Sir W. THOMSON, Kt.
Mariner's Compass.

No. 210,066. Patented Nov. 19, 1878.
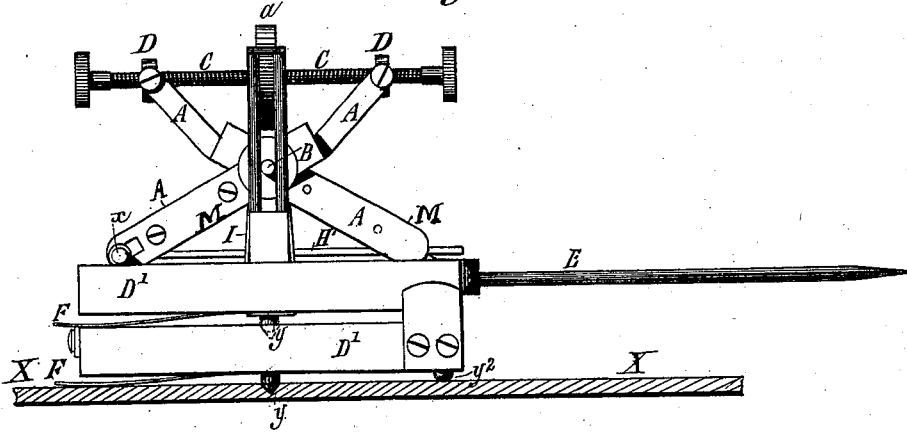
Fig. 1.
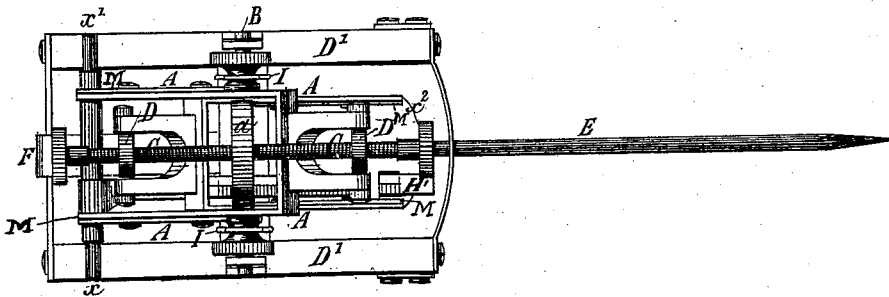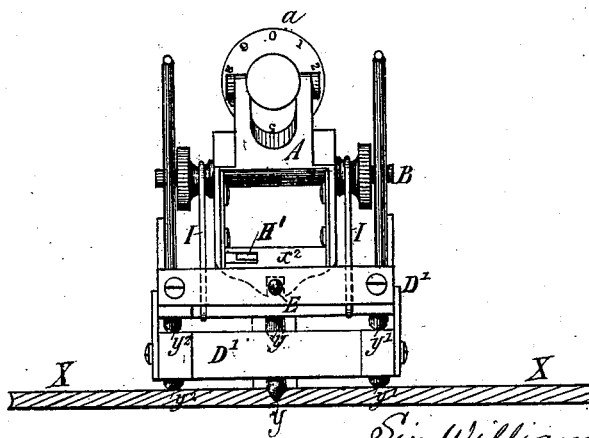
Fig. 2.

Fig. 3.

Witnesses
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UNITED STATES PATENT OFFICE.

IMPROVEMENT IN MARINERS' COMPASSES.

To all whom it may concern:

Be it known that I, Sir WILLIAM THOMSON, Knight, of Glasgow College, Doctor of Laws, and Professor of Natural Philosophy in the University and College of Glasgow, in the county of Lanark, North Britain, have invented an Apparatus for Ascertaining and Correcting Errors in the Mariner's Compass, of which the following is a specification:

This invention consists of apparatus for applying auxiliary deflecting-magnets, and which I call the "deflector," for the purpose of measuring the horizontal directive magnetic force on board ship, as the ship's head is turned in different directions, and from these observations ascertaining, by the application of the formulas of Archibald Smith, published in the Admiralty Compass Manual, the semicircular and quadrantal errors.

This apparatus is shown in side elevation at Figure 1, in plan at Fig. 2, and in end elevation at Fig. 3, of the accompanying drawing.

It consists of two frames, A, movable about a common horizontal axis, B. Each frame A is constructed of two arms, connected together at both ends, as seen at Fig. 2. The frames A are at right angles to the axis B, and are inclined to the vertical in opposite directions, so that they cross one another, as seen more particularly at Fig. 1.

There are four magnets, M, each about inch long, one attached to each of the lower inclined arms of the two frames A.

The magnets M attached to one frame A have both their true north poles at the ends farthest from the axis, while the magnets M belonging to the other frame A have their true north poles at the ends nearest to the axis. The frames are prolonged upward beyond the axis, and the upper parts are connected together by means of a right-and-left-handed screw, C, working in gimbaled nuts D. This screw C and gimbaled nuts D are for altering the distance between the poles of the magnets M carried in the lower part of the frames A, and so increasing or diminishing the power of the magnet upon the compass-needles by varying the distance of the poles of the magnets from the needles. The frames A are supported and kept in a fixed position by means of a frame-work consisting of an H-shaped

brass or other non-magnetic metal stand, D', with a pair of upright brass guides on each side, in which the ends of the horizontal axis B slide up and down as the distance between the poles of the magnets is altered. The jointed frames A, carrying the magnets, are supported, like a painter's easel, on three legs, x x^1 x^2, which move horizontally when the distance between the poles of the magnets attached to the frames A is altered. The lower horizontal bar of the frame A is prolonged beyond the sides of the frame, and the prolongations serve for two of the legs, x and x^1, which rest on the upper sides of the H-stand. A fork at the center of the lower bar of the other frame, riding on a pointer, E, attached to the center of the H-stand, and parallel to its sides, forms the third foot, x^2.

When in use this apparatus is mounted on the compass-bowl, so as to be free to move round an axis perpendicular to the plane of the glass cover X, and passing through its center. This I effect by means of a geometrical slide in the following manner: The stand is supported on three feet, one of which, y, is central, as shown at Figs. 1 and 3, and attached to the cross-bar of the H-stand.

When used the central foot rests upon a conical hollow in the center of the glass of the compass-case, its center of gravity being over the central foot. A light spring, F, is applied to bear a small part of the weight and cause the feet y^1 and y^2 to press lightly on the glass.

In the drawing I have shown two H-stands, D', the one mounted on the other, which two stands may be used when necessary to elevate the magnets M to a greater height from the compass-needles than when the upper stand rests directly on the glass X.

The screw for adjusting the distance between the poles of the magnets is a micrometer, with a divided indicating-disk, a, attached. A divided scale, H', between the cross-bars constituting the lower edges of the frames, counts the turns of the screw, and the circumference of the disk is divided to show tenths of a turn. The movable or adjustable frames A and their attachments are drawn down onto the under frame D' by the tension of the two elastic bands I passed over the axis B and under the central bar of the frame D'.

The apparatus is used in the following manner: When the ship's iron is symmetrical on the two sides and the ship's compass is placed amidships, the ship's head is put successively on the different cardinal points, as shown by the compass to be adjusted, north, south, east, and west, in any order. The deflector is so adjusted by raising or lowering the magnets M, by turning the micrometer-screw C, as to deflect the north point through an angle of eighty-five degrees, when the pointer is over the east or west point of the card. This is done for each of the cardinal points, and the readings of the deflector noted. When the four readings thus found do not agree there will be either quadrantal or semicircular error, or both.

If, when the ship's head is north, the reading is less (indicating a less directive force in virtue of the ship's magnetism) than when her head is south, the difference shows that the fore-and-aft component of the ship's magnetism is sternward; or, vice versa, if, when the ship's head is north, the directive force on the compass is greater than when her head is south, the fore-and-aft component is headward. To correct this the revolving corrector hereinafter described must be turned and moved on its screw so as to give the requisite headward or sternward force. When this is done the readings with the ship's head north and south for a deflection of eighty-five degrees are the same, and are nearly the mean of the two former readings. Similarly, if, when the ship's head is east, the reading is greater than when her head is west, the difference shows that the thwart-ship component of the ship's magnetism is to port, and the revolving magnetic corrector hereinafter described must be turned and moved on its screw so as to give the requisite thwart-ship force. When this is done the deflector readings, with the ship's head east and west for a deflection of eighty-five degrees, are the same, and are nearly the mean of the two former readings for these points. When the correctors have now been adjusted so that the reading for a deflection of eighty-five degrees when the ship's head is north is the same as when her head is south, and the reading with the ship's head east the same as with her head west, the semicircular error is completely corrected. If, now, the reading when the ship's head is north or south is greater than when the head is east or west, there is a quadrantal error, which is to be corrected by means of the soft-iron globes shown on the drawings appended to another application of mine for United States patent.

When the compass is not placed symmetrically with respect to the ship's iron, the deflector is to be used with different bearings of the ship's head, so as to find the bearings which give the maximum and minimum directive force of the ship's magnetism after the directive force has been equalized on two pairs of opposite bearings by the magnetic correctors.

When the ratio between the horizontal force on shore and the horizontal force on board any ship is known, and when the quadrantal error has been corrected, the semicircular error may be corrected by means of the deflector without the necessity of moving the ship, provided the true bearing of the ship's head be known.

From mathematical reasoning and from experiment it is found that the ratio between the horizontal force on board and the horizontal force on shore (called "λ" in the Admiralty Compass Manual) remains the same for the same ship, so that, having once found this ratio for any ship, the compass can very easily be corrected at any time without swinging the ship.

The following is the procedure for adjusting the compass when this ratio is known: The compass card and bowl are carried on shore to a place as free from the influence of iron as possible, and are fixed with the glass of the case level. The deflector is set so as to give a deflection such that the ratio of the sine of this deflection to the sine of eighty-five degrees is the same as the ratio of the horizontal force on board to the horizontal force on shore. The compass card and bowl are then brought on board to the binnacle, and the correctors are adjusted, so that without the deflector the compass-card may indicate correctly the true bearing of the ship's head, and with the deflector applied may rest with a deflection of eighty-five degrees from this position, with the scale reading the same as on shore. When this is accomplished the semicircular error will have been corrected completely.

I claim—

The apparatus for applying auxiliary deflecting-magnets, consisting of the adjustable and jointed frames A, supported on the **H**-stand D', and carrying at their lower arms the magnets M, right-and-left-handed micrometer-screw C, gimbaled nuts D, indicating-disk a, divided scale H', and spring F, substantially as and for the purpose set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM THOMSON. [L. S.]

Witnesses:

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