



PATENT SPECIFICATION

Application Date: Jan. 11, 1923. No. 952/23. **210,265**

Complete Left: Sept. 12, 1923.

Complete Accepted: Jan. 31, 1924.

PROVISIONAL SPECIFICATION.

Slide-rule or Computing Apparatus for Calculating Ship Stability.

I, SHIRLEY BROOKS RALSTON, "Rosyth", Glenburn Road, Bearsden, Dumbartonshire, British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to a slide-rule or computing-apparatus for mechanically calculating the G.M. or measure of the initial stability of a ship, after the ship has been inclined or heeled and the degrees of heel ascertained by a pendulum or other method, the term G.M. denoting the distance or height of the metacentre M above the centre of gravity G of the ship. The ship may be inclined by means of filling a tank on one side of the ship with a known weight of water or by moving a known weight from one side to the other of the ship or by other means of using a known inclining moment.

The apparatus consists of a main body or flat board or surface in which is inserted a narrow board or slide capable of a sliding movement and forming a flush surface with the main body. On the main body and slide are suitably engraved, printed or otherwise marked four logarithmic scales representing respectively:—

Scale A—Displacement in tons.

Scale B—Inclining moment in foot-tons.

Scale C—Degrees of heel or inclination (spaced in terms of the tangent of the angle or $\tan. \theta$).

Scale D—Height of G.M. in feet and inches.

The scales A and D are carried on the main body and the scales B and C on the slide and arranged so that scale B slides parallel to and against scale A whilst scale C slides parallel to and against scale D, or the scales may be otherwise arranged to obtain the same result, say upon a computing-apparatus of the circular, superposed disc or other dial type.

The scales are made of such proportions and are so placed in relation to each other that, on moving the slide or scale B so that a known inclining moment is placed opposite the known displacement on scale A, the corresponding G.M. can be read off from scale D opposite the ascertained heel on scale C without any calculation or reference to tables of tangents or other methods used at present.

The above apparatus is designed to eliminate the usual calculations used for finding the G.M. of a ship, viz.:—Displacement = G.M. $\tan \theta$ = Inclining moment.

A scale A may be made to represent the corresponding drafts instead of displacements and the scale B may represent the corresponding ballast tanks instead of moments or both displacements and drafts may be shown on scale A and both moments and tank marks on scale B.

Dated this 10th day of January, 1923.

JOHNSONS,

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COMPLETE SPECIFICATION.

Slide-rule or Computing Apparatus for Calculating Ship Stability.

I, SHIRLEY BROOKS RALSTON, of "Rosyth", Glenburn Road, Bearsden, Dumbartonshire, a British subject, do hereby declare the nature of this

[Price 1/-]

invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

5 This invention relates to a computing-apparatus for calculating mechanically the metacentric height or G.M. (a measure of the initial stability of a ship) after the ship has been inclined or heeled
10 and the degrees of heel ascertained as by reference to an inclinometer, for example, the term G.M. denoting the distance or height of the metacentre above the centre of gravity of the ship. The ship may be
15 inclined by filling a tank on one side of the ship with a known weight of water or by moving a known weight from one side to the other side of the ship or by other methods of applying a known
20 inclining or heeling moment.

Broadly the invention consists in a computing-apparatus comprising a pair of relatively slidable (rectilinearly or curvilinearly) members inscribed with
25 logarithmic scales representative of displacement in tons and/or draft, heeling moment and/or ballast tanks, degrees of heel and metacentric height.

The apparatus consists of a main body
30 member or flat board or surface in or on which is mounted a narrow rectilinearly or curvilinearly movable slide, the main body being preferably channeled to receive the slide so that the surface of the slide may be flush with the
35 surface of the main body. On the main body and slide are suitably inscribed four logarithmic scales representing respectively:—

- 40 A—Displacement in tons.
- B—Heeling moment in foot-tons.
- C—Metacentric height in feet and inches.
- D—Degrees of heel or inclination.

45 There may also be fitted within the casing of the apparatus an inclinometer which may conveniently be of the spirit level type.

Two scales, say the scales A and D,
50 are on the main body, and the two others, say the scales B and C, on the slide, the scale B co-operating with the scale A and the scale C co-operating with the scale D.

55 The scales are so proportioned and are so disposed in relation to one another that, when the scale B is so related to the scale A that a known heeling moment on the scale B is indicated opposite a
60 known displacement on the scale A, the corresponding G.M. can be read off from the scale C opposite the ascertained heel (θ) on the scale D without any other calculation or reference to tables of tan-
65 gents or other data.

In effect, with the described apparatus there is calculated mechanically the quotient obtained by dividing the heeling moment by the product of the displacement and degrees of heel, the
70 apparatus being applicable to all ships or any ship for which the above particulars are known.

The only formula involved is:—

$$\text{G.M.} = \frac{\text{Heeling moment}}{\text{Displacement} \times \theta}. \quad 75$$

Although, theoretically, θ should be replaced by $\tan \theta$, for the small angles concerned it is sufficiently accurate to take the angle itself. θ in the formula is expressed in circular measure but it is
80 conveniently measured on the inclinometer in degrees, and the multiplier 57.3 is incorporated in the scales of the slide rule.

Regarding the formula, therefore, θ is
85 determined directly from an observation of the inclinometer; displacement is determined from a reading of the draft marks on the ship's hull, or otherwise. The heeling moment is determined from
90 the weights applied for inclining the ship and the distance from the centre line at which they act; hence, all these three quantities being known, the G.M. is found by the simple arithmetical rule
95 given above, being calculated upon the slide rule which has ordinary logarithmic scales, but marked suitably for this particular calculation.

As stated above, the heeling moment
100 may either be ascertained, as is well known, by placing actual weights at a measured distance from the centre line of the ship or by filling with ballast
105 water certain tanks each of which represents a known or calculable heeling moment. The scales of heeling moment, displacement, and inclination will thus be standard for all ships, whereas tank
110 scales for heeling moment due to filling particular tanks and draft scales are peculiar to each ship. An additional scale may thus be applied to the standard scale in such a way that the draft reading for the ship in question appears
115 opposite the displacement which it represents on the displacement scale of the slide rule and the marking for each particular tank is placed opposite the heeling moment graduation to which it corresponds.
120

Thus, in lieu of, or in addition to, the scale A there may be provided for a particular ship a scale A¹ to represent the corresponding drafts instead of displacements and, similarly, for a particular
125 ship, a co-operating scale B¹ to represent

the corresponding ballast tanks in lieu of heeling moments.

In practice the relatively slidable members may bear permanent markings representative of the said scales A, B, C and D and slips suitable for the particular ship may be applied to these members to represent either or both of the scales A¹ and B¹ or auxiliary markings representative of either or both of the scales A¹ and B¹ may be inscribed on the relatively slidable members.

Two embodiments of apparatus according to the invention are illustrated in the accompanying drawings.

In the embodiment shown in Fig. 1 the flat board 1 is formed with an annular groove in which is received for circular adjustment an annulus or disc 2 to which is connected an operating knob 3. The scales A, B, C and D are in concentric relation, the relative movement of the scales being effected by manipulation of the knob 3. The auxiliary scales A¹ and B¹ may be inscribed on the board 1 and disc 2, respectively, or may be inscribed on arcuate slips applied to these members.

Within the casing 4 of the apparatus is mounted an inclinometer 5 for indicating the degrees of heel.

In the embodiment shown in Fig. 2 the scales A and C are inscribed on a grooved board 6 and the scales B and D are inscribed on a slide 7 fitted to the groove. The scales A¹ and B¹ are indicated by dotted lines.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:—

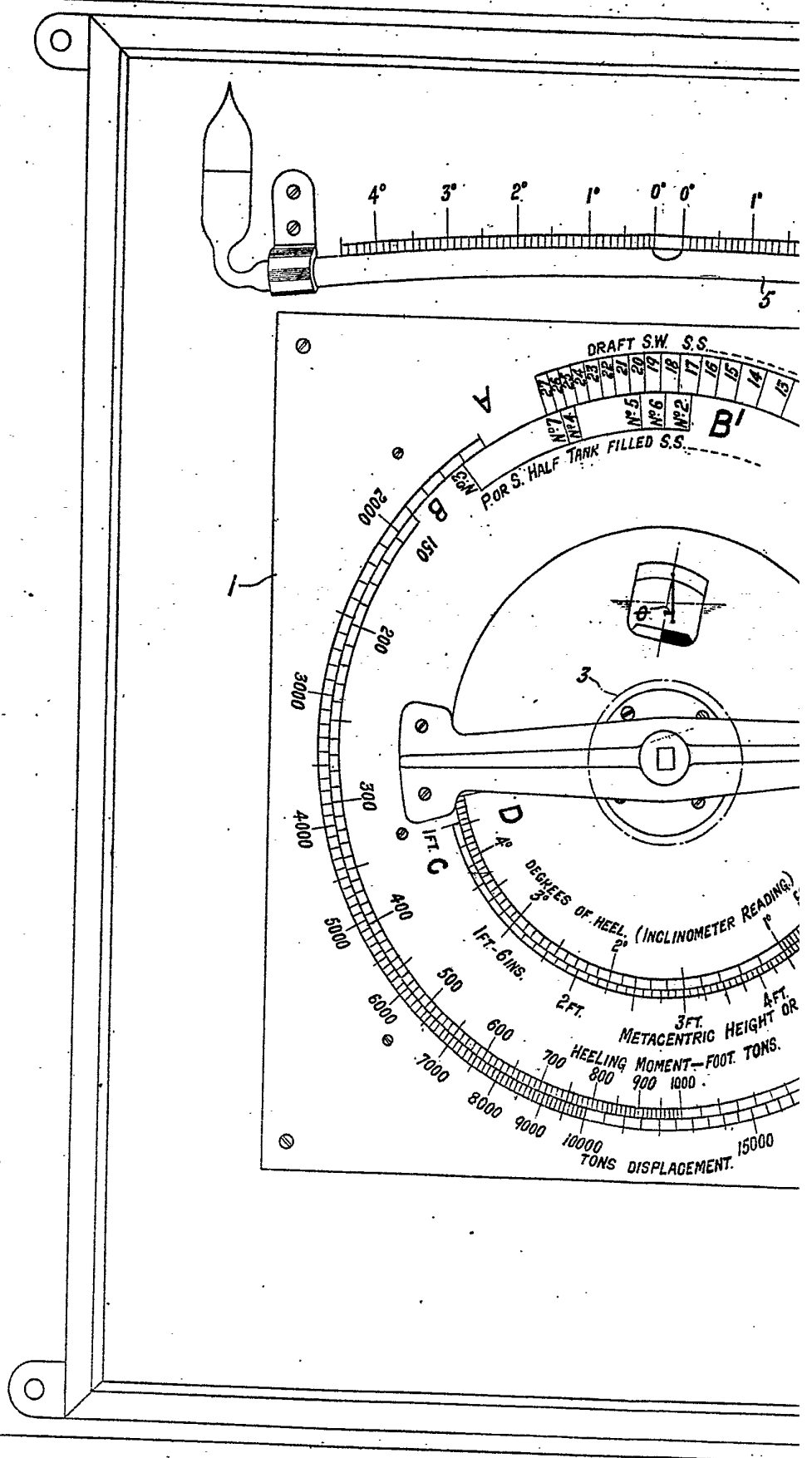
1. A computing apparatus comprising a pair of relatively slidable or rotatable members inscribed with logarithmic scales representative of displacement in tons and/or draft, heeling moment and/or ballast tanks, degrees of heel, and metacentric height, arranged for operation substantially as described to calculate mechanically the G.M. of a ship.

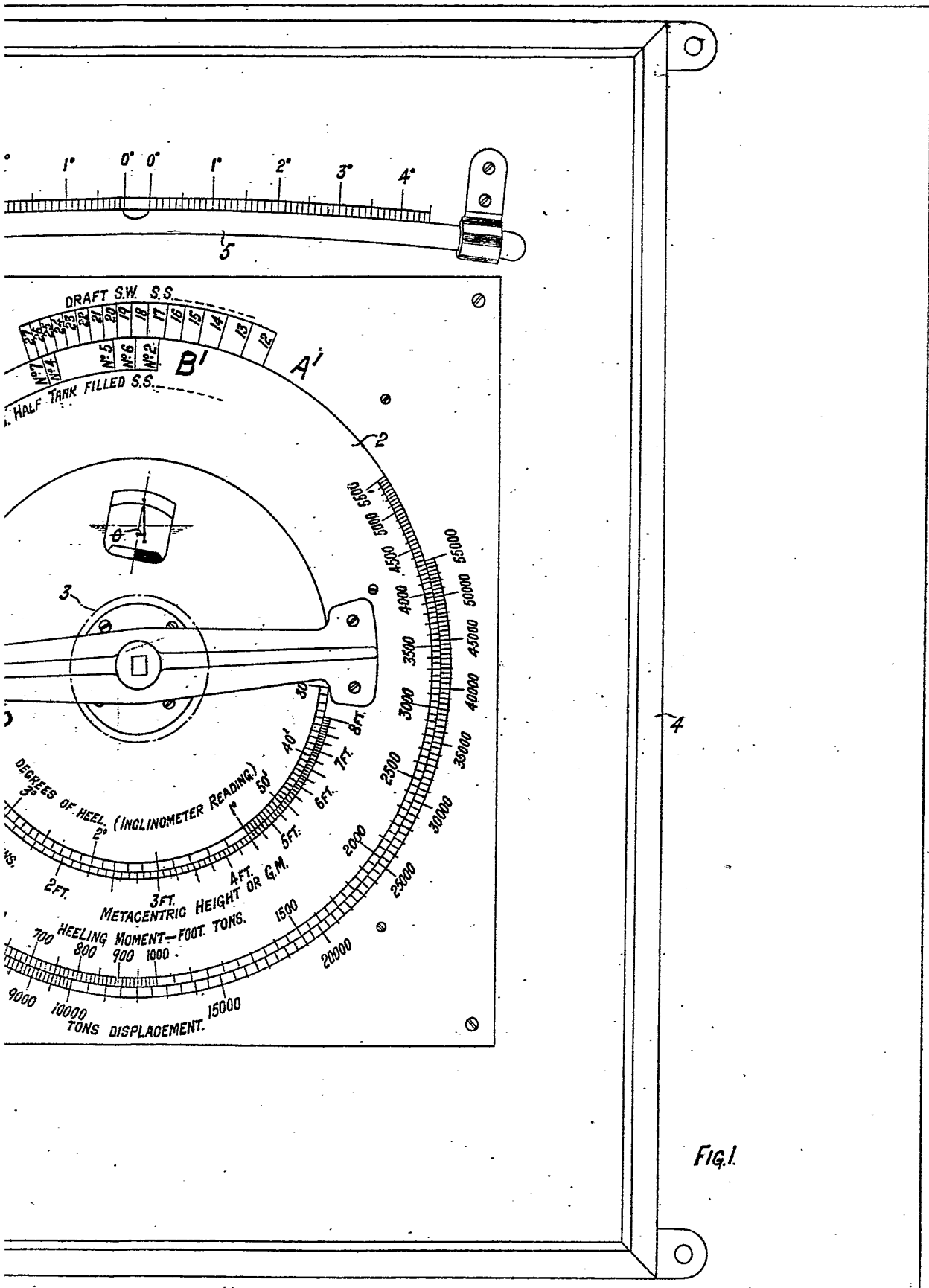
2. Computing apparatus as described and illustrated in Fig. 1 or in Fig. 2 of the accompanying drawings.

Dated this 11th day of September, 1923.

CRUIKSHANK & FAIRWEATHER,
29, Saint Vincent Place, Glasgow, &
65—66, Chancery Lane, London, W.C.,
Agents for the Applicant.

[This Drawing is a reproduction of the Original on a reduced scale]





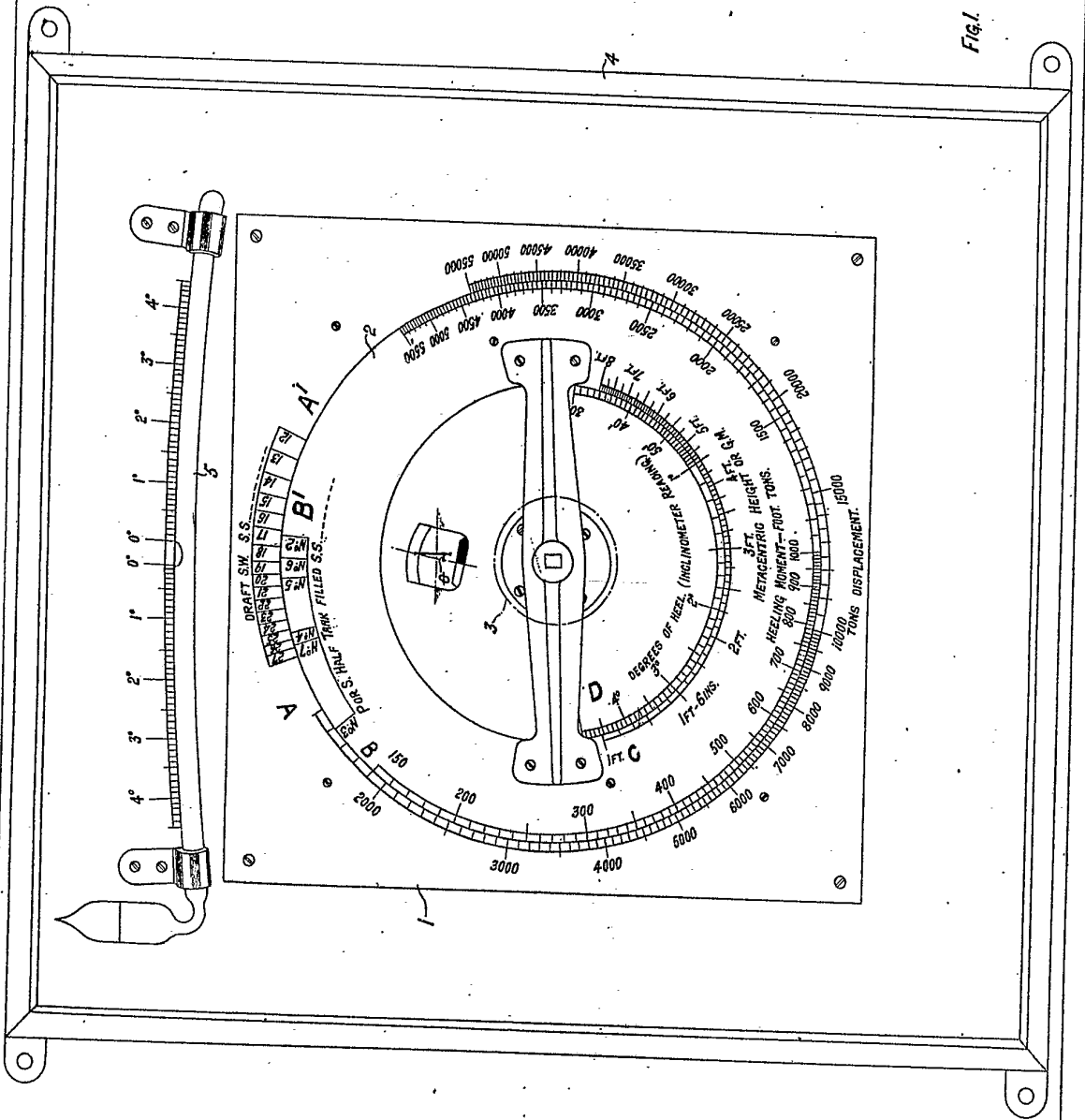


Fig. 1.

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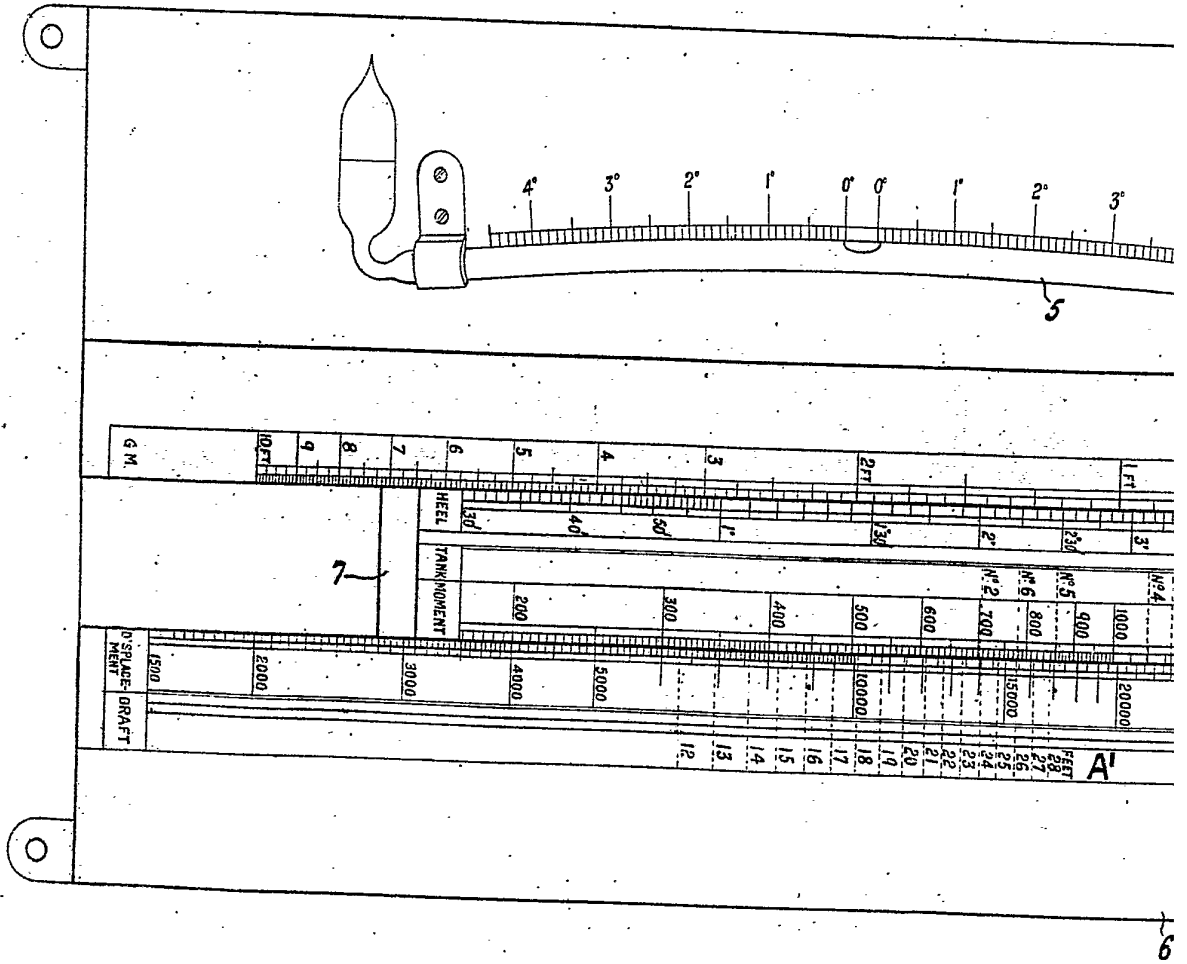


FIG. 2.

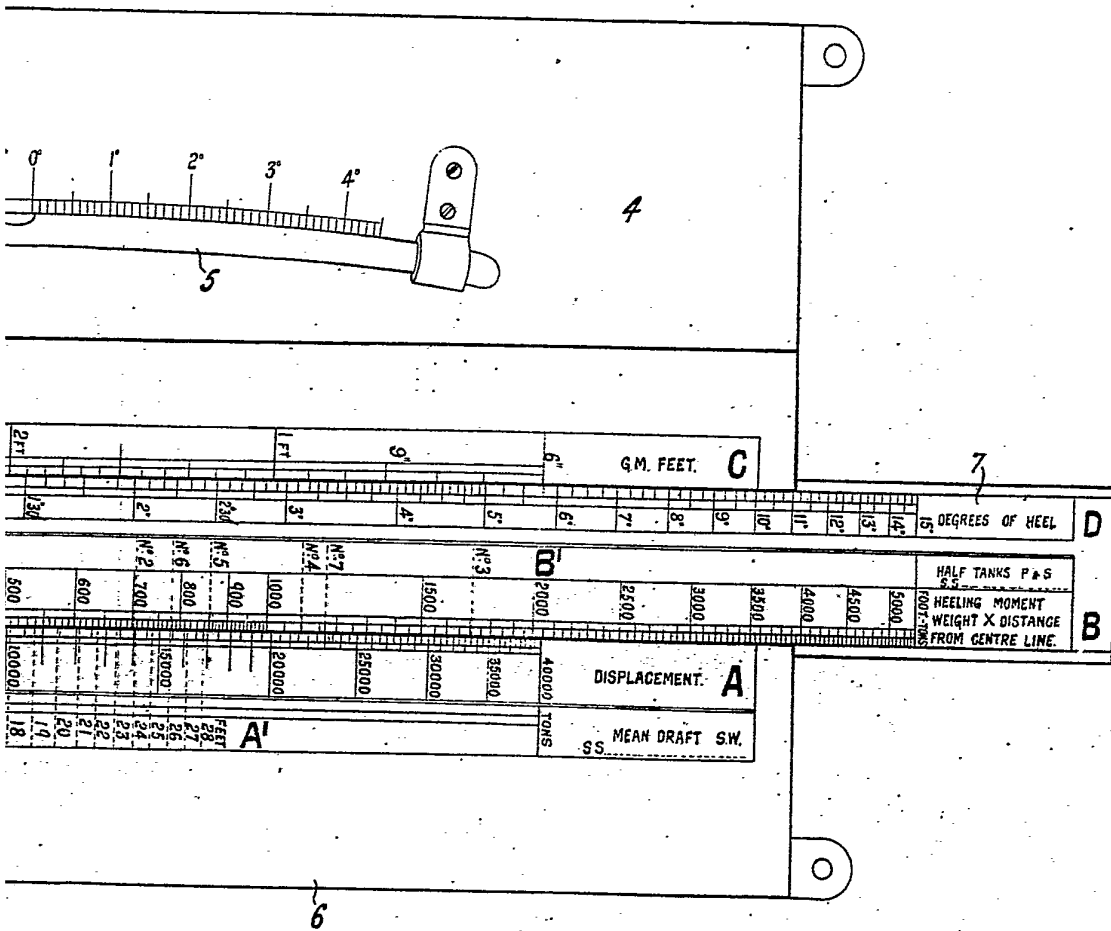


Fig. 2.

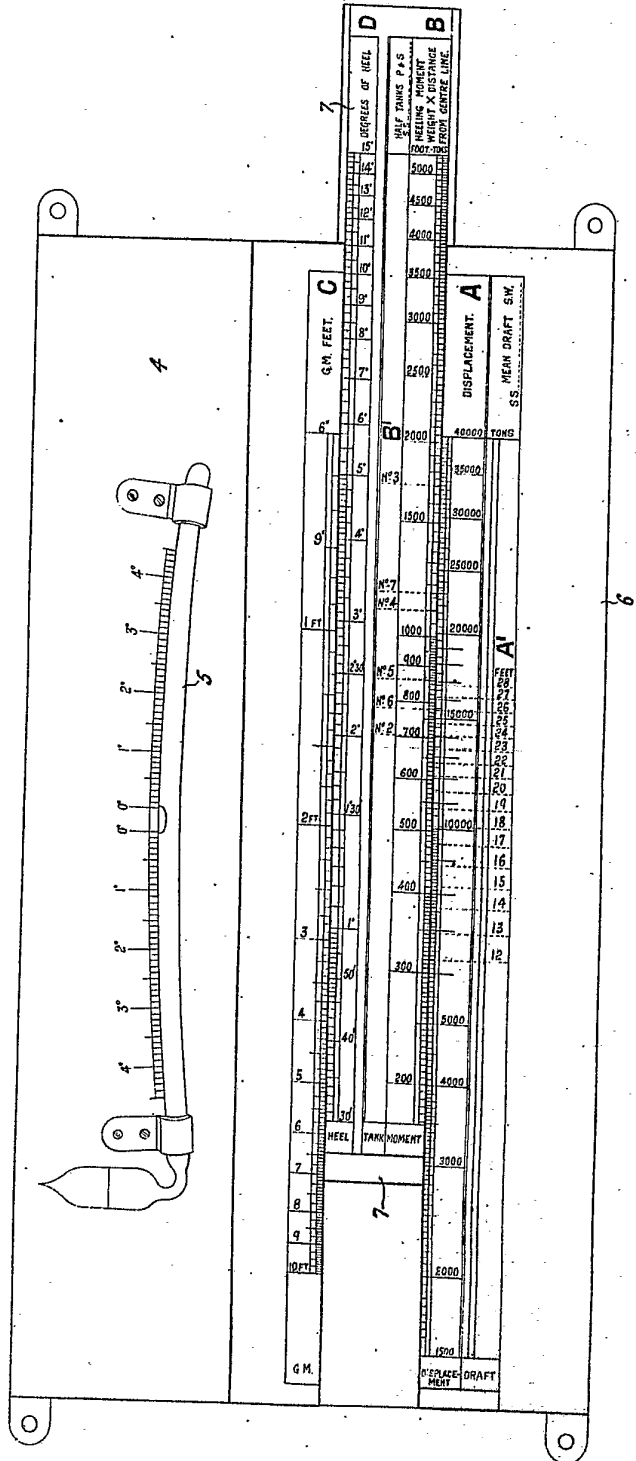


Fig. 2.

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