W. D. MacDOUGALL.

METHOD OF AND APPARATUS FOR SIMULATING THE APPEARANCE OF MOVEMENT IN A TARGET CAUSED AT SEA BY ROLLING AND YAWING.

APPLICATION FILED AUG. 27, 1912.

1,093,639.

Patented Apr. 21, 1914.

2 SHEETS—SHEET 1.

Fig. 1.

Side Elevation.

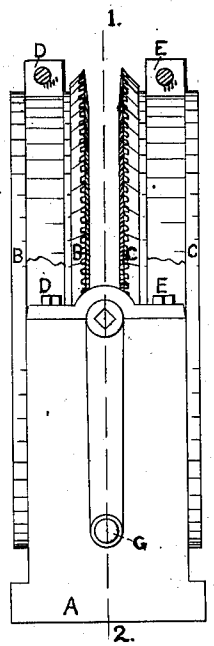


Fig. 2.

Section on 1-2-3.

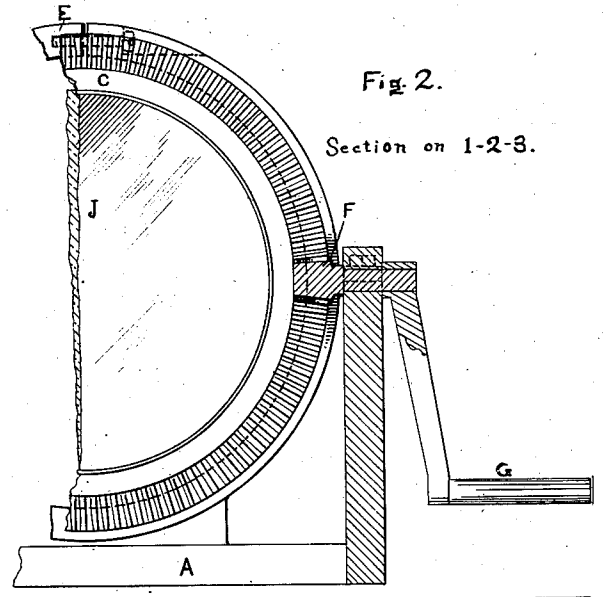
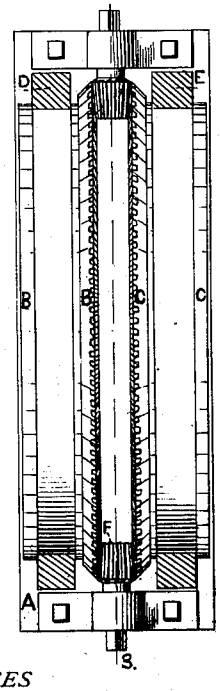


Fig. 3.

Plan.



Vertical Motion, Plans. ½ Scale

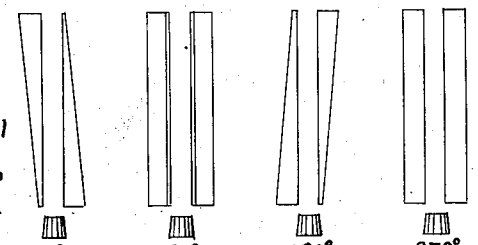


Fig. 4. Fig. 5. Fig. 6. Fig. 7.

Horizontal Motion, Plans. ½ Scale.

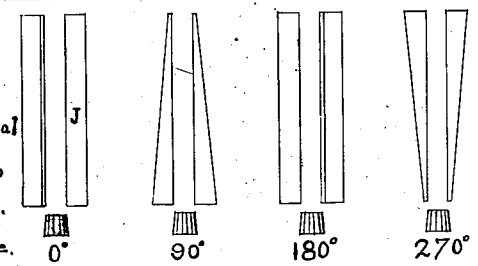


Fig. 8. Fig. 9. Fig. 10. Fig. 11.

WITNESSES

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2 SHEETS—SHEET 2.

Vertical Motion, Side Elevations.

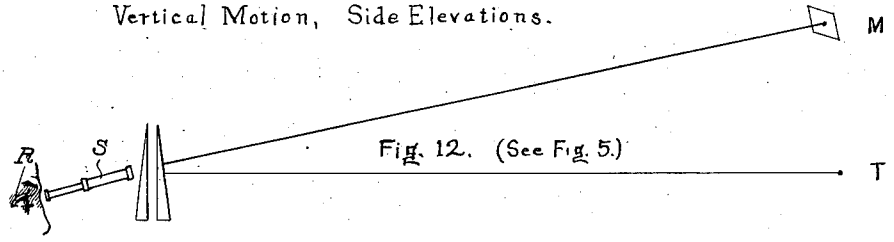


Fig. 12. (See Fig. 5.)

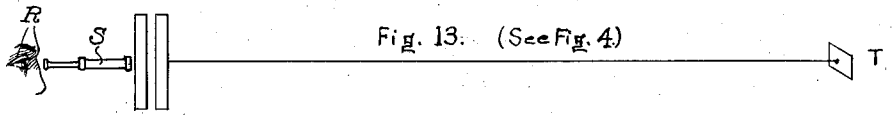


Fig. 13. (See Fig. 4)

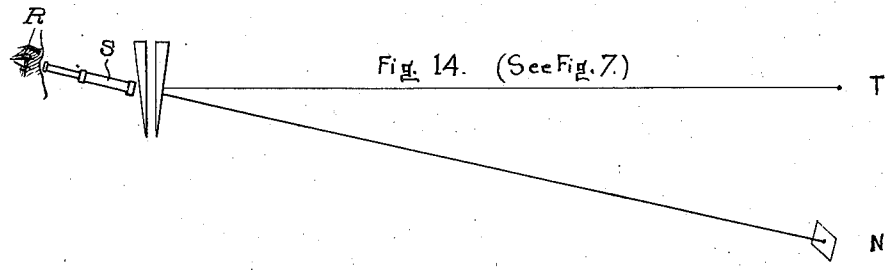


Fig. 14. (See Fig. 7.)

Horizontal Motion, Plans.

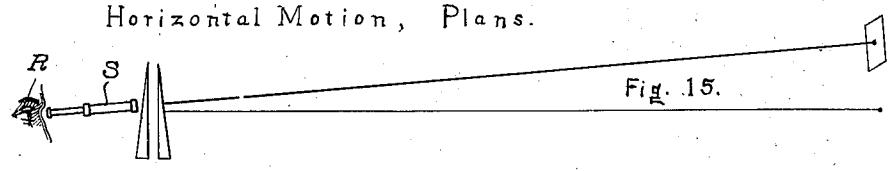


Fig. 15.

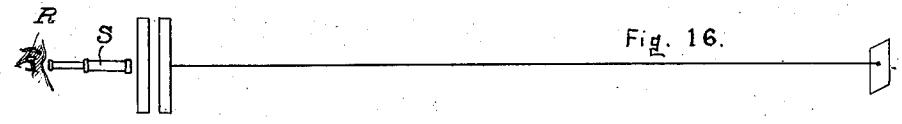


Fig. 16.

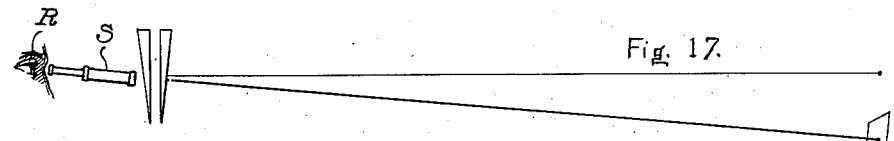


Fig. 17.

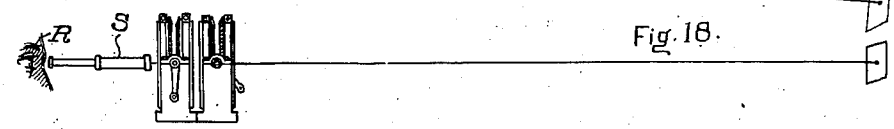


Fig. 18.

WITNESSES

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METHOD OF AND APPARATUS FOR SIMULATING THE APPEARANCE OF MOVEMENT IN A TARGET CAUSED AT SEA BY ROLLING AND YAWING.

1,093,639. Specification of Letters Patent. Patented Apr. 21, 1914.

Application filed August 27, 1912. Serial No. 717,361.

To all whom it may concern:

Be it known that I, WILLIAM D. MacDOUGALL, a citizen of the United States of America, and a resident of Washington, in the District of Columbia, have invented certain new and useful Improvements in Methods of and Apparatus for Simulating the Appearance of Movement in a Target Caused at Sea by Rolling and Yawing, of which invention the following is a specification.

Be it understood that by the term "gun pointer" is meant the man stationed to aim a heavy gun or cannon, especially a gun mounted on board a ship.

In practising gun pointing, the best method may be said to be with the ship rolling at sea, pointing the gun at another ship, or other distant target, the pointer striving to so manipulate the machinery which moves his gun as to point the gun at the target despite the rolling and yawing motion of his own ship on which the gun is mounted. While doing this the pointer looks through a telescope sight attached to the gun, and his skill and success are measured, since he does not actually fire the gun, by the frequency with which he can bring the cross wires of the telescope sight steady on the target.

When in port it is necessary to keep the gun pointers in practice, but the ship does not roll or yaw, and there is not usually available any distant target with sufficient motion to afford any practice. Hence, until now, it has been possible to use this method of practising only when the ship was in a sea-way. As will more fully hereinafter appear, my invention makes its possible to use the said method effectively at all times.

My invention relates to the bending of the line of sight by passing it through transparent alterable prisms in such manner that the target, viewed through the sights of the gun, will appear, by reason of the refraction, above or below and to the left or the right of its real position with reference to the line through the sights, and by so varying the position and angle of the prisms as to give the target an apparent motion in any direction in a plane approximately perpendicular to the line of sight. (It will be understood that the line of sight is the line from the eye through the intersection of the sight telescope cross wires, or through the rear and the front sights, to the target as it appears to the vision.)

I am aware that, broadly speaking and for other purposes, alterable prisms are not new, but to the best of my knowledge and belief I am the first to devise both the method and the apparatus claimed herein.

I may use one alterable prism, the component parts of which, geared to revolve irregularly, to give a variety of apparent motions in all directions in the approximately perpendicular plane, or I may attain the variety of apparent motions by the use of two alterable prisms, the component parts of which are geared to revolve at equal speeds, alined one before the other, in series, one alterable prism giving vertical displacement, and the other alterable prism giving horizontal displacement. The two alterable prisms may be exactly similar in all parts but are assembled at different angles so far as the revolution of the turning parts is concerned, their zero positions being substantially 90° apart.

Referring to the drawings: Figure 1 is a side elevation (with upper portions of bearings of frame wheels removed from foreground). Fig. 2 is a part section on the line 1—2—3 (of Fig. 1 and Fig. 3), showing a portion of the front half (that is the right hand half of Fig. 1) of an alterable prism assembled to give horizontal motion, when in primary or zero position, *i. e.*, before the handle is turned. Fig. 3 is a plan, the bearings being shown in section. Figs. 4 to 7 are plan view diagrams showing the positions of the two component revolving prisms which together form an alterable prism assembled to revolve at equal speeds and to give vertical motion only, after certain amounts of revolution, indicated by the number of degrees marked below each pair. Figs. 8 to 11 show similarly plan views of the pair of component prisms which make up an alterable prism assembled to revolve at equal speeds and to give horizontal motion only. Figs. 12, 13 and 14 are side elevations showing the principle giving vertical motion. Figs. 15, 16 and 17 are plans showing the principle giving horizontal motion. Fig. 18 is a view in elevation of the entire apparatus, the entire gun, except the

sighting telescope, being as in the other figures, omitted. But it is to be understood that, although shown in the drawings as separate, the apparatus may be as well attached to the front of the telescope, moving therewith, and having a similar effect on the eye of the gun pointer as when separate.

Similar letters refer to similar parts throughout the several views.

By my method the appearance of movement in a target caused at sea by rolling and yawing is simulated by bending the line of sight of the gun pointer up and down to simulate the rolling and at the same time to right and left to simulate the yawing. The target is sighted through alterable prismatic devices and the line of sight refracted up and down to simulate rolling and at the same time to right and left to simulate yawing. The nature of the method will be more fully apparent from the rest of the specification. The device by which I prefer to carry out this method consists of an alterable prism, that is a prism which, by revolving or swinging, or moving, or by change of angle between its limiting sides, causes a change in the bending of the line of sight, and this alterable prism I choose to construct by placing component prisms of suitable angle, of glass or other transparent substance in revolving frame wheels B and C (Figs. 1, 2 and 3). These frame wheels are placed parallel to each other and are so mounted in bearings on the base A that they may be revolved about their center line axis which is perpendicular to their plane. The frame wheels B and C are mounted in bearings D and E on their perimeters (see Figs. 1 and 3) so that the passage of rays of light through the prisms which the frames hold is not obstructed. The edges of the frame wheels B and C are geared as shown, and so connected with the pinion F (which with its shaft may be revolved by turning the crank G) that the frame wheels revolve in opposite directions. The pinion F with its shaft and the crank G are supported in a suitable bearing forming a part of the base A. The pinion F and shaft with bearing are duplicated on the opposite side of the alterable prism so that crank G may be shipped on either side, or that two or more alterable prisms may be connected to work together. Thus it appears that by operation of the mechanism shown in Fig. 1, Fig. 2 and Fig. 3, or of any suitable mechanism, there is presented for passage of the line of sight, a prism altering as the mechanism is operated, the limits of alteration being reached when the two component prisms, as shown in Fig. 5, and in Fig. 7, are both turned for the same direction of refraction. That is, supposing the operation to begin with the two component prisms as in Fig. 4, the alterable prism formed by the combination of the pair revolving at equal speeds in opposite directions would progress through Fig. 5, Fig. 6 and Fig. 7 and back to Fig. 4 position. The same is shown in Fig. 12, Fig. 13 and Fig. 14 in side elevation.

In Fig. 13 suppose that R is the eye of the gun pointer looking through the sights S (which move with the gun) to the target T. It is not necessary to consider differences in coefficients of refraction or other refinements. It is obvious that when the operation of the alterable prism has proceeded to the position shown in Fig. 12, the observer's eye at R will see the target at M (whereas it has not in reality moved from T) and that, in order to bring his gun sight on the target, he must move it so as to coincide with the line R M. Similarly, when the alterable prism has been operated until it reaches the form shown in Fig. 14, the effect is to move the apparent position of the target to N. Hence we have a vertical motion by operation of this one alterable prism.

In order to obtain a horizontal motion suppose in Fig. 16 (a plan) that R is the eye of the gun pointer looking through the sights S and through a horizontal motion alterable prism to a target X. It is obvious that when the operation of the prism has proceeded to the position shown in Fig. 15 that eye at R will see the target at Y (whereas it has not in reality moved from X) and that, in order to bring his gun sight on the target, he must move it so as to coincide with the line R Y. Similarly, when the alterable prism has been operated until it reaches the form shown in Fig. 17, the effect is to move the apparent position of the target to Z. Hence we have a horizontal motion by operation of this one alterable prism. And it is obvious that by passing the line of sight through two such single alterable prisms in series we get a combination of vertical and horizontal motion, *i. e.*, a diagonal motion, in any direction in the approximately perpendicular plane. And it is obvious that if the revolution of the component parts of one alterable prism be irregular, instead of at equal speeds, that the relative position of the component parts to each other will vary in such a manner as to show to the eye a varying apparent motion, vertical, horizontal, or oblique, according to the shape taken by the alterable prism from moment to moment, when operated. This is obviously true also where two alterable prisms are used, the varying apparent motion being the resultant of the varying apparent motions produced by said alterable prisms. The alteration of each prism may be effected by varying the speed of the two component parts while rotating them completely or otherwise in the same or in opposite directions.

What I claim as my invention is:

1. The method of simulating the appear-

ance of movement in a target caused at sea by rolling and yawing which consists in bending the line of sight of the gun pointer up and down to simulate the rolling and at the same time to right and left to simulate the yawing.

2. The method of simulating the appearance of movement in a target caused at sea by rolling and yawing which comprises the following steps, sighting the target through one or more alterable prismatic devices, and refracting the line of sight up and down to simulate the rolling and at the same time to right and left to simulate the yawing.

3. The method of simulating the appearance of movement in a target caused at sea by rolling and yawing which comprises the following steps, sighting the target through two alined alterable prisms, having their zero positions substantially 90° apart, refracting the line of sight up and down to simulate the rolling by altering one of the prisms and at the same time refracting the line of sight to right and left to simulate the yawing by altering the other of said prisms.

4. The method of simulating the appearance of movement in a target caused at sea by rolling and yawing which comprises the following steps, sighting the target through two alined alterable prisms, having their zero positions substantially 90° apart, refracting the line of sight up and down to simulate the rolling by altering one of the prisms and at the same time refracting the line of sight to right and left to simulate the yawing by altering the other of said prisms independently of the first.

5. The method of simulating the appearance of movement in a target caused at sea by rolling and yawing which comprises the following steps, sighting the target through two alined alterable prisms, having their zero positions substantially 90° apart, refracting the line of sight up and down to simulate the rolling by completely and continuously rotating in opposite directions the component prisms of one of said alterable prisms and at the same time refracting the line of sight to right and left to simulate the yawing by oscillating in opposite directions the component prisms of the other of said alterable prisms.

6. Apparatus for simulating the appearance of movement in a target comprising in combination gun sights, alterable prismatic apparatus in line therewith, and means for altering said prismatic apparatus to refract the line of sight up and down to simulate rolling and at the same time to right and left to simulate yawing.

7. Apparatus for simulating the appearance of movement in a target comprising in combination gun sights, an alterable refracting prism in line therewith having two rotatably mounted component prisms and means for simultaneously rotating said component prisms in such manner as to simulate the appearance of movement in a target caused by the movement of the sea.

8. Apparatus for simulating the appearance of movement in a target comprising in combination gun sights, two alterable prisms in line therewith having their zero positions substantially 90° apart and each having two rotatably mounted component prisms, means for simultaneously rotating the members of one of said pairs in such manner as to simulate rolling, and independent means for simultaneously rotating the members of the other of said pairs in such manner as to simulate yawing.

9. Apparatus for simulating the appearance of movement in a target comprising in combination gun sights, an alterable prism comprising two component prisms at least one of which is movable on an axis substantially parallel to the triangular section of the alterable prism intersecting its edges at right angles, and means for producing relative movement between said component prisms to vary the angle between the limiting sides of the alterable prism in such manner as to simulate the appearance of movement in the target caused by the movement of the sea.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM DUGALD MACDOUGALL.

Witnesses:
VICTOR BLUE,
HENRY J. ZIEGEMEIER.