No. 834,985. PATENTED NOV. 6, 1906.

S. LAKE & E. L. HUBBARD.

SIGHTING INSTRUMENT.

APPLICATION FILED SEPT. 28, 1905.

7 SHEETS—SHEET 1.

Fig. 1.

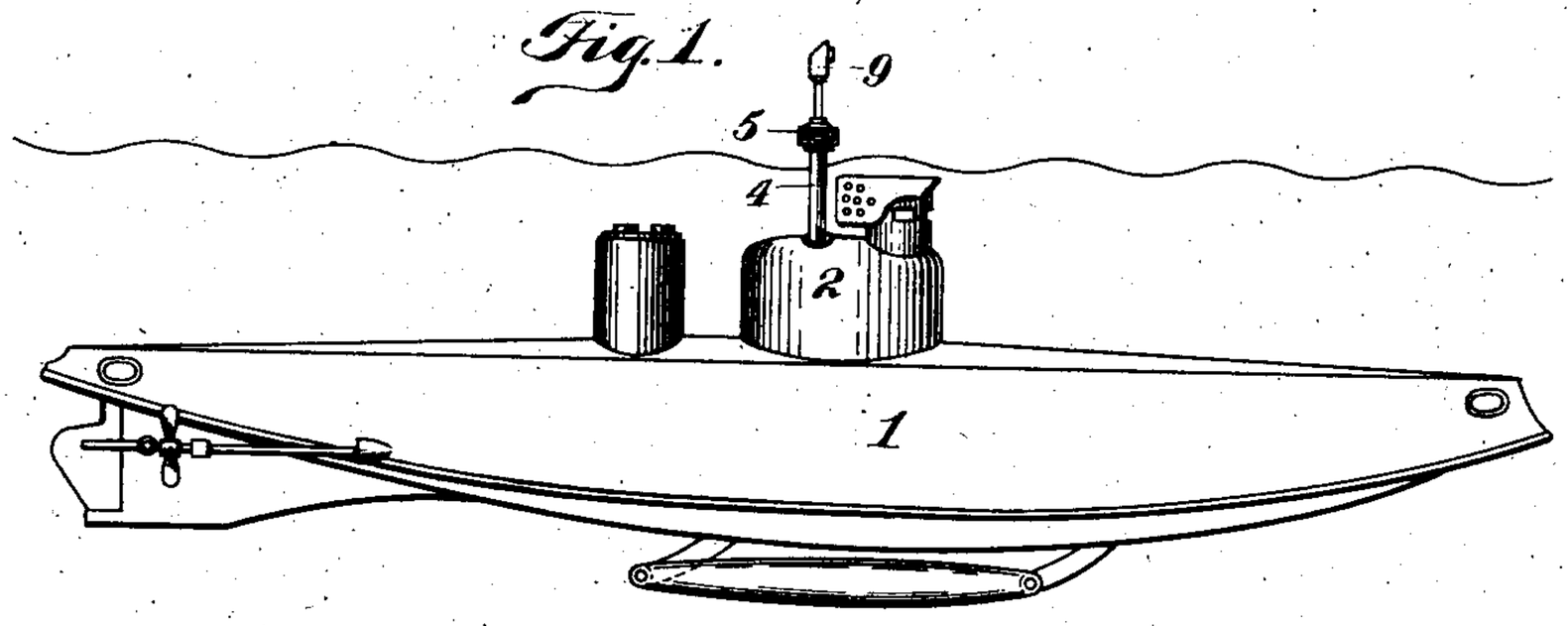
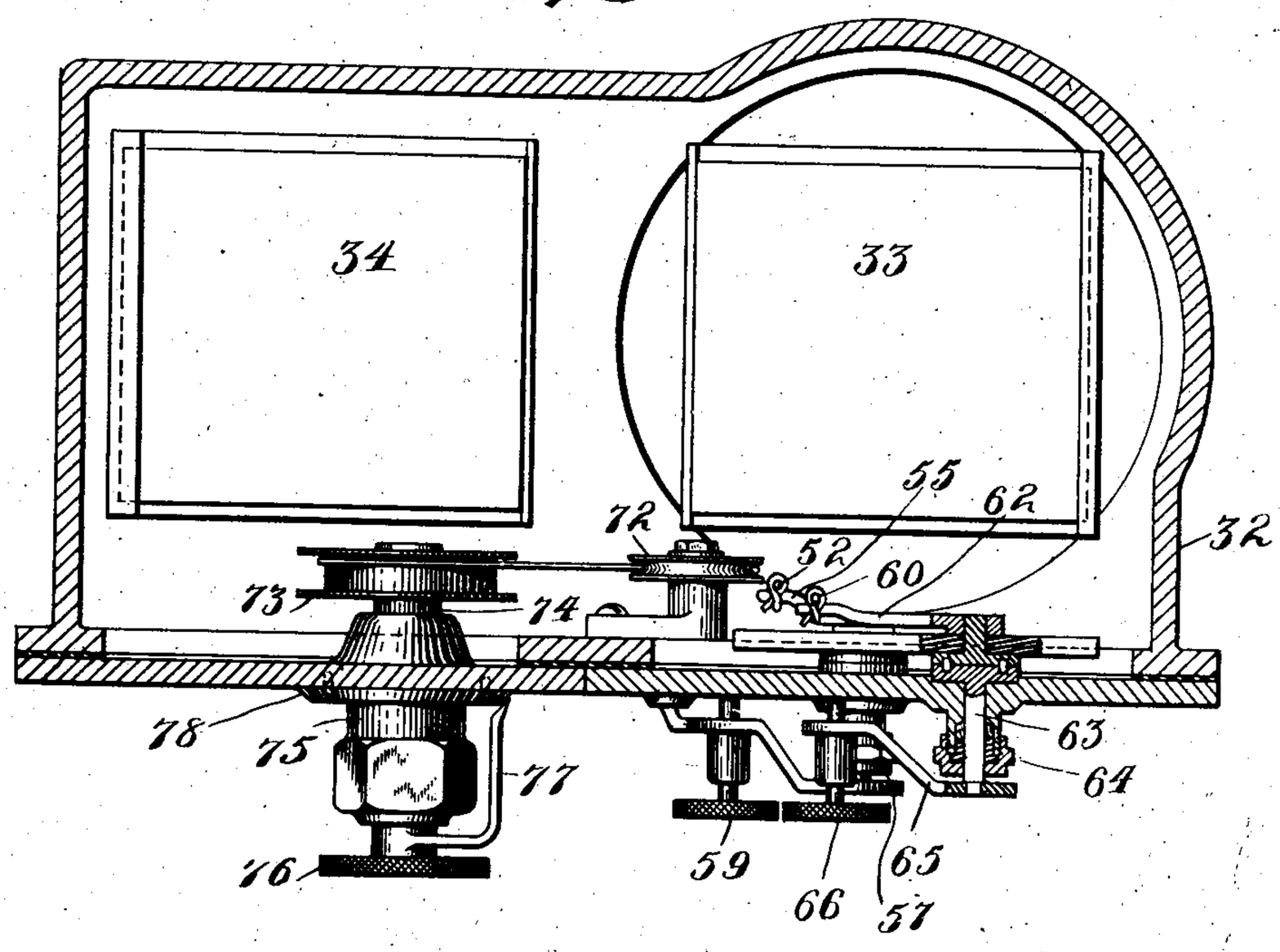


Fig. 16.



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7 SHEETS—SHEET 2.

Fig. 2.

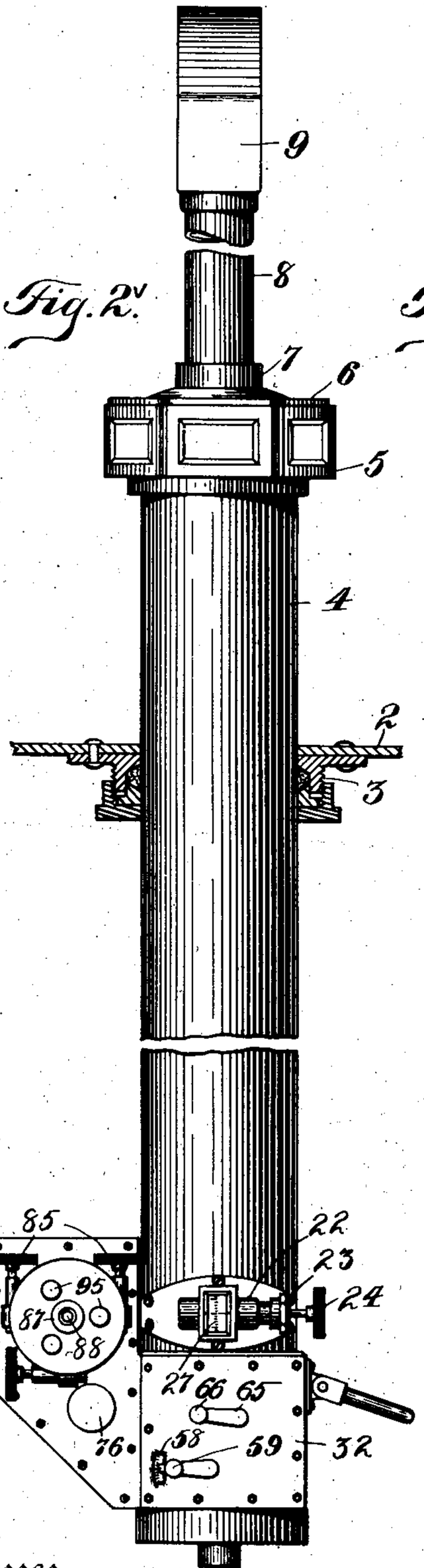
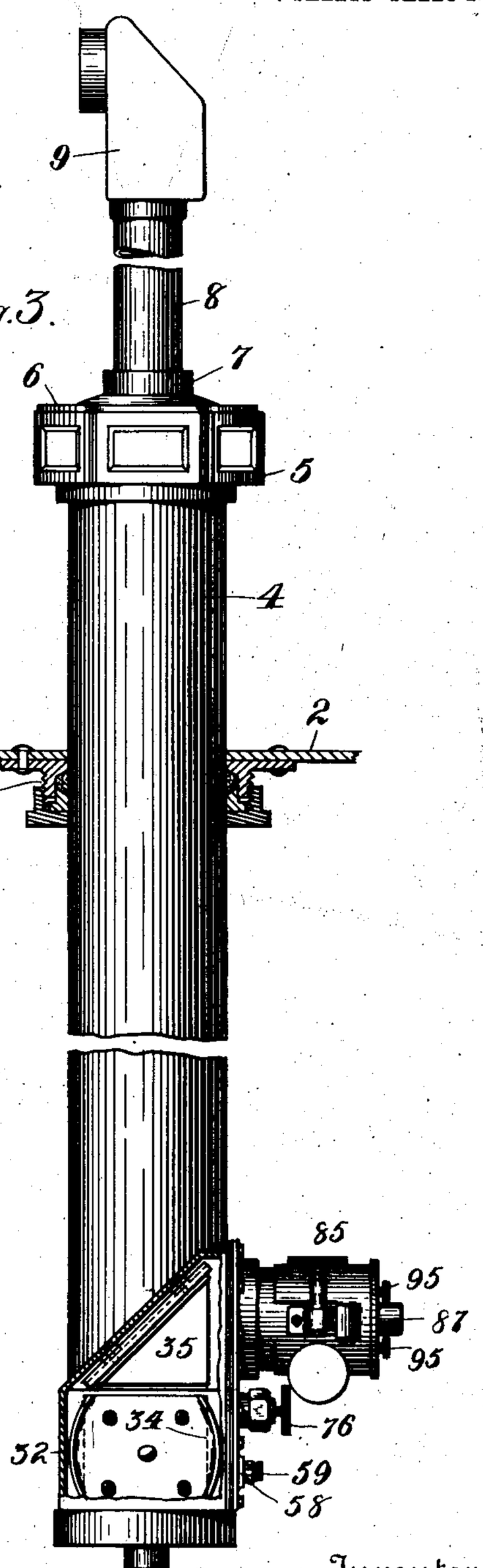


Fig. 3.



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7 SHEETS—SHEET 3.

Fig. 4.

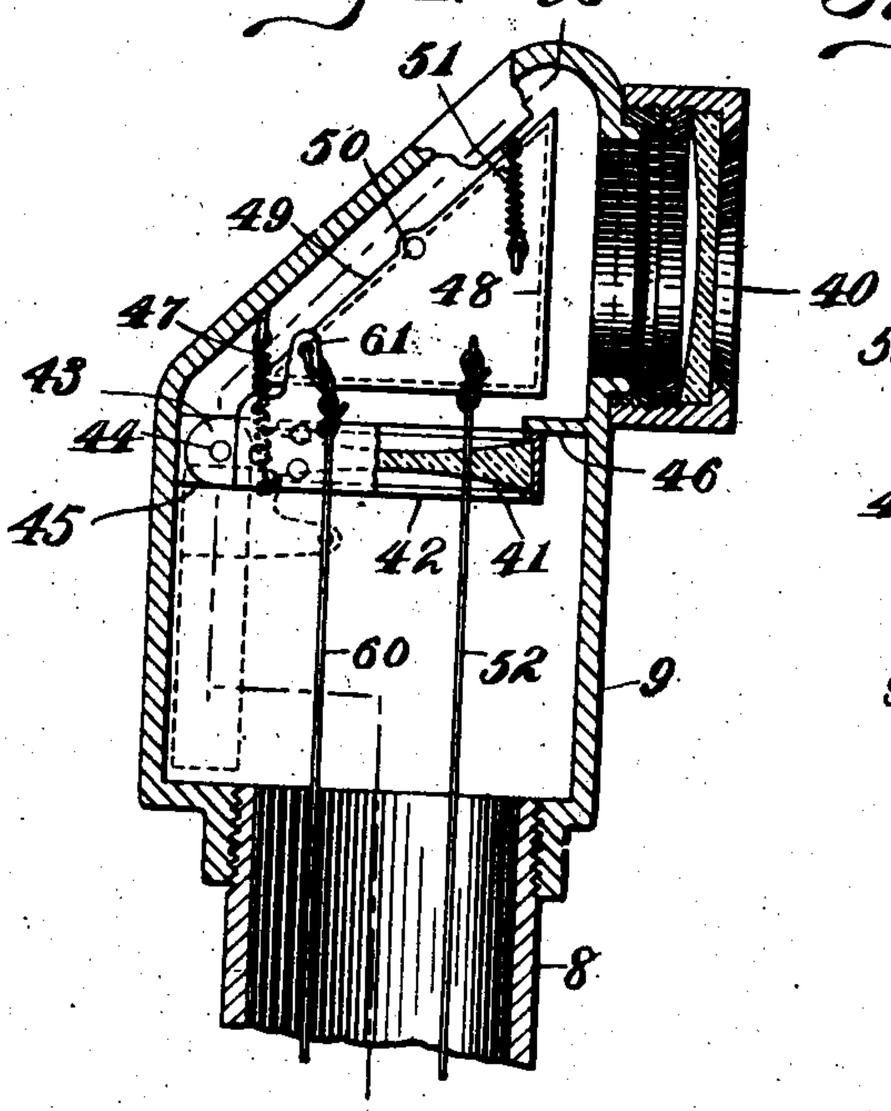

Fig. 5.

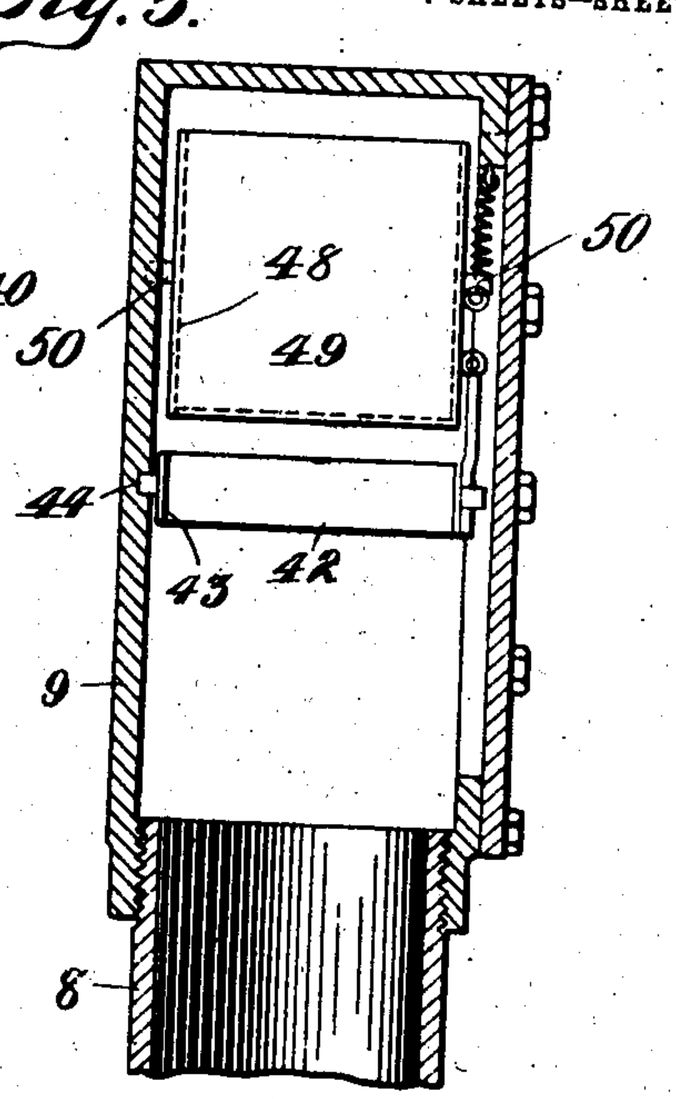

Fig. 6.

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7 SHEETS—SHEET 4.

Fig. 9.

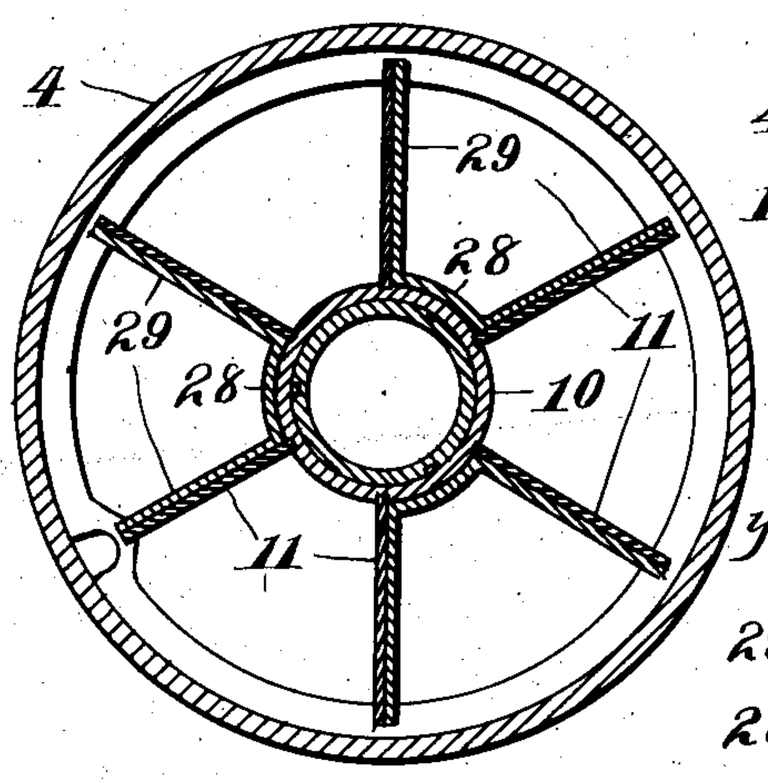


Fig. 7.

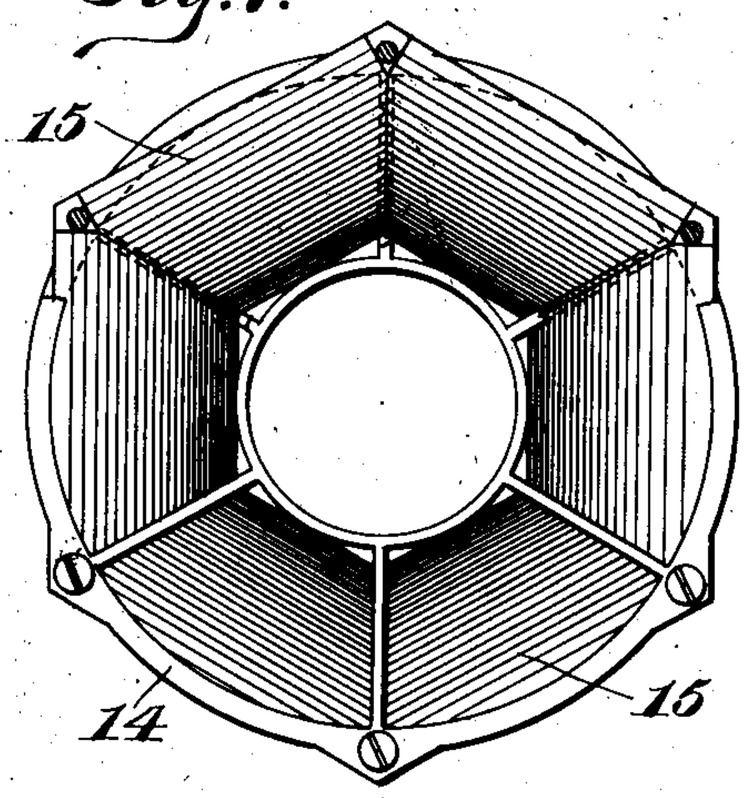


Fig. 8.

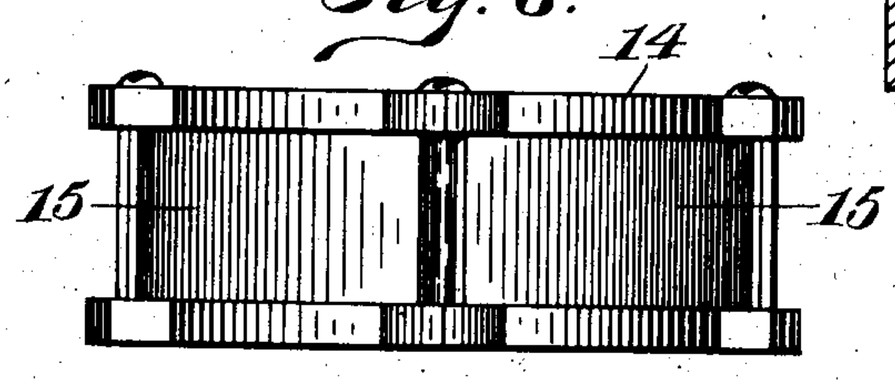
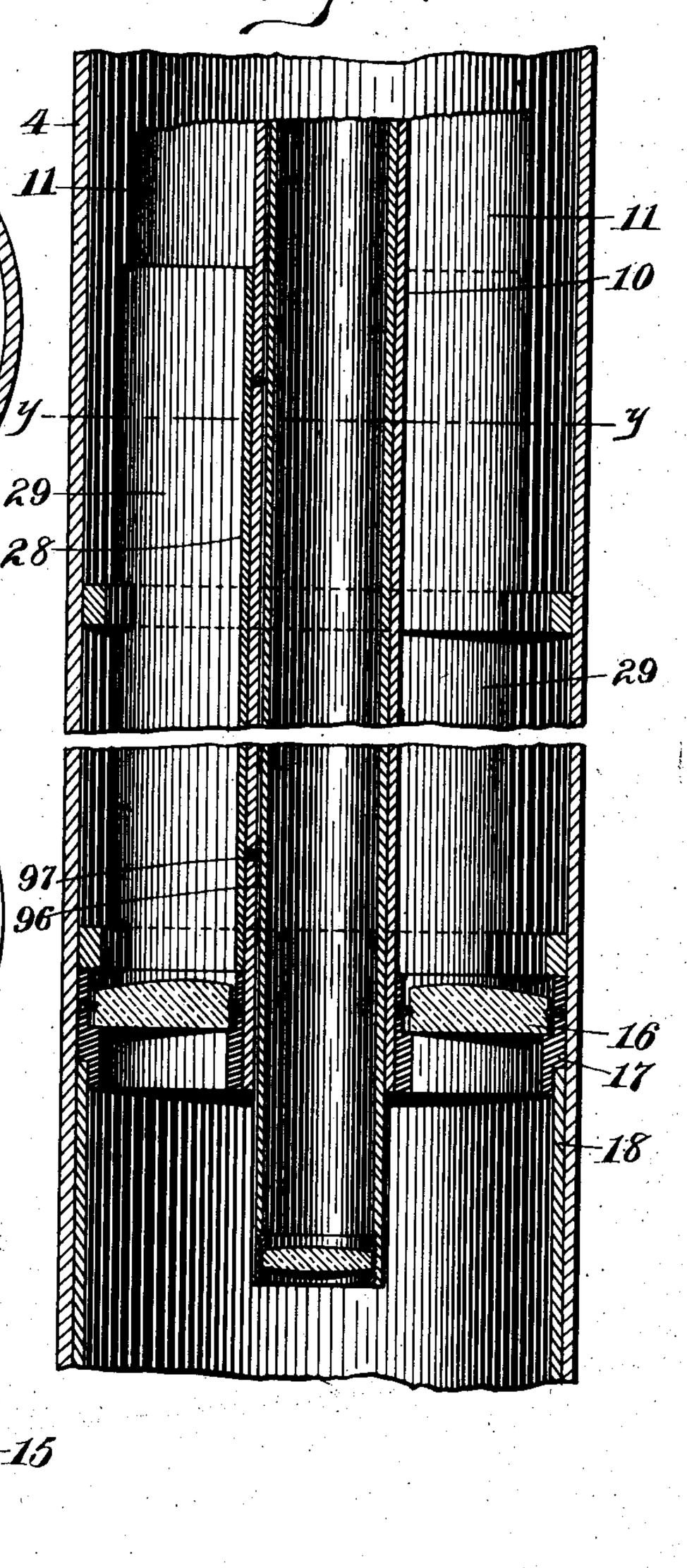


Fig. 10.



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No. 834,985. PATENTED NOV. 6, 1906.

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SIGHTING INSTRUMENT.

APPLICATION FILED SEPT. 28, 1905.

7 SHEETS—SHEET 5.

Fig. 11.

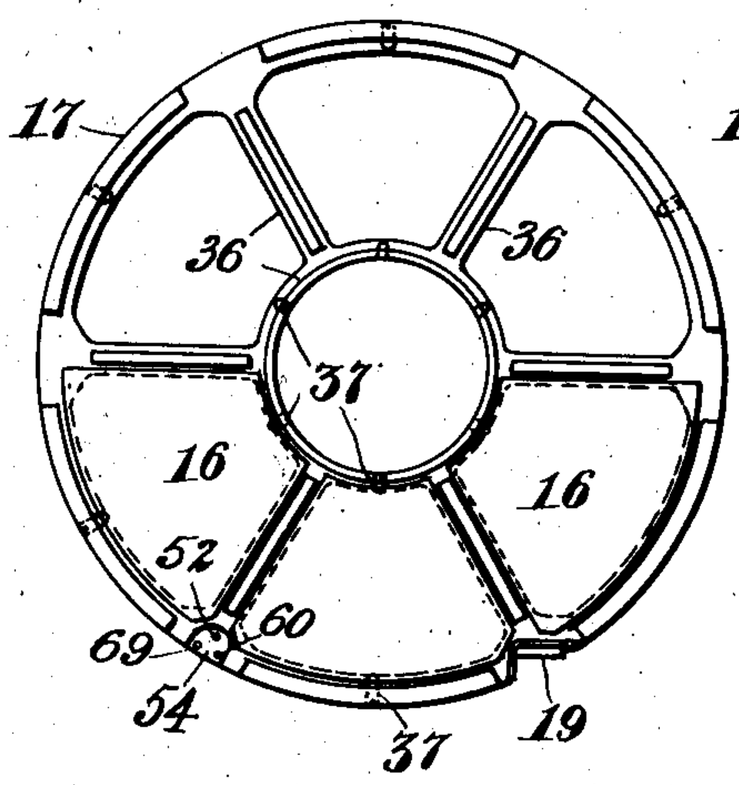


Fig. 12.

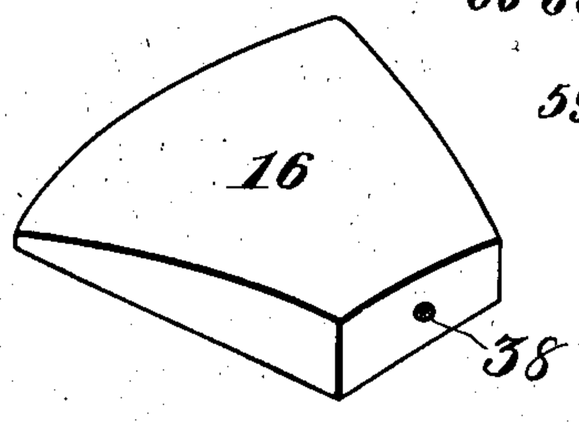
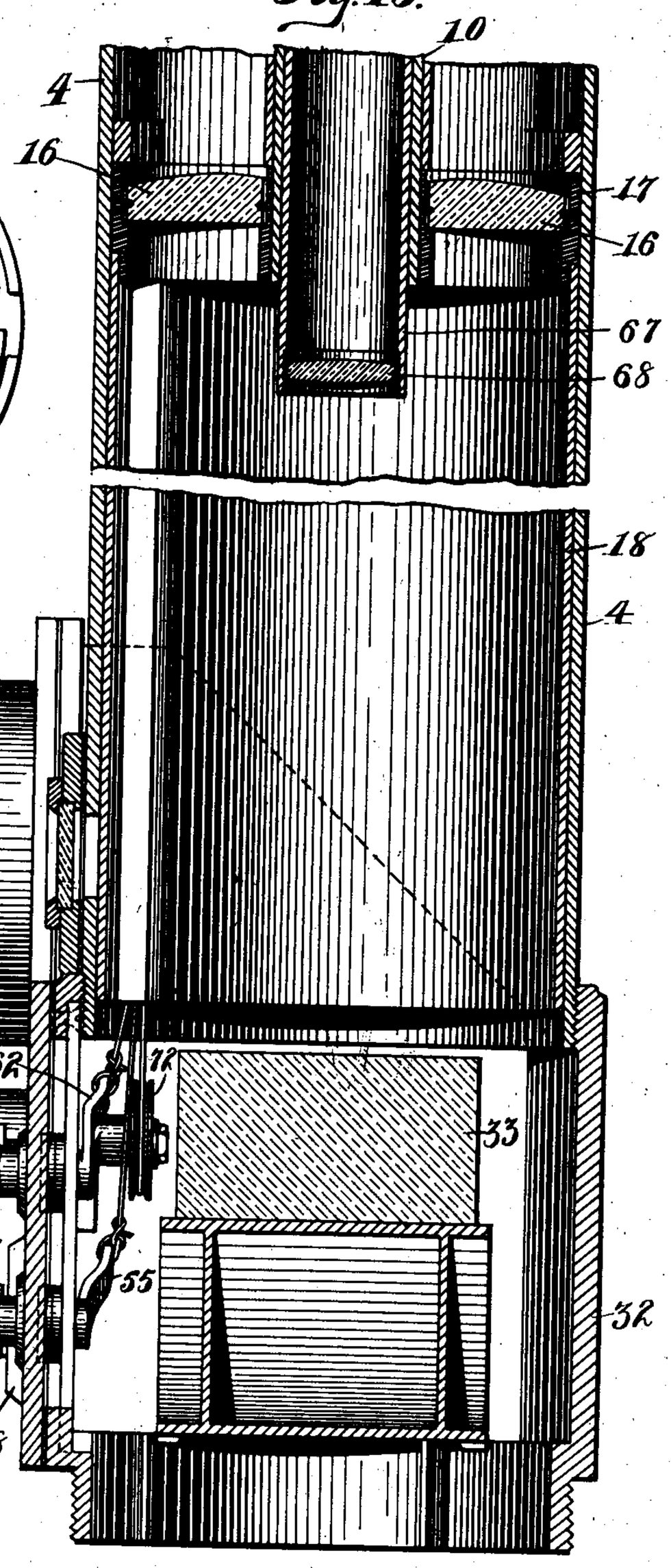


Fig. 13.



Witnesses

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7 SHEETS—SHEET 6.

Fig. 14.

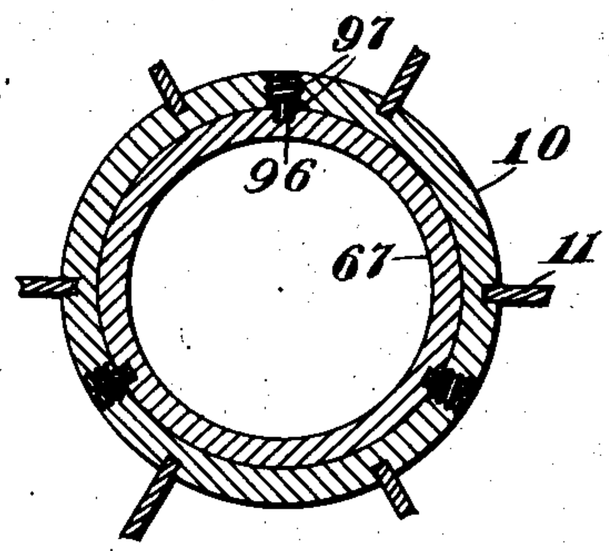

Fig. 15.

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SIGHTING INSTRUMENT.

APPLICATION FILED SEPT. 28, 1905.

7 SHEETS—SHEET 7.

Fig. 17.

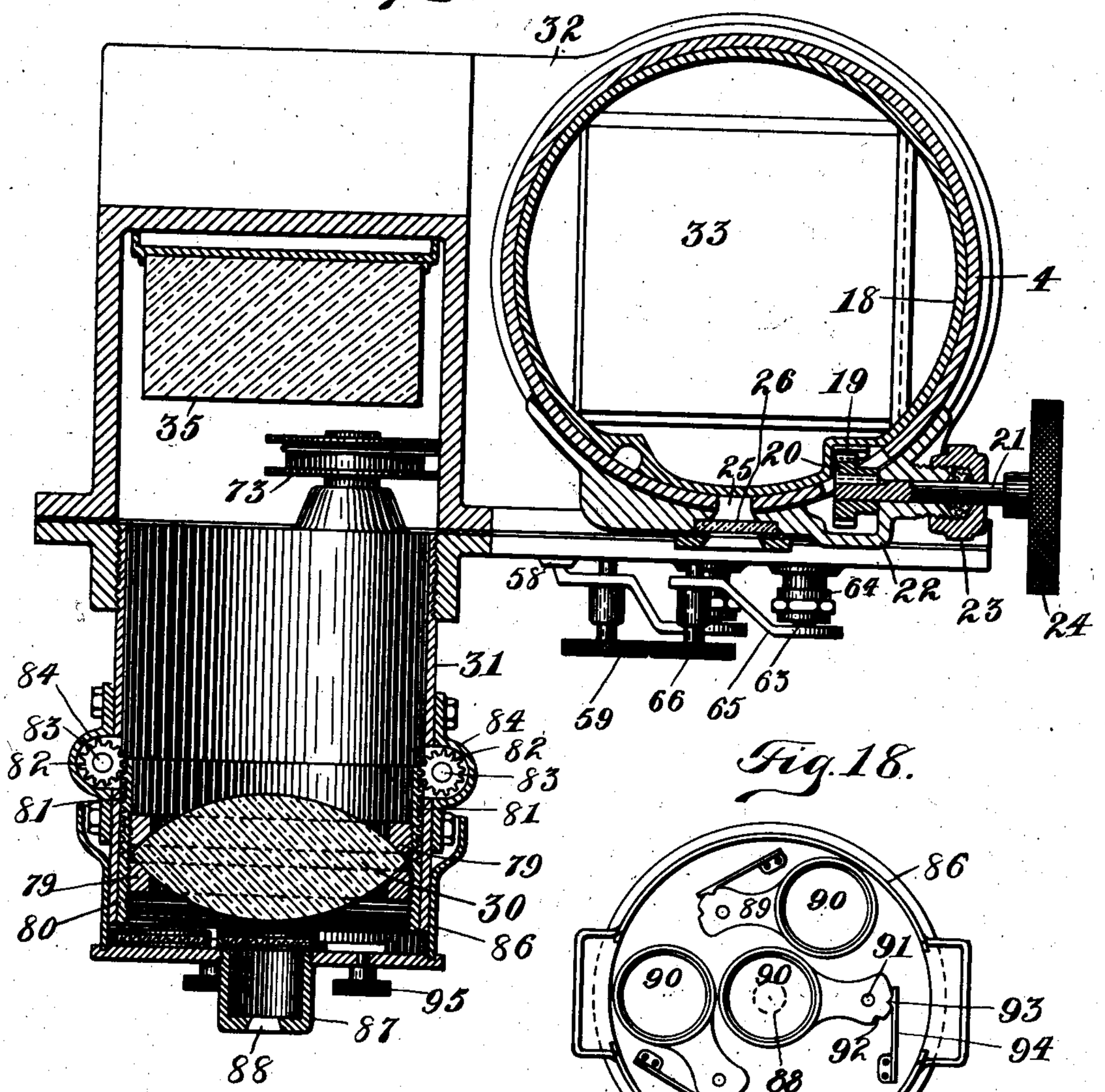

Fig. 18.

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UNITED STATES PATENT OFFICE.

SIMON LAKE, OF BRIDGEPORT, CONNECTICUT, AND EDWARD L. HUBBARD, OF WASHINGTON, DISTRICT OF COLUMBIA.

SIGHTING INSTRUMENT.

No. 834,985. Specification of Letters Patent. Patented Nov. 6, 1906.

Application filed September 28, 1905. Serial No. 280,538.

To all whom it may concern:

Be it known that we, SIMON LAKE, residing at Bridgeport, in the county of Fairfield and State of Connecticut, and EDWARD L. HUBBARD, residing at Washington, District of Columbia, citizens of the United States, have invented certain new and useful Improvements in Sighting Instruments, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to certain improvements in that class of optical instruments designed for use in connection with naval vessels, and particularly with subsurface or submarine vessels in taking observations of other vessels or exterior objects without exposure of the observer or of the vessel of which he is an occupant.

The invention has for its object to provide an instrument of such character which will afford a range of view simultaneously covering substantially the whole horizon without reduction of scale of the object observed, while presenting the latter to the observer in the same relative position to the vessel of which he is an occupant as it would appear in when viewed by the naked eye.

The present improvement consists partly in a particular arrangement of lenses and other glasses for attaining the described object, partly in special means of adjustment therefor and of manipulation thereof to produce different desirable results under varying conditions, and partly in various constructive features of the instrument, whereby the latter is specially adapted for use in connection with submarine boats.

The invention will be understood by reference to the drawings annexed, in which—

Figure 1 is a side elevation of a submarine boat provided with a sighting instrument embodying the present invention. Fig. 2 is a rear elevation, and Fig. 3 a side elevation, of the instrument with the middle portion of the primary or lower tube-section removed. Fig. 4 is a partial sectional elevation of the upper or secondary hood with the adjacent portion of its supporting tube-section, and Fig. 5 is a longitudinal section of the same on line $x\,x$ of Fig. 4. Fig. 6 is a sectional elevation of the primary hood with the adjacent connected portions of the primary and secondary tube-sections. Fig. 7 is a plan with a portion at one side broken out to expose certain constructive features of the lower prism-holder and prisms therein, and Fig. 8 is a side elevation of the same. Fig. 9 is a transverse section of the primary tube-section on line $y\,y$ of Fig. 10, which is a sectional elevation of the middle portion of the lower tube adjacent the lens-holder. Fig. 11 is a plan of the lower focusing-lens holder, and Fig. 12 a perspective view of one of its lenses. Fig. 13 is a partial sectional elevation of the lower casing inclosing the inverting-prisms with the adjacent portion of the primary tube-section. Fig. 14 is an enlarged detail sectional view of the tube carrying the inner or secondary focusing-lens and showing the means for maintaining such tube in fixed relation to the inclosing tubular portion of the fixed partition member. Fig. 15 is a rear elevation of the lower portion of the instrument with the cap upon the side of the inverting-prism casing removed; and Figs. 16 and 17 are sectional plans of such casing upon transverse planes, respectively, immediately above the prisms and through the axis of the eyepiece. Fig. 18 is a detail elevation of the inner side of the eyepiece-cap.

As represented in the drawings, the observing-tube comprises a main or primary section 4, passing upwardly through and revoluble and longitudinally movable within a stuffing-box 3 in the roof of the conning-tower 2 of a submarine vessel 1 and is surmounted by a primary hood 5, preferably of polygonal form, of which the top or cap plate 6 is provided with a hollow boss 7, in which is secured the lower end of the upper or secondary tube-section 8, surmounted by a secondary hood 9.

Extending downwardly from the hood 5 for a portion only of its length is a fixed partition member comprising a central tube 10, forming a continuation of the tube-section 8, and a series of radial wings 11, projecting therefrom to the inner surface of the tube 4, so as to divide the primary tube-section into as many lateral compartments extending longitudinally thereof as there are sides of the primary hood 5. Each of the six sides of this polygonal hood, as herein represented, is formed with a lateral opening 12, in which is secured a plano-concave lens 13, con-

stituting an object-glass, behind which is fixed in a suitable frame 14 a prism 15, whose inclined reflecting-surface bends light-rays entering the tube through the object-glass downwardly through its respective lateral compartment of the primary tube-section 4. The prisms 15 of the series are of peculiar form, their ends being inclined each to the others in planes at substantially sixty degrees apart to enable them to fit closely together and utilize to the fullest extent the area of the tube-section 4, their inclined reflecting-faces thus assuming a trapezoidal shape, as represented in Fig. 7.

The light-rays from each of the prisms 15 are directed upon one of a series of double convex lenses 16, constituting the primary focusing-glasses, which are cut to truncated sectoral shape and mounted upon a suitable transverse frame 17 in the upper end of a sleeve 18, which is fitted movably within the primary tube-section 4, beneath the fixed divisional cage 10 11 therein, and provided externally with longitudinal rack-teeth 19, engaged by a pinion 20, entering a corresponding slot in the tube 4 and carried by a shaft 21, mounted in a housing 22, secured to the exterior of said tube, and provided with a stuffing-box 23, embracing said shaft, whereby the series of sectoral lenses may be longitudinally adjusted relatively to the fixed object-glasses 13 by suitably turning the wheel 24 upon the outer end of the shaft 21. A rectangular inspection-aperture 25, closed by a glass plate 26, is shown provided in the tube-section 4 adjacent the shaft 21 to expose a longitudinal series of graduations 27 upon the exterior of the sleeve 18 to indicate the position of the lenses 16, which are shifted longitudinally of the tube 4 for adjustment by the turning of the wheel 24.

It will be observed that as the pinion 20 enters a groove in the exterior of the sleeve 18 for the rack-teeth 19 the rack-and-pinion shifting means for longitudinal adjustment of the lens-holding sleeve within the primary tube-section affords an interlocking connection serving as a guide between these relatively movable tubular parts and prevents the turning of the sleeve within the tube-section.

Mounted upon the longitudinally-movable frame 17 is an auxiliary partition member or shield composed of the segmental portions 28 and flat radial wings 29, so as to substantially correspond in cross-section with the fixed partition member 10 11 and form a movable continuation thereof, whereby the partitions of the main tube-section are rendered practically extensible to correspond with the adjustments of the focusing-lenses whose ranges of vision intermediate the same and the respective object-glasses are thus maintained entirely separate and distinct and are prevented from overlapping, as would be the case to more or less extent were the partitions omitted.

The convex lens 30, herein represented as the eyepiece, is mounted in a horizontally-disposed cylindrical casing 31 at the lower end of the tube-section 4. The light-rays transmitting the several images from the series of focusing-lenses 16 could be readily deflected laterally into the range of the eyepiece 30 by means of a single prism or reflector; but the images received therefrom would be inverted and left-handed, and the observer would be thus liable to some confusion in making his observations. In order to present to the observer the objects in their true relations, therefore, an inverting device is provided which comprises an angular casing 32 at the foot of the primary tube-section 4, containing a prism 33 in the range of the focusing-glasses 16, and of which the inclined reflecting-face is so disposed as to reflect the light-rays therefrom laterally to a second prism 34, serving to bend upwardly the light-rays into range of a third prism 35, which again deflects such light-rays laterally in a plane transverse to the direction of action of the others into the range of the eyepiece and parallel with that of the rays directed upon the respective upper prism 15 through the objective 13, whose visual range corresponds in direction with that of an objective 40 in the secondary hood, to be hereinafter described.

By reference to the drawings it will be observed that the similarly-disposed objectives 13 and 40 and the eyepiece 30 are directed laterally and parallel each with the others, but that the optical axes of the objectives lie in a different vertical plane from that of the eyepiece, and hence the reflecting-faces of the lower prisms 33 and 34 are necessarily arranged to reflect the light-rays transversely of the vertical planes of said optical axes, and thus serve to reverse the images received through the objectives and the focusing-lenses.

It has been found in actual practice that by the use of a concave objective having a wide angle of vision and a small resistance to the passage of the light-rays, combined with a weak focusing-glass for condensing the light-rays for the eyepiece, a wide angle of vision could be secured to present to the observer images of external objects of natural size with a very high efficiency, the reduction of intensity of the light by the three members of the instrument being slight, owing to the comparatively small thickness of glass traversed by the light-rays. Thus by the present improvement a practically all-round view of the entire horizon may be obtained upon a natural scale to enable the observer not only to see objects within distances in which they might be seen by the natural eye, but to judge of the distances of such objects

from one another or from the vessel carrying the observer, the longitudinal adjustment provided for the frame carrying the focusing-lenses affording means of accommodating the instrument to the eyes of each individual.

As a further means of adapting the instrument as thus far described to the eyes of the observer, each of the sectoral lenses is movably mounted in its respective section of the frame 17 and adjustably secured in position while resting upon the supporting-flanges 36 by means of the radial center screws 37 entering suitable conical bearing-cavities 38 in the edges of the lenses. By this means the optical centers of the lenses, which are in practice located within the contracted angular portion of the same, may be adjusted inwardly or outwardly, so that the light-rays passing through them may be directed most advantageously for transmission to the eye of the observer by disposition nearer to or farther from the center of field of the convex lens forming the eyepiece.

The secondary hood 9 is represented as of angular form with a single lateral aperture 39, in which is disposed a weak plano-concave lens 40, constituting one member of a compound object-glass, of which the other member consists of a reducing-lens 41, mounted in a swinging frame 42, having lateral ears 43, pivoted, by means of a pin 44, within the hood 9 below the level of the lens 40. The swinging frame 42 is maintained normally in horizontal operative position with its edge in contact with the fixed stop-shoulder 46 by means of a spring 47, connecting the same with the upper end of the hood.

Intermediate the lenses 40 and 41 and within the direct range of vision of both is disposed a prism 48, adapted to bend the light-rays entering the hood laterally through the former, downwardly through the latter, and through the inner tubular portion of the partition member immediately beneath. The prism 48 is carried by a frame 49, mounted to oscillate upon the pivotal pins 50 through a small angle in the upper portion of the hood and yieldingly held in one of its extreme inclined positions by means of a spring 51, connecting it with the top of the casing.

A cord 52 for use in tilting the prism 48 in opposition to the spring 51 is connected therewith at a suitable point on the same side of its axis of suspension and is led through the upper tube-section and through a guide-eye 53 in the inner opening of the prism-holder 14 through one of the compartments of the main tube-section and a peripheral guide-notch 54 in the lens-holder 17 to the end of an arm 55, carried by a spindle 56, passing through a stuffing-box 57 in the lower casing 32 and provided upon the outer end with a pointer-arm acting in conjunction with the graduated segmental scale 58 to indicate the degree of inclination of the prism, a set-screw 59, carried by the pointer-arm, serving not only to secure the same in a given adjustment, but as a handle whereby the same may be conveniently manipulated. The employment of a spring for pressing the prism 48 constantly in the same direction operates to maintain the cord 52 taut under all circumstances and obviates any lost motion in the prism-adjusting means, so that the registering device in the base of the instrument maintains its accuracy and correctly indicates the inclination of the prism in all of its adjustments.

A second cord 60 is connected with an upwardly-projecting arm 61 of a bracket-piece upon one side of the swinging frame 42 and led also through the upper tube-section 8 and the guides 53 and 54 through the same lateral compartment of the main tube-section 4 to the apertured end of a crank-arm 62, mounted upon the inner end of a spindle 63, passing through a stuffing-box 64 in the casing 32 and having upon its outer end a lever 65, provided with a set-screw 66, by means of which it may be shifted and secured in position by impingement upon the side of the casing 32. The lens 41 may be readily shifted downwardly by such means out of range of the lens 40 and prism 48 by swinging the lever 65 so as to pull the cord 60 downwardly, and thereby cause the frame 42 to assume a position parallel with the axis of the tube 8, as indicated in dotted lines in Fig. 4.

Fitted to the inner compartment of the fixed partition member is a sliding sleeve 67, carrying in its lower end a weak secondary focusing-lens 68. As herein represented, this tube is suspended by a cord 69, attached to its upper end and passing through the wall of the tube 10 and around a grooved pulley 70, mounted, by means of a pin 71, upon one of the wings 11 of the partition member, from which it is led downwardly around a guide-pulley 72 to a winding-drum 73, carried by a shaft 74, passing through a stuffing-box 75 in the casing 32 and provided with a knob 76 for turning the same and a pointer-arm 77, serving in conjunction with a graduated scale 78 to indicate the position of the secondary focusing-lens.

In order to steady the sleeve 67, so as to prevent its turning within the tube 10 or any slight play therein which would interfere with coaction of its focusing-glass with the other members of the system of which it is a member, such sleeve is provided with a series of external longitudinal guide-grooves 96, entered by the rounded inner ends of the screws 97, applied to the walls of the inclosing tube and adapted for a slight lateral adjustment therein, as represented particularly in Fig. 14.

The component members 40 and 41 of the compound objective are of such character that even when combined their field of vision

is much less than that of the lower object-glasses 13, whereby objects viewed through the upper tube-section 8 appear upon an enlarged scale, and the glasses composing this inner tube-section constitute practically a telescope as compared with the outer systems. In order to increase the magnifying power of the inner system of glasses with a reduced field of vision, the lower member 41 of the compound object-glass may be shifted into lower inoperative position by the means before described, when the lowering of the inner focusing-lens 68 restores the operative relation of the three component members of the system and produces the desired magnification of the object to be scrutinized.

As another means of increasing the size of images transmitted through the objective, the focusing-lens 68 is in practice given a range of adjustment equivalent to the difference in the distances of the conjugate foci to the lens, whereby the shifting of the focusing-lens from its primary position covering a comparatively large field of vision to the secondary position produces an increase of its magnifying power with a corresponding decrease of the field of vision of the portion of the instrument of which this lens is an element.

It is evident that the range of adjustment of the primary focusing-lenses may be extended in a similar manner by increasing the capability of longitudinal movement of the primary focusing-lens-holding frame 17.

To adapt the eyepiece for such adjustment as may be desirable under the various conditions in which the instrument is intended to be used, the lens 30 is mounted between suitable clamping-rings 79, fitted to the threaded interior of a movable sleeve 80, which is in turn fitted within the tubular casing 31, projecting laterally from the main lower casing 32, and is provided externally upon opposite side, with series of rack-teeth 81, engaged by pinions 82, carried by shafts 83, mounted externally in the lateral housings 84, provided with suitable stuffing-boxes, the shafts being provided exterior to the casing 31 with suitable wheels 85, by which they may be turned to shift the carrying-sleeve and the lens mounted therein longitudinally in the inclosing tubular casing 31.

The outer end of the casing 31 is provided with a cap 86, having the usual boss 87 with small sighting-aperture 88 to insure the proper alinement of the eye of the observer in relation to the lens 30, and has upon its inner face several swinging arms 89, each having at its outer end a frame within which is fitted a plain smoked glass disk 90, and pivoted at the opposite end to the cap by means of a pin 91 and having notches 92 in its edge adapted for engagement by a tooth 93 upon the outer end of a flat spring 94, whose opposite end is fastened rigidly to the inner face of the cap 86. The glass disks 90 are of different degrees of resistance to the passage of light and are so mounted that they may be swung, each independently of the others, into line with the sighting-aperture 88 of the cap by means of a knob 95 upon the outer end of the pin 91, whereby the intensity of the light received through the instrument upon a bright day may be sufficiently reduced to enable the observer to use the instrument without the inconvenience which would be experienced in case such means for temporarily introducing a variable resistance were lacking.

From the foregoing description it will be observed that the various component parts of the instrument may be widely varied without departure from the scope of the present invention. The object-glasses are represented as weak plano-concave lenses; but it is evident that the strength and particular form of the lenses of the general class required for the purpose may be varied to suit the particular uses for which the instrument may be designed, the number and scope of the lower series of objectives constituting the "finders" being determined by the particular requirements of the instrument for individual cases.

The lenses 14 of the circular series of focusing-glasses, while represented as "sectoral," in order to secure the advantage of the greatest area possible for passage of light and for deflection of the light-rays inwardly nearer to the center of the eyepiece, are obviously not limited to such shape to make them operative, the same merely involving a maximum efficiency for glasses of a given strength.

It will be observed that the employment of an upper contracted section for the observing-tube for submarine vessels is particularly advantageous, as the same permits of the submergence of the vessel when in close range of the enemy, so as to hide the finding portion of the same containing the wide angle objectives and to expose a tube of only a few inches diameter with which accurate observation of the enemy may be effected through the narrow-angle objective with but slight chance of discovery by him.

In the drawings annexed the reflectors are shown as prisms which are independent of the simple lenses with which they coöperate; but it is evidently immaterial whether this construction be adopted or such lenses and reflectors be made integral in a manner well known.

In the instrument as herein represented the line of vision from the observer to the object observed resembles somewhat the shape of the letter "Z," the deflection of the light-rays from the upper prism laterally below the eyepiece and then upwardly into the range of the eyepiece, however, making necessary the inclination of the reflecting-face of

the upper prism and that of the prism adjacent the eyepiece in planes at a right angle to each other instead of parallel, as would be the case were each of these prisms in the range of reflection of the other, the image transmitted to the second of such prisms being received from below instead of above, as in instruments heretofore designed for a like purpose.

Having thus set forth the invention, what we claim herein is—

1. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in alinement with the primary tube-section, and a secondary hood mounted thereon, of similarly-directed wide-angle and narrow-angle objectives disposed respectively in the primary and secondary hoods, and a reflector in the visual range of the objective in each hood adapted to receive an image of the same external object and reflect it downwardly through the primary tube-section.

2. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in alinement with the primary tube-section, and a secondary hood mounted thereon, of similarly-directed wide-angle and narrow-angle objectives disposed respectively in the primary and secondary hood, a reflector in the visual range of the objective in each hood adapted to receive an image of the same external object and reflect it downwardly through the primary tube-section, and independent focusing-lenses for condensing the light-rays from the respective objectives.

3. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in alinement with the primary tube-section, and a secondary hood mounted thereon, of similarly-directed wide-angle and narrow-angle objectives disposed respectively in the primary and secondary hoods, a reflector in the visual range of the objective in each hood adapted to receive an image of the same external object and reflect it downwardly through the primary tube-section, and a partition member within the primary tube-section forming a tubular extension of the secondary tube-section to inclose the light-rays from the narrow-angle objective.

4. In a sighting instrument, the combination with a tube-section and a hood surmounting the same, of a plurality of divergently-directed reflectors mounted in said hood and each adapted to receive laterally an image of an external object and reflect it downwardly through said tube-section, an objective in the visual range of each of said reflectors, and a partition member adapted to divide said tube into a plurality of tubular compartments each inclosing the light-rays from its respective reflector and objective.

5. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in axial relation with the primary tube-section, and a secondary hood mounted thereon, of a plurality of divergently-directed reflectors mounted in said primary hood and a reflector disposed in said secondary hood, each adapted to receive laterally an image of an external object and reflect it downwardly through said primary tube-section, a wide-angle objective disposed in the visual range of each reflector in the primary hood and a narrow-angle objective disposed in the visual range of the reflector in the secondary hood, and a partition member adapted to divide said tube into a plurality of compartments each inclosing the light-rays from its respective reflector and objective.

6. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in alinement with the primary tube-section, and a secondary hood mounted thereon, of similarly-directed wide-angle and narrow-angle objectives disposed respectively in the primary and secondary hoods, an inclined reflector in the visual range of the objectives in the primary hood, an inclined reflector pivotally mounted in the visual range of the objective in the secondary hood, means for yieldingly maintaining the last-named reflector in one of its extreme positions, and a flexible connection between the latter and the lower end of the primary tube-section for varying its degree of inclination.

7. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in alinement with the primary tube-section, and a secondary hood mounted thereon, of similarly-directed wide-angle and narrow-angle objectives disposed respectively in the primary and secondary hood, an inclined reflector in the visual range of the objective in the primary hood, an inclined reflector pivotally mounted in the visual range of the objective in the secondary hood, a partition member to separate the light-rays directed downwardly through the primary tube-section from the said objectives, means for yieldingly maintaining the last-named reflector in one of its extreme positions, and a flexible connection between the latter and the lower end of the primary tube-section led through the secondary tube-section and a lateral compartment of the primary tube-section for varying its degree of inclination.

8. In a sighting instrument, the combina-

tion with a tube-section and a hood surmounting the same, of a plurality of divergently-directed reflectors mounted in said hood and each adapted to receive laterally an image of an external object and reflect it downwardly through said tube-section, an objective in the visual range of each of said reflectors, an eyepiece at the lower end of said tube-section, a plurality of focusing-lenses mounted in a longitudinally-movable common frame, each intermediate said eyepiece and one of said objectives, a fixed partition member intermediate said objectives and focusing-lenses and adapted to divide said tube into a plurality of tubular compartments each inclosing the light-rays from its respective reflector and objective, an auxiliary partition member disposed in telescopic relation with said fixed partition member and movable with the frame carrying the said focusing-lenses, and means for shifting said focusing-lenses longitudinally of said tube-section.

9. In a sighting instrument, the combination with an inclosing tube and a hood mounted thereon, of a plurality of divergently-directed inclined reflectors within said hood each adapted to receive an image of an external object and to reflect it downwardly within said tube, an objective in the visual range of each of said inclined reflectors, a single eyepiece at the lower end of said tube, a plurality of focusing-lenses each disposed intermediate one of said objectives and the eyepiece, a longitudinally-movable common holder for said focusing-lenses, and means external to said tube for longitudinally adjusting the position of said holder in respect of said eyepiece and objectives.

10. In a sighting instrument, the combination with an inclosing tube and a hood mounted thereon, of a plurality of divergently-directed inclined reflectors within said hood each adapted to receive an image of an external object and to reflect it downwardly within said tube, an objective in the visual range of each of said inclined reflectors, a single eyepiece at the lower end of said tube, and a plurality of convergently-arranged focusing-lenses of truncated sectoral shape mounted within said tube each disposed intermediate one of said objectives and the eyepiece.

11. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in axial relation with the primary tube-section, and a secondary hood mounted thereon, of a plurality of divergently-directed reflectors mounted in said primary hood and a reflector disposed in said secondary hood each adapted to receive laterally an image of an external object and reflect it downwardly through said tube-section, a wide-angle objective disposed in the visual range of each reflector in the primary hood and a narrow-angle objective disposed in the visual range of the reflector in the secondary hood, an eyepiece at the lower end of the primary tube-section, a plurality of focusing-lenses in annular arrangement within the primary tube-section, each intermediate the eyepiece and one of the primary objectives, a common frame in which said focusing-lenses are mounted and an additional focusing-lens disposed axially within said primary tube and intermediate said eyepiece and the secondary objective.

12. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in axial relation with the primary tube-section, and a secondary hood mounted thereon, of a plurality of divergently-directed reflectors mounted in said primary hood and a reflector disposed in said secondary hood, each adapted to receive laterally an image of an external object and reflect it downwardly through said tube-section, a wide-angle objective disposed in the visual range of each reflector in the primary hood and a narrow-angle objective dipsosed in the visual range of the reflector in the secondary hood, an eyepiece at the lower end of the primary tube-section, a plurality of focusing-lenses mounted in annular arrangement upon a common frame within the primary tube-section, each intermediate the eyepiece and one of the primary objectives, an additional axially-disposed focusing-lens mounted within said primary tube to be longitudinally adjustable intermediate said eyepiece and the secondary objective, and means external to said tube for adjusting the position of the last-named focusing-lens.

13. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in axial relation with the primary tube-section, and a secondary hood mounted thereon, of a plurality of divergently-directed reflectors mounted in said primary hood and a reflector disposed in said secondary hood, each adapted to receive laterally an image of an external object and reflect it downwardly through said tube-section, a wide-angle objective disposed in the visual range of each reflector in the primary hood and a narrow-angle objective disposed in the visual range of the reflector in the secondary hood, an eyepiece at the lower end of the primary tube-section, a plurality of focusing-lenses mounted in annular arrangement upon a common frame within the primary tube-section, each intermediate the eyepiece and one of the primary objectives, an additional axially-disposed convex focusing-lens movably mounted within said primary tube intermediate said eyepiece and the secondary objective, and means con-

structed and arranged to shift the last-named focusing-lens longitudinally of said tube a distance equivalent to the difference of the distances of said lens from its conjugate foci.

14. In a sighting instrument, the combination with an inclosing tube, a hood mounted thereon, an inclined reflector in said hood adapted to receive laterally an image of an external object and reflect it downwardly through said tube, an objective in the visual range of said reflector, an eyepiece at the lower end of said tube, a focusing-lens movably mounted in said tube intermediate said objective and eyepiece, and means for shifting said focusing-lens longitudinally of said tube between extreme positions a distance equivalent to the difference of the distances between said focusing-lens and its conjugate foci.

15. In a sighting instrument, the combination with an inclosing tube, a hood mounted thereon, an inclined reflector in said hood adapted to receive laterally an image of an external object and reflect it downwardly through said tube, an objective in the visual range of said reflector, an eyepiece at the lower end of said tube, a focusing-lens intermediate said objective and eyepiece, a sleeve by which said focusing-lens is carried provided externally with longitudinal grooves, a tubular support to which said sleeve is movably fitted, transverse screw-pins applied to said movable support with their ends entering said external grooves in the sleeve, and means for shifting said sleeve longitudinally of said tube.

16. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in axial relation with the primary tube-section, and a secondary hood mounted thereon, of a plurality of divergently-directed reflectors mounted in said primary hood and a reflector disposed in said secondary hood, each adapted to receive laterally an image of an external object and reflect it downwardly through said primary tube-section, a wide-angle objective disposed in the visual range of each reflector in the primary hood and a narrow-angle objective disposed in the visual range of the reflector in the secondary hood, an eyepiece at the lower end of the primary tube-section, a plurality of focusing-lenses mounted in annular arrangement upon a common frame within the primary tube-section, each intermediate the eyepiece and one of the primary objectives, an additional axially-disposed focusing-lens mounted in a carrying-sleeve within said primary tube to be longitudinally adjustable intermediate said eyepiece and the secondary objective, a partition member adapted to divide said tube into a plurality of compartments each inclosing the light-rays from its respective reflector and objective, a grooved pulley mounted upon said partition member, a drum in the lower portion of said instrument, and a cord connected at one end with said carrying-sleeve and at the other with said drum and passing over said grooved pulley, whereby said sleeve and focusing-lens carried thereby may be raised and lowered.

17. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in alinement with the primary tube-section and a secondary hood mounted thereon, of similarly-directed wide-angle and narrow-angle objectives disposed respectively in the primary and secondary hoods, reflectors in the visual range of the objective in each hood adapted to receive an image of the same external object and reflect it downwardly through the primary tube-section, an eyepiece at the lower end of the primary tube-section, a focusing-lens intermediate said eyepiece and the wide-angle objective, a focusing-lens intermediate said eyepiece and the narrow-angle objective and a longitudinally-movable sleeve by which the same is carried, a partition member within the primary tube-section forming a tubular extension of the secondary tube-section to inclose the light-rays from the narrow-angle objective, a grooved pulley mounted upon said partition member external to its tubular portion, a drum in the lower portion of the instrument, a supporting-shaft for said drum passing through the wall of said instrument and carrying external thereto means for turning the same, and a cord attached at one end to the lens-holding sleeve and at the opposite end to said drum and passing through the wall of said partition member and around the grooved pulley mounted thereon.

18. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in alinement with the primary tube-section and a secondary hood mounted thereon, of similarly-directed wide-angle and narrow-angle objectives disposed respectively in the primary and secondary hoods, reflectors in the visual range of the objective in each hood adapted to receive an image of the same external object and reflect it downwardly through the primary tube-section, an eyepiece at the lower end of the primary tube-section, a focusing-lens intermediate said eyepiece and the wide-angle objective, a focusing-lens intermediate said eyepiece and the narrow-angle objective and a longitudinally-movable sleeve by which the same is carried, a partition member within the primary tube-section forming a tubular extension of the secondary tube-section to inclose the light-rays from the narrow-angle objective, a grooved pulley

mounted upon said partition member external to its tubular portion, a drum in the lower portion of the instrument, a supporting-shaft for said drum passing through the wall of said instrument and carrying external thereto a pointer and means for turning the same, a graduated scale adjacent said supporting-shaft, and a cord attached at one end to the lens-holding sleeve and at the opposite end to said drum and passing through the wall of said partition member and around the grooved pulley mounted thereon.

19. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in axial relation with the primary tube-section, and a secondary hood mounted thereon, of a plurality of divergently-directed reflectors mounted in said primary hood and a reflector disposed in said secondary hood each adapted to receive laterally an image of an external object and reflect it downwardly through said tube-section, a wide-angle primary objective disposed in the visual range of each reflector in the primary hood and a compound objective comprising a plurality of lenses in normal operative relation, one of which is movable out of such relation with another, said compound objective being disposed normally in the visual range of the reflector in the secondary hood, an eyepiece at the lower end of the primary tube-section, a plurality of focusing-lenses disposed in annular arrangement within the primary tube-section, each intermediate the eyepiece and one of the primary objectives, a common frame upon which said focusing-lenses are mounted, an additional focusing-lens disposed axially within said primary tube and intermediate said eyepiece and the secondary objective with means for longitudinally shifting the same, and means for shifting said movably-mounted member of the compound objective out of normal operative relation with the other or others.

20. In a sighting instrument, the combination with a compound objective composed of a plurality of members in normal operative relation, one of which is movable out of such normal operative relation, an eyepiece, a focusing-lens intermediate said eyepiece and the compound objective, means for shifting the movable member of said objective out of normal relation with another, and means for adjusting the position of said focusing-lens to compensate for the change thus effected in the objective.

21. In a sighting instrument, the combination with an inclosing tube, of a compound objective composed of a plurality of members in normal operative relation, one of which is movable out of such normal operative relation, a swinging frame in which said movable member is mounted, means applied to said swinging frame for yieldingly maintaining the movable member in operative position, means applied to said swinging frame for shifting said movable member out of operative position, an eyepiece, a focusing-lens intermediate said eyepiece and the compound objective, and means for adjusting the position of said focusing-lens to compensate for the change thus effected in the objective.

22. In a sighting instrument, the combination with an inclosing tube, of a compound objective composed of a plurality of members in normal operative relation, one of which is movable out of such normal operative relation, a swinging frame in which said movable member is mounted, a stop in contact with which said swinging frame rests when in operative position, a spring for yieldingly holding said frame in contact with said stop, a connection from said swinging frame to the lower portion of said inclosing tube whereby the same may be shifted out of operative position, an eyepiece, a focusing-lens intermediate said eyepiece and the compound objective, and means for adjusting the position of said focusing-lens to compensate for the change thus effected in the objective.

23. In a sighting instrument, the combination with an inclosing tube, of a compound objective composed of a plurality of members in normal operative relation, one of which is movable out of such normal operative relation, a vertically-swinging frame in which said movable member is mounted, a stop in contact with which said swinging frame rests when in operative position, a spring for yieldingly holding said frame in contact with the lower side of said stop, a spindle passing through the wall of the inclosing tube in its lower portion and provided upon its inner end with a crank-arm and upon its outer end with means for turning the same, a connection between said crank-arm and swinging frame whereby the latter may be shifted downwardly to remove the movable member of the compound objective from operative position, an eyepiece, a focusing-lens intermediate said eyepiece and the compound objective, and means for adjusting the position of said focusing-lens to compensate for the change thus effected in the objective.

24. In a sighting instrument, the combination with an inclosing tube, of a compound objective composed of a plurality of members in normal operative relation, one of which is movable out of such normal operative relation, a vertically-swinging frame in which said movable member is mounted, a stop in contact with which said swinging frame rests when in operative position, a spring for yieldingly holding said frame in contact with the lower side of said stop, a

spindle passing through the wall of the inclosing tube in its lower portion and provided upon its inner end with a crank-arm and upon its outer end with an operating-lever having at its outer end means for securing it in position, a connection between said crank-arm and swinging frame whereby the latter may be shifted downwardly to remove the movable member of the compound objective from operative position, an eyepiece, a focusing-lens intermediate said eyepiece and the compound objective, and means for adjusting the position of said focusing-lens to compensate for the change thus effected in the objective.

25. In a sighting instrument, the combination with an inclosing tube, of a laterally-directed objective, an inclined reflector in the visual range of the same and adapted to reflect downwardly light-rays received therefrom, an eyepiece having its optical axis parallel with and disposed in a different vertical plane from that of said objective, an adjacent inclined reflector adapted to receive light-rays from beneath in a direction substantially parallel with those of the first-named reflector and direct them into range of said eyepiece, and a plurality of reflectors adapted to receive light-rays from said first-named reflector and to direct them upon the second-named reflector.

26. In a sighting instrument, the combination with an inclosing tube, of a laterally-directed objective, a reflector having an operative face disposed transversely of the optical axis of said objective and inclined downwardly and backwardly in respect of the latter, an eyepiece having its optical axis parallel with and disposed in a different vertical plane from that of said objective, an adjacent reflector having its operative face disposed transversely of said axis and inclined at right angles with that of said first-named reflector and downwardly and forwardly in respect of said eyepiece, and a plurality of reflectors adapted to receive light-rays from said first-named reflector and to direct them upon the second-named reflector.

27. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section carried by said primary hood in axial relation with the primary tube-section, and a secondary hood mounted thereon, of a plurality of divergently-directed reflectors mounted in said primary hood and a reflector disposed in said secondary hood, each adapted to receive laterally an image of an external object and reflect it downwardly through said primary tube-section, a wide-angle objective disposed in the visual range of each reflector in the primary hood and a narrow-angle objective disposed in the visual range of the reflector in the secondary hood, an eyepiece at the lower end of the primary tube-section having its axis disposed parallel with that of the said narrow-angle objective, a plurality of focusing-lenses mounted in annular arrangement within the primary tube-section, each intermediate the eyepiece and one of the primary objectives, an additional focusing-lens disposed axially within said primary tube-section and intermediate said eyepiece and the secondary objective, a reflector in the visual range of said eyepiece and adapted to reflect thereto light-rays received from beneath the same, and a plurality of reflectors adapted to receive the light-rays from all of the first-named reflectors and direct them upwardly to the said reflector adjacent the eyepiece.

28. In a sighting instrument, the combination with a primary tube-section, a primary hood mounted thereon, a secondary tube-section, carried by said primary hood in axial relation with the primary tube-section and a secondary hood mounted thereon, of a plurality of divergently-directed primary reflectors having operative faces of trapezoidal shape with their upper and lower edges disposed in regular polygonal arrangement, thereby forming a central opening intermediate the same, said reflectors being mounted in said primary hood, and a secondary reflector disposed in said secondary hood, each of said reflectors being adapted to receive laterally an image of an external object and reflect it downwardly through said tube-section, the reflection from said secondary reflector being through the central opening of the primary reflectors, a wide-angle objective disposed in the visual range of each reflector in the primary hood and a narrow-angle objective disposed in the visual range of the reflector in the secondary hood, an eye-piece at the lower end of the primary tube-section, a plurality of focusing-lenses mounted in annular arrangement within the primary tube-section, each intermediate the eyepiece and one of the primary objectives, and an additional focusing-lens disposed axially within said primary tube and intermediate said eyepiece and the secondary objective.

29. In a sighting instrument, the combination with an objective, an eyepiece, a suitable housing in which the same is mounted and an intermediate focusing-lens, of a cap applied to the eyepiece-housing and provided with a sighting-aperture in the range of said eyepiece, a plurality of swinging arms each carrying at its outer end a disk of smoked glass, supporting-spindles passing through said cap to the inner extremities of which the opposite ends of said swinging arms are respectively fixed, and means upon the outer extremity of each of said spindles for turning it independently of the others.

30. In a sighting instrument, the com na-

tion with an objective, an eyepiece mounted in a suitable housing and an intermediate focusing-lens, of a cap applied to the eyepiece-housing and provided with a sighting-aperture in the range of said eyepiece, a plurality of swinging arms each carrying at its outer end a disk of smoked glass and formed with a plurality of notches in the rounded extremity of its inner end, supporting-spindles to the inner extremities of which the inner ends of said swinging arms are fixed, means upon the outer extremity of each of said spindles for turning it independently of the others, and spring-detents adapted to engage the notches in the edges of said swinging arms.

In testimony whereof we have signed our names to this specification each in the presence of two subscribing witnesses.

SIMON LAKE.
EDWARD L. HUBBARD.

Witnesses as to S. Lake:
J. C. LAKE,
HENRY J. MILLER.
Witnesses as to E. L. Hubbard:
R. F. SHREVE,
HENRY CHAPMAN.