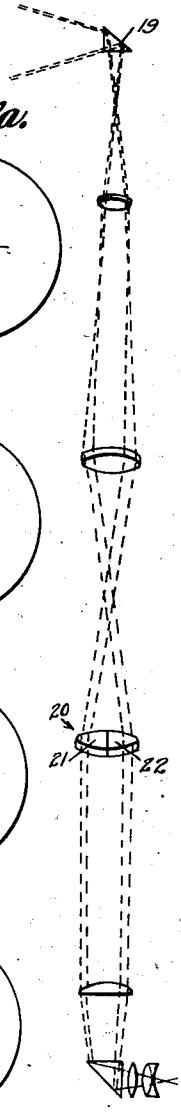


Fig. 7a.

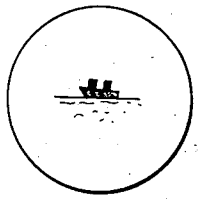


Fig. 9a

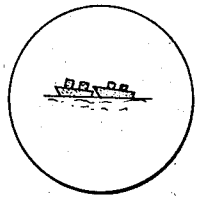
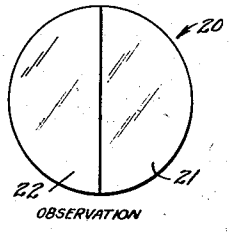
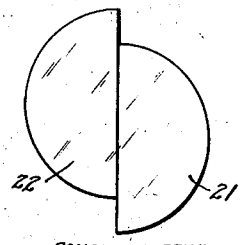


Fig. 7.



OBSERVATION

Fig. 8.



RANGE OBSERVATION

Fig. 8a.

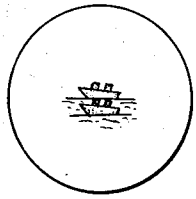


Fig. 10a.

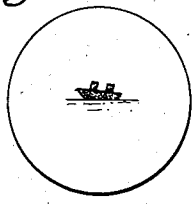
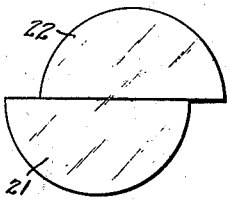
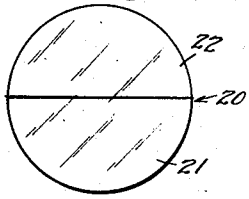


Fig. 9.



COURSE ANGLE OBSERVATION

Fig. 10.



CONCLUSION OF COURSE ANGLE OBSERVATION

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Fig. 3.

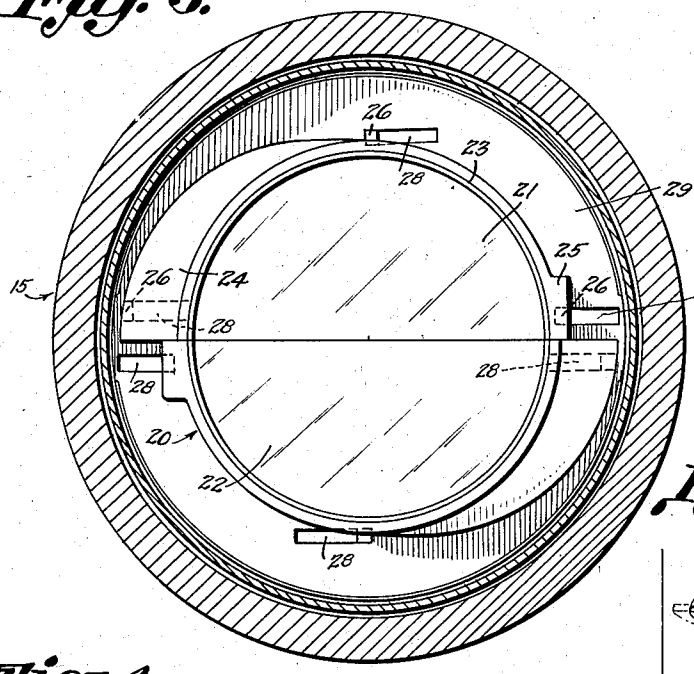


Fig. 6.

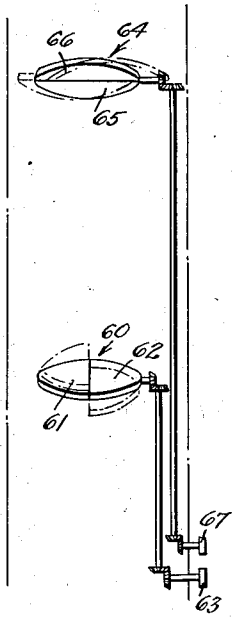
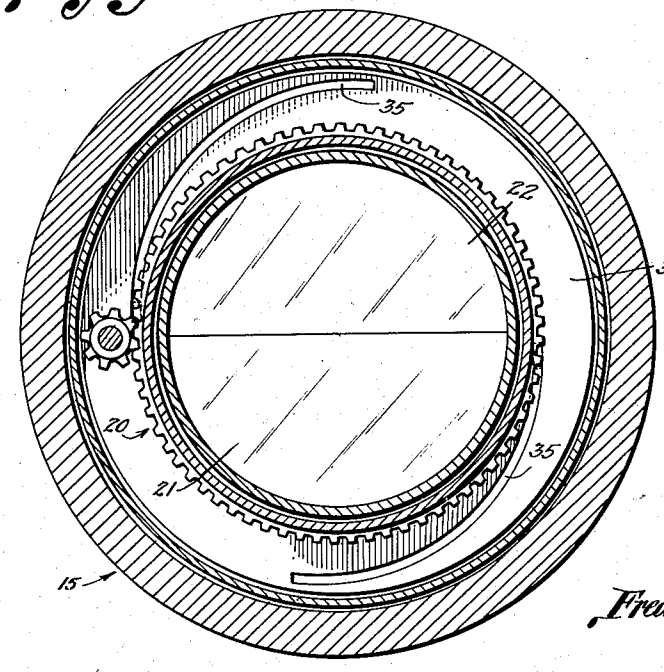


Fig. 4.



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UNITED STATES PATENT OFFICE

1,986,731

COMBINATION PERISCOPE AND STADIMETER

Frederick L. G. Kollmorgen, Mountain Lakes, N. J.

Application December 8, 1932, Serial No. 646,316

5 Claims. (Cl. 88—2.7)

This invention refers to a submarine periscope designed to be used for determining the distance of an object ship and its course, the distance being determined from the known height of any part of the ship, such as the height of the smoke stack measured from the water level, and the course being found from the horizontal dimension of the image of the ship as referred to the known length of the ship. Devices achieving these measurements have been used before and are known as stadimeters.

Usually a stadimeter when employed on a submarine periscope has been made in the shape of a small attachment to the eyepiece, made detachable so that the periscope could be used for ordinary observation when required, and for obtaining the range and course angle if the stadimeter had been attached. This method has various serious drawbacks. The mechanical thickness of the stadimeter introduced between the front of the eyepiece lens and the eye pupil shortens the eye distance considerably, so that some times the visible field is reduced and sighting is rendered uncomfortable under all conditions. Furthermore, since the stadimeter attachment produces two images, one in one half and the other in the other half of the field, the eye pupil takes in only the parts of both images lying near the dividing line and it is difficult under certain conditions to make satisfactory measurements.

Also, since the doubling up of the images is obtained by having one or more prismatic wedges of variable angle, these wedges introduce prismatic colors which interfere with clear vision. Another drawback is that the angles measured with the stadimeter outside of the eyepiece are affected by the position of the eyepiece when focussed for the eye of the observer, so that diffemt readings are obtained by different observers, which makes it necessary to set the eyepiece for one definite focus and correct for the individual focus of each observer by means of additional lenses. Both the wedges and the additional lenses diminish the light transmission of the periscope.

In another type of range and course measuring periscope, wedges with variable angle have been used between the large lens usually referred to as the lower objective and the eyepiece. In this case the eye distance of the periscope does not become shortened and the measurement is not dependent on the individual focussing of the periscope, but the errors due to the prismatic shape of the wedges are still present and even more noticeable.

This invention overcomes all these difficulties. For the purpose of obtaining a double image one of the large lens in the interior of the periscope tube, preferably the lower objective, is divided in two substantially equal parts and mounted in such a way that the two halves are slidable against each other, in a plane normal to the optical axis of the periscope. When the two halves are in such a positon as to supplement each other to form a full circle, a single image is visible in the eyepiece and the periscope can then be used for ordinary observations. It is not necessary that the lens be divided into two substantially equal parts, nor that the two images formed be of approximately equal intensity. Other arrangements, such as a three-part lens, two of which parts are stationary with respect to each other, would serve as well. Nor is it necessary that all parts of the lens be movable; similar results can be obtained with only one moving part. For the purpose of this description, however, the lens is considered as being divided into two halves of substantially the same size and shape.

When it is desired to determine the range and course of an enemy ship, a handle conveniently located near the eyepiece is rotated. This rotation is transferred by means of suitable gears or other mechanical means to the mounts of the two objective halves, which then begin to slide against one another. This sliding produces two images of approximately equal intensity in the field of view, both images being just as clear and sharp as those produced by the objective when in its observation position. The movement is continued until the waterline of one image coincides with the top of the smoke stack of the other image. (Any other known vertical dimension of the object ship may of course be chosen.) The movement of the knob at the same time rotates a scale conveniently located near the eyepiece, and after the desired coincidence has been effected, the observer can read the range upon this scale against the known height measured.

The range being thus obtained, if the course angle is required the rotation of the knob is continued until the maximum displacement of the images is reached. At this point both objective halves together begin to rotate and turn exactly 90°, so that displacement of the images is no longer in a vertical but in a horizontal direction. The observer then reverses the direction of the knob and continues until the bow of the ship in one image coincides with the stern of the ship in the other image, and can then find the course angle on either the same or another scale against the known length of the ship. After this he continues rotation until again one image is obtained, and further rotation will bring the two objective halves to a full stop in the original vertical position, where they are secured by an automatic detent, so that the periscope is again ready for ordinary observation. The terms "vertical" and "horizontal" in this description are

used with reference to the image as seen through the periscope.

The advantages of this invention over previous constructions are that there is a first class optical quality free from all errors introduced by wedges, no loss of light transmission and no shortening of the eye distances.

In another form for carrying out this invention, it would of course be possible to bisect (or otherwise divide) the upper objective of the periscope in a similar manner at right angles to that of the lower objective for obtaining course angles, and displace the two halves by a separate mechanism instead of rotating the lower objective to a horizontal position without departing from the spirit of the invention. It would also be possible to bisect or otherwise divide only one objective, and to produce the lateral displacement of the portions of the lens by one means, and the rotation by another, with substantially the same results.

With the foregoing and other objects in view, as will hereinafter become apparent, this invention comprises the constructions, combinations and arrangements of parts, hereinafter set forth, disclosed and shown on the accompanying drawings. In these drawings,

Figure 1 is a cross sectional view through that portion of the periscope containing the lower objective lens and mountings, the center tube being partially broken away to show the construction therein,

Figure 1A is a cross section of the eyepiece and prism box, showing the means for revolving and displacing the objective halves,

Figure 2 is a sectional view taken on line 2—2 of Figure 1A,

Figure 3 is a sectional view taken on line 3—3 of Figure 1,

Figure 4 is a sectional view taken on line 4—4 of Figure 1, showing clearly the shape of the slots or grooves in the track,

Figure 5 is a diagrammatic view indicating the arrangement of the optical elements which are in the periscope,

Figure 6 is a modified view shown diagrammatically wherein two lens are bisected, each operated independently of the other, and

Figures 7, 7A, 8, 8A, 9, 9A, 10 and 10A are diagrammatic views showing the different positions of the lens during the course of operation, together with a representation of the image produced in each of these positions.

There is shown at 15 a periscope tube or housing to which this invention has been applied, it being observed that the invention is not limited to the particular mechanical details which are hereinafter shown only for the purpose of illustrating an operative device embodying this invention. Mounted in the side of the tube 15 is the usual periscope eye piece 16 directed toward the usual reflecting prism 17, which receives its light through the usual field lens 18, the light being refracted through the various lens of the periscope from the upper reflector 19.

This invention consists principally in taking one of the objective lens of the periscope, preferably the lower objective lens 20, and in transversely dividing this objective lens 20 into two or more sections, only two sections 21 and 22 being shown in the preferred form. The objective lens 20 is so mounted in the periscope that its bisected portions 21 and 22 are under the control of the observer, whereby they may be displaced longitudinally from each other, rotated through a quarter circle as a unit when so displaced, then replaced into coincidence with each other and then reversed back through the quarter circle to the original position.

Each objective lens section 21 and 22 is mounted in a mount or frame 23, which it will be observed has a lateral flange 24. Guide pins project from the frame or mount 23, preferably at the three positions shown, one pin being on the lateral flange 24, a second pin being on a projection 25, and a third pin mounted on a frame intermediate these positions.

The other objective lens section 22 is identically mounted. The pins 26 are received in a complementary shaped track 28 in a flange 29 formed in the lens mount tube 30, it being observed that there are six such tracks 28 appropriately placed in the flange 29, one for each of the pins 26. As will be obvious, the two objective lens sections 21 and 22 can be slid along their tracks 28 either into coincidence, as shown in Figures 3, 4, 7 and 10, or can be longitudinally displaced from each other, as shown in Figures 8 and 9. The means for so sliding these sections toward or away from each other and for rotating them includes a rotating track 31, which is formed as a flange on a geared cylindrical section 32, gear teeth 33 being provided for cooperation with a pinion 34. Formed within the track 31 is a pair of cam slots 35, one of the pins 26 preferably that one mounted on the projection 25 being extended downward so as to project into its cam slot 35.

A stop pawl and detent 36 is mounted on the enclosing stationary cylinder 55 and projects through a slot 56 therein into one of two stop depressions 57 located 90° apart on the outside of lens barrel 30 so as to limit its rotation to exactly a quarter of a circle or 90°, the pawl and detent being so constructed that it will retain the lens barrel 30 in either of its rotated positions until a sufficient amount of turning force is applied, whereupon it will release and allow it to rotate.

The pinion 34 is mounted on the end of a shaft 37 provided with ball bearing mountings 38 and controlled by a bevel gear 39 on the other end thereof. This bevel gear 39 meshes with a bevel gear 40 mounted on a control shaft 41 projecting through the periscope tubing or housing 15 and terminating in a handle knob 42 for convenient operation by the observer. Also in mesh with this bevel gear 40 is another bevel gear 43 mounted on a shaft 44, which in turn operates a range or course meter 45 provided with suitable graduations 46.

In operation, the lens sections 21 and 22 are left in coincidence as in Figure 7 when the periscope is being used for ordinary observation, a single image as shown in Figure 7A being formed through the objective lens 20 in the usual manner. When it is desired to determine the range of the object, a control knob 42 is actuated, causing the lens sections 21 and 22 to be longitudinally displaced from each other as the rotating track 31 is rotated thereby.

When the sections 21 and 22 are displaced longitudinally of each other, two images are formed, one by each section of the lens, as shown in Figure 8A. The handle knob 42 will be rotated until the two images are vertically displaced of each other until the water line of one image coincides with the top of the smoke stack of the other image, as shown in Figure 8A. The operation of the handle knob 42 will simultaneously

operate the range meter 45 and by applying the known distance between the height of the smoke stack and the water line of the ship being observed to the graduations 46, the exact range can be immediately read off there. Any other known vertical distance of the observed ship may be used, it only being necessary to so move the objective lens sections until those parts of the observed ship of which a distance is known are placed in horizontal line with each other as shown in Figure 8A.

In order to take an observation of the course angle of the observed ship, the knob 42 is then continued in rotation until the objective lens sections have moved to their maximum separation, at which time the pawl and detent stop 36 will let go permitting the lens mount barrel 30 to rotate exactly 90°, whereupon the pawl and detent 36 will operate to prevent further rotation. The rotation of a handle knob 42 will then be reversed and the lens sections 21 will then commence to approach each other longitudinally towards the coincidental position. When the lens sections have been allowed to approach each other until the fore part of one image is in contact with the aft part of the second image, as shown in Figure 9A, the apparent length of the image as foreshortened by its course angle, is read off against the known length on the scale 46, and the course angle thus determined.

After this is completed, the knob 42 is rotated to bring the objective lens sections 21 and 22 into coincidence as in Figure 10 and further rotation in this same reversed direction will then rotate the lens mount sections 21 and 22 back to the observation position of Figure 7 through the operation of the pawl and detent 36 letting go when the sections have come into coincidence as of Figure 10 and taking hold again when the sections are back in the observation position of Figure 7.

Although the objective lens 20 has been shown as divided into two halves 21 and 22, it will be obvious that the transverse division of this lens is not limited to either division in halves or to division in two sections. Further, this invention is not limited to merely transversely dividing the lower objective lens, but if desired both the upper and lower objective lens may be divided, one at right angles to the other, as schematically shown in Fig. 6, thereby eliminating the necessity for rotating the divided sections.

In Fig. 6 the lower objective lens 60 is divided into two lens sections 61 and 62 capable of longitudinal displacement relative to each other by the remote control knob 63, this lower objective lens 60 being then used for one observation only as for range observation. The upper objective lens 64 will be transversely divided at right angles to the division of the lower objective lens 60 into two sections 65 and 66 controllable for longitudinal displacement relative to each other by the remote control knob 67 whereby the upper objective lens 64 may be used for course angle observation.

As will be apparent, suitable meters will be geared to the remote control knobs 63 and 67 in the same manner as in the preferred form, thereby serving for the same purpose.

With this invention the applicant has provided a periscope which also serves as a stadimeter without, however, having the usual objections present in the conventional stadimeter. The images produced with this invention are free from all aberrations thereby guaranteeing great accuracy in measurement. There is no decrease in light transmission through the interposition of additional stadimeter lens nor is the eye distance changed cutting down the field of observation and thus convenient and comfortable observation is produced. The necessity of moving the eye across the dividing line in order to see two images as is necessary in all stadimeter attachments is eliminated. Further, the stadimeter effect of this invention is instantly available under all conditions and it is not necessary to attach and detach a stadimeter in order to convert this periscope for ordinary observation purposes to range or course angle observation purposes.

The novel features and the operation of this device will be apparent from the foregoing description. While the device has been shown and the structure described in detail, it is obvious that this is not to be considered limited to the exact form disclosed and that changes may be made therein within the scope of what is claimed without departing from the spirit of the invention.

Having thus set forth and disclosed the nature of this invention, what is claimed is:

1. A combined periscope and stadimeter, an objective lens in said periscope, said objective lens being bisected, said bisected objective lens forming part of said stadimeter, means for symmetrically moving the bisected halves of said objective lens longitudinally of each other and in a plane normal to the optical axis of said lens, and means for rotating said longitudinally displaced bisected halves of said objective lens.

2. A periscope including an objective lens, said objective lens being bisected, and means for symmetrically moving said bisected objective lens sections longitudinally of each other and in a plane normal to the optical axis of said lens and for then rotating said longitudinally displaced objective lens sections as a unit.

3. A periscope including an objective lens, said objecting lens being bisected, means for symmetrically moving said bisected objective lens sections longitudinally of each other and in a plane normal to the optical axis of said lens and for then rotating said longitudinally placed objective lens sections as a unit, said latter means being reversible to first move said longitudinally displaced bisected objective lens sections into coincidence and then rotate said objective lens to its original position.

4. A combination periscope and stadimeter comprising a bisected objective lens in said periscope, means for symmetrically displacing the bisected sections of said objective lens longitudinally of each other and in a plane normal to the optical axis of said lens, means for rotating as a unit said longitudinally displaced objective lens sections one-quarter of a revolution, and means for measuring the amount of displacement.

5. A combination periscope and stadimeter for obtaining range and course angle measurements, including a bisected objective lens in said periscope, means for symmetrically displacing said bisected objective lens sections longitudinally of each other and in a plane normal to the optical axis of said lens, means for measuring the longitudinal displacement in terms of range, means for rotating said longitudinally displaced objective lens sections as a unit, said displacing and rotating means being reversible to replace the bisected objective lens portions toward each other, said measuring means measuring the replacement of said lens sections in terms of course angle.

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