(No Model.) 9 Sheets—Sheet 1.

J. HOPE.

SHIP'S RECORDING COMPASS.

No. 505,361. Patented Sept. 19, 1893.

Fig. 1.

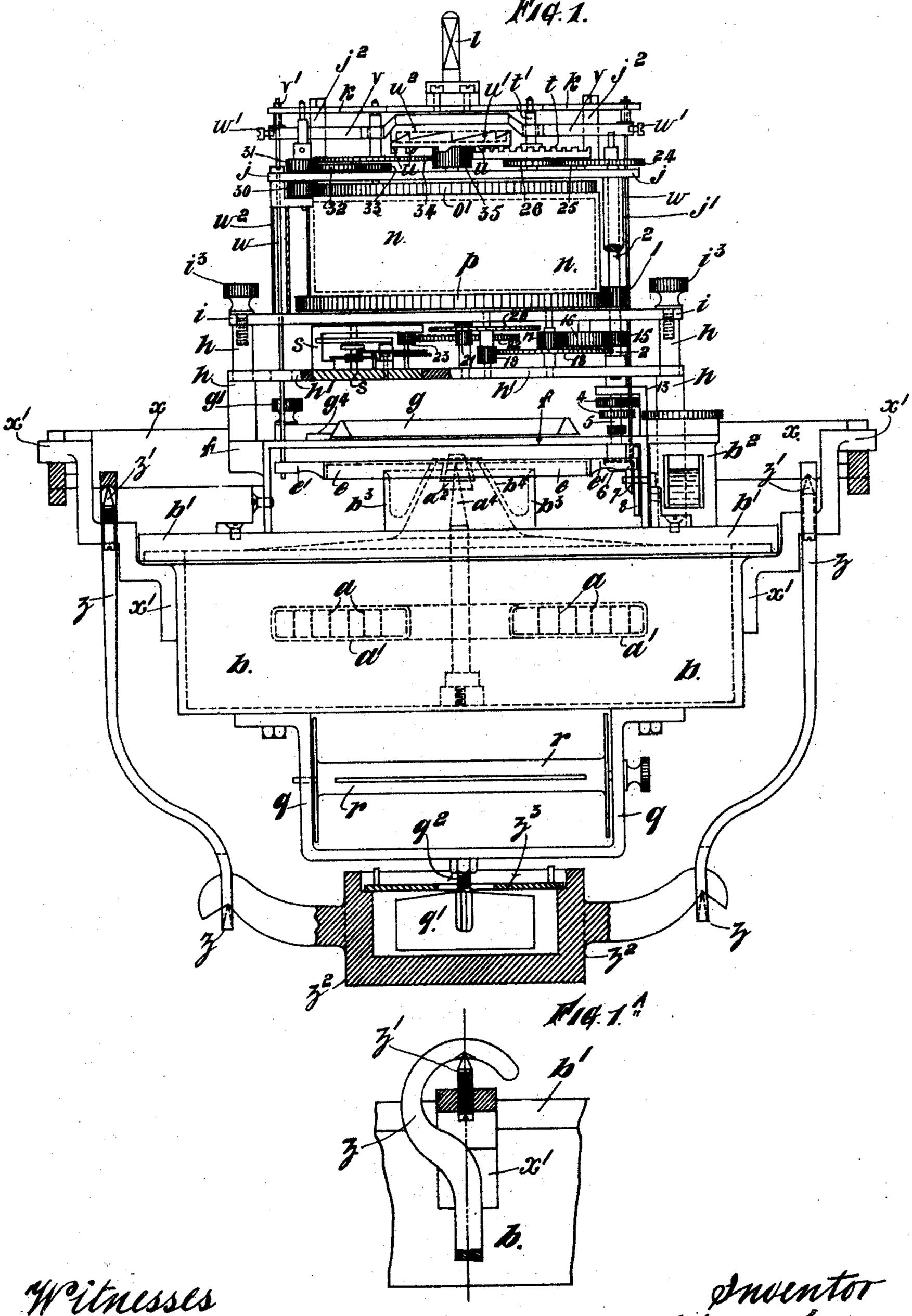
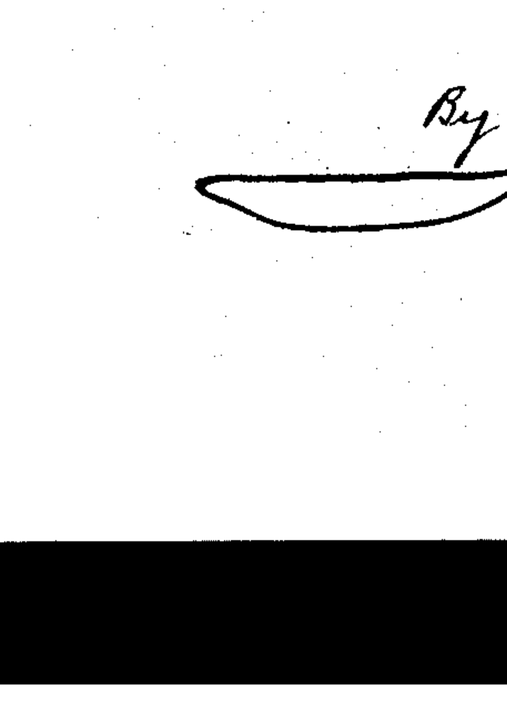


Fig. 1ª.



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(No Model.) 9 Sheets—Sheet 2.

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SHIP'S RECORDING COMPASS.

No. 505,361. Patented Sept. 19, 1893.

Fig. 2.

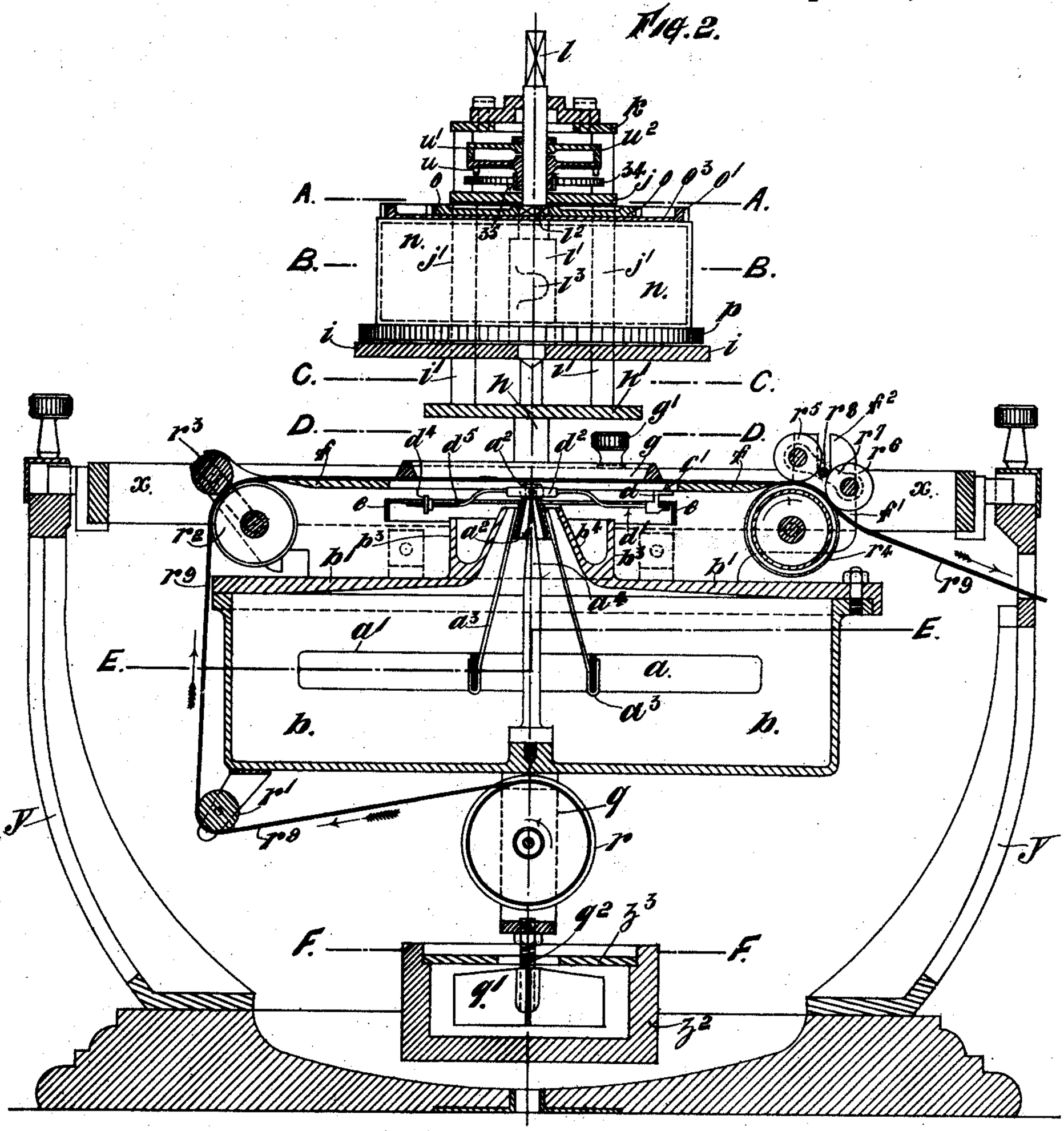
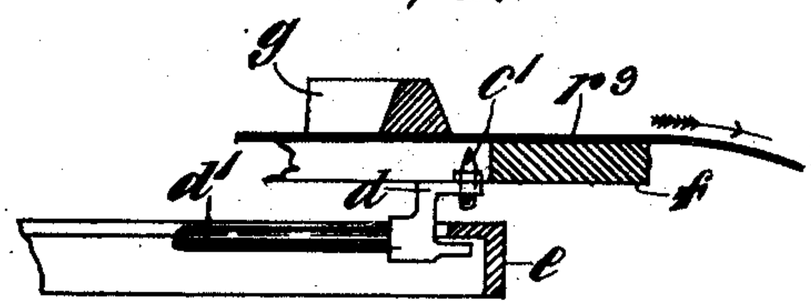


Fig. 2.A



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SHIP'S RECORDING COMPASS.

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Fig. 3A.

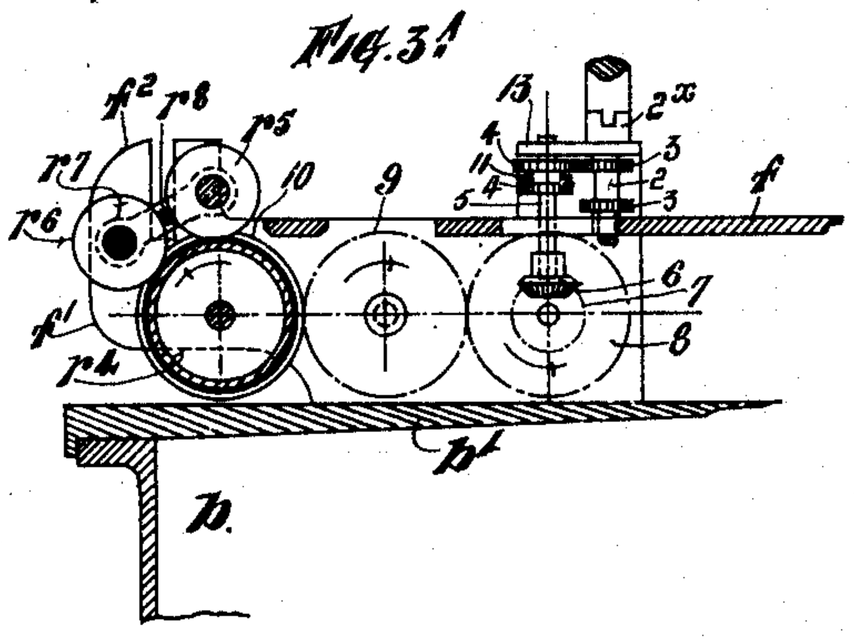


Fig. 3B.

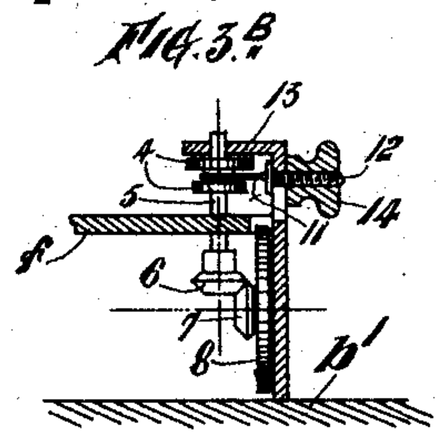
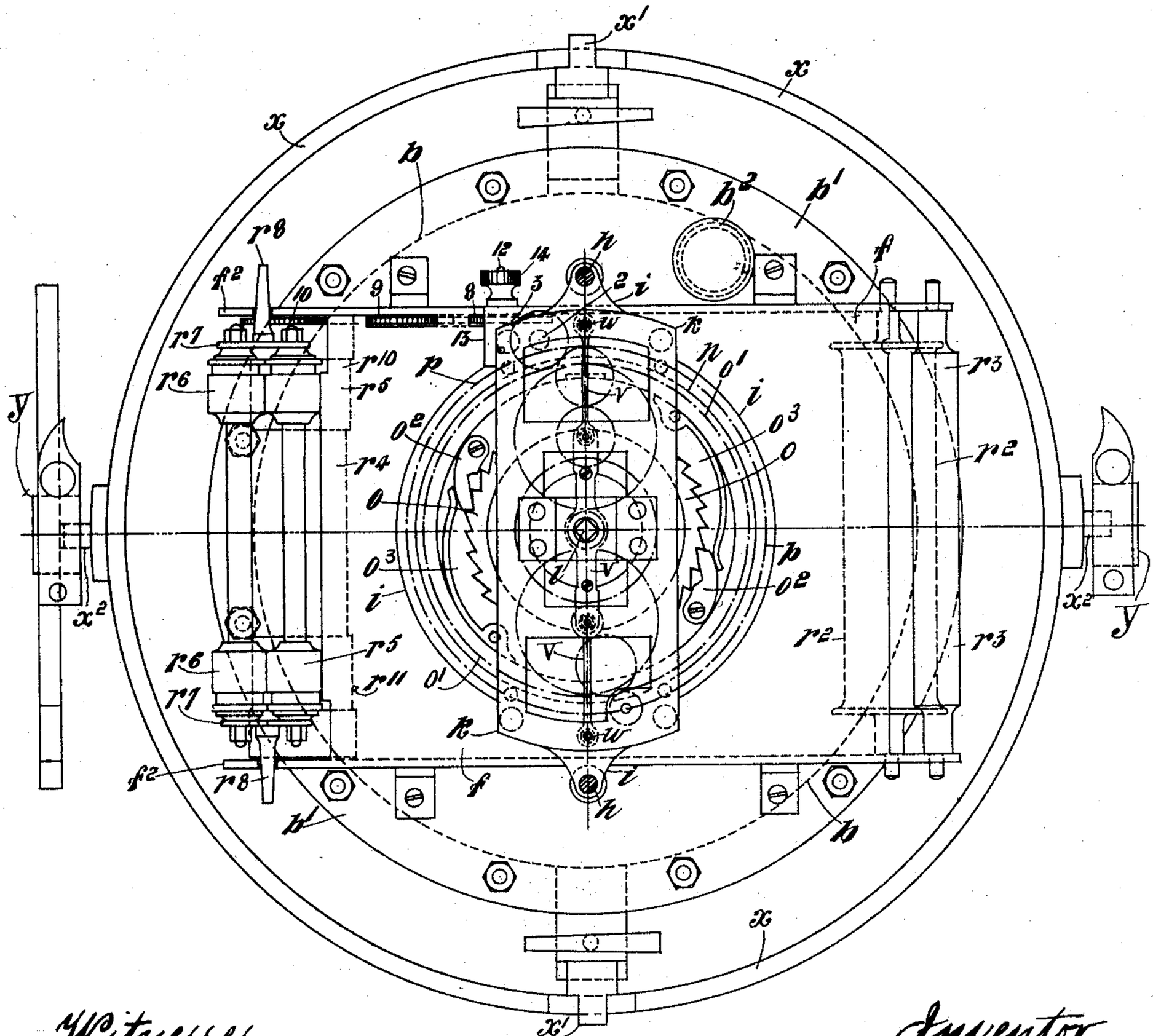


Fig. 3.



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(No Model.) 9 Sheets—Sheet 4.

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SHIP'S RECORDING COMPASS.

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Fig. 6.

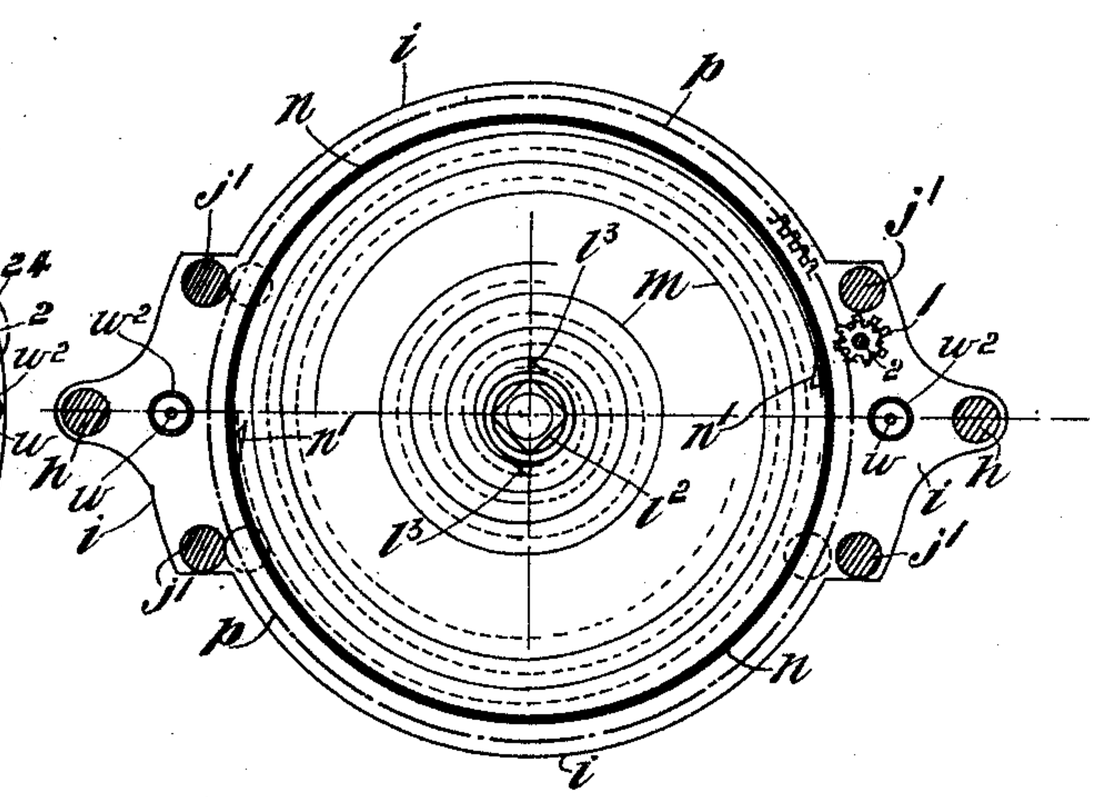


Fig. 4.

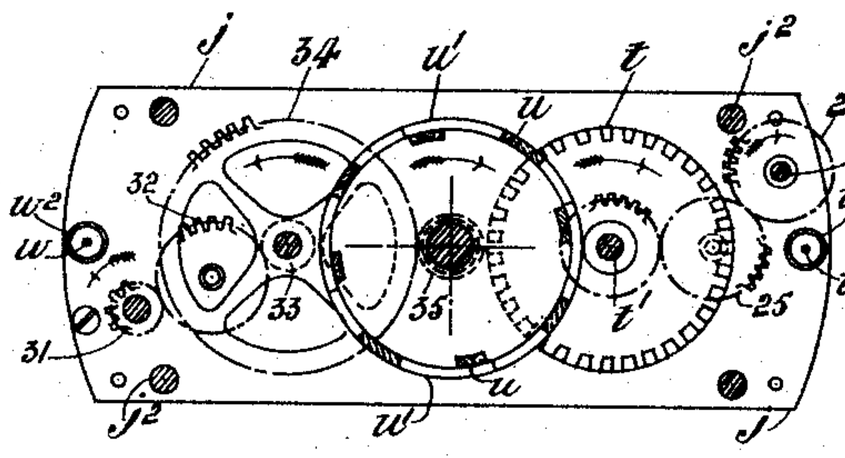


Fig. 5.

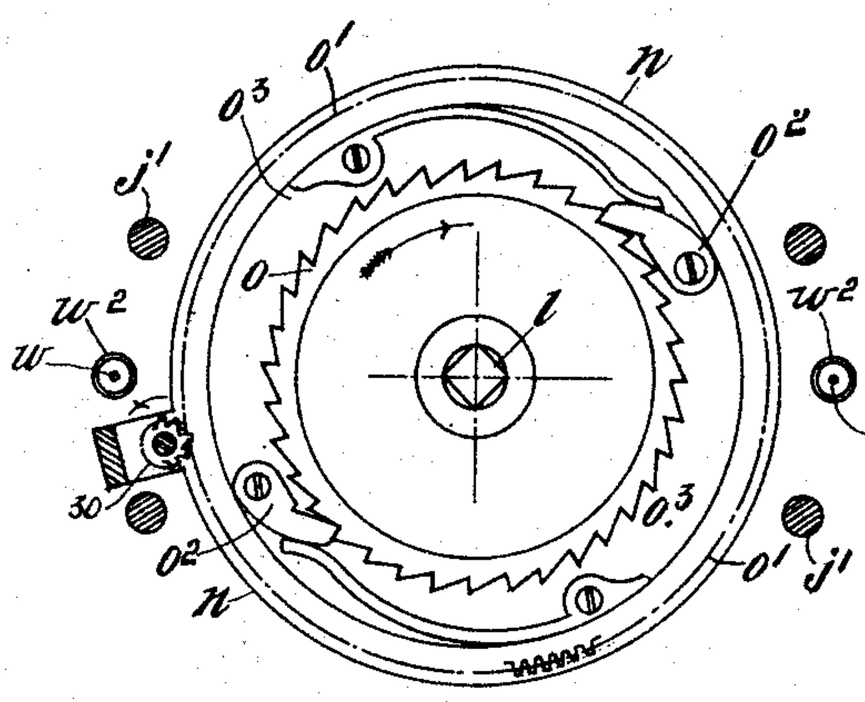
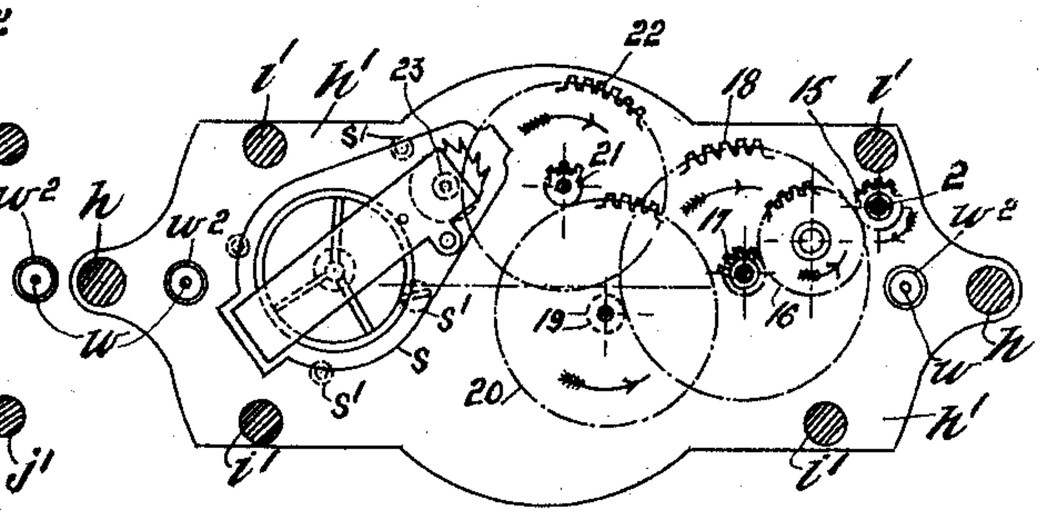


Fig. 7.



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SHIP'S RECORDING COMPASS.

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Fig. 8.

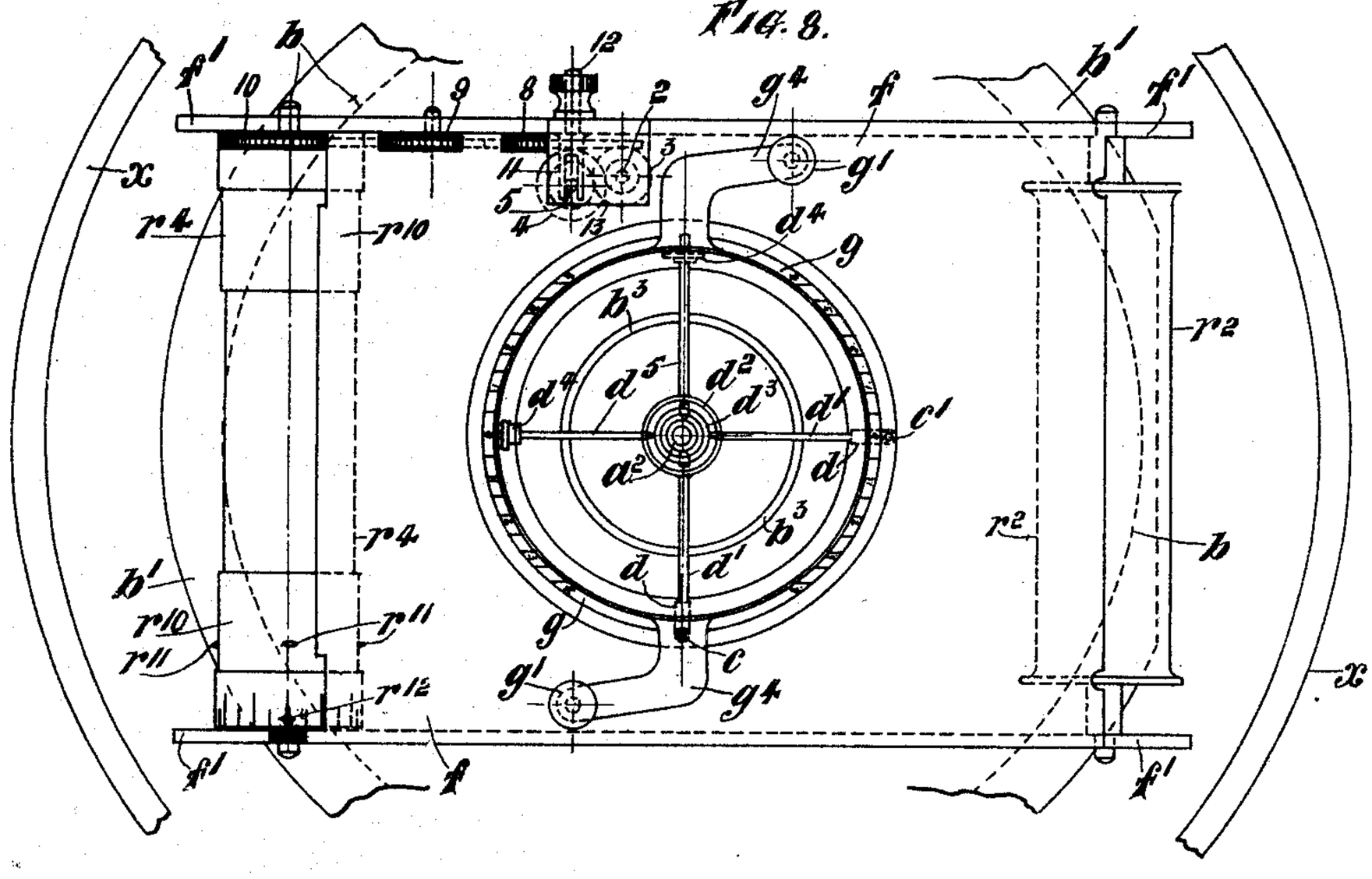
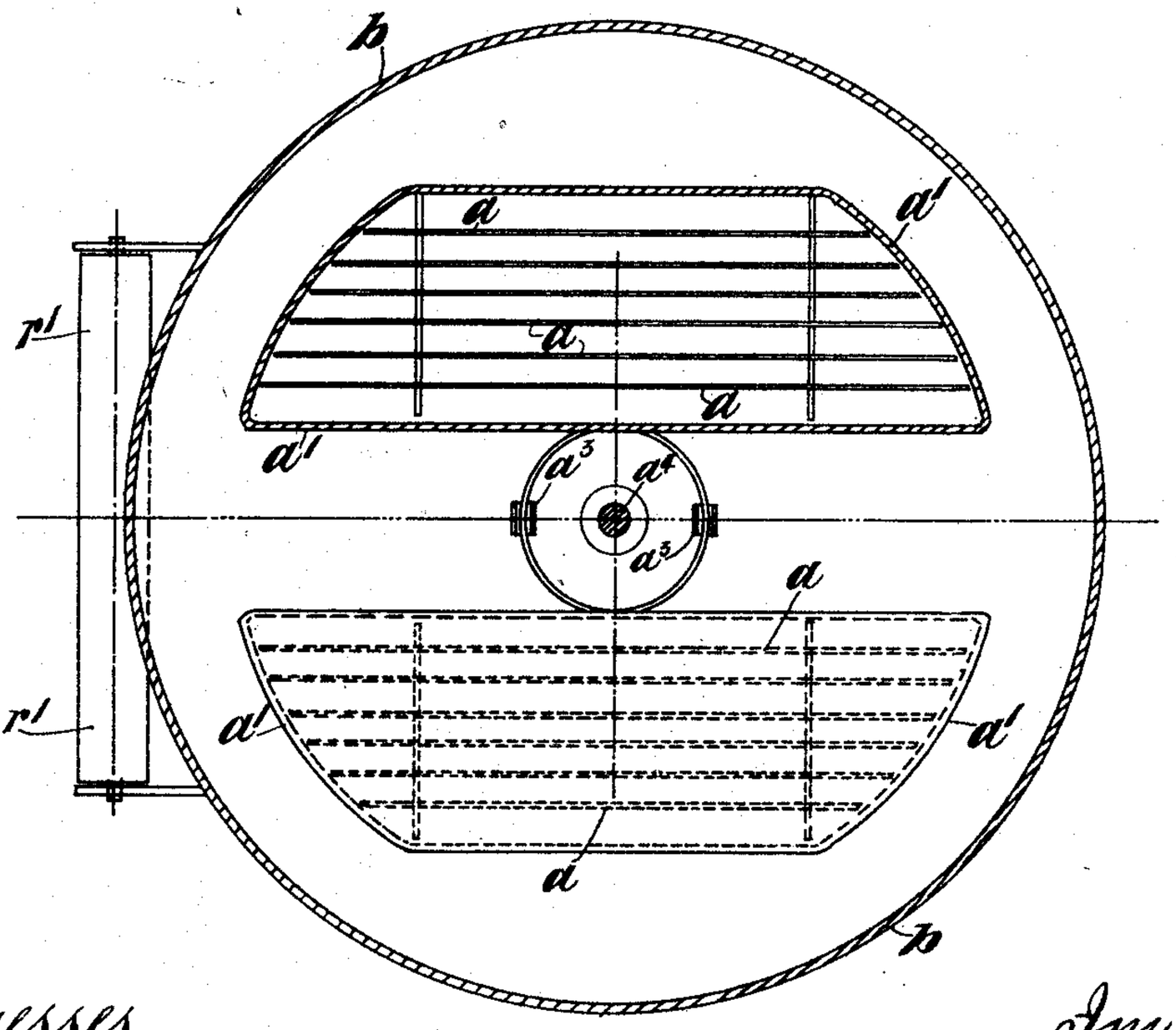


Fig. 9.



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SHIP'S RECORDING COMPASS.

No. 505,361. Patented Sept. 19, 1893.

Fig. 10.

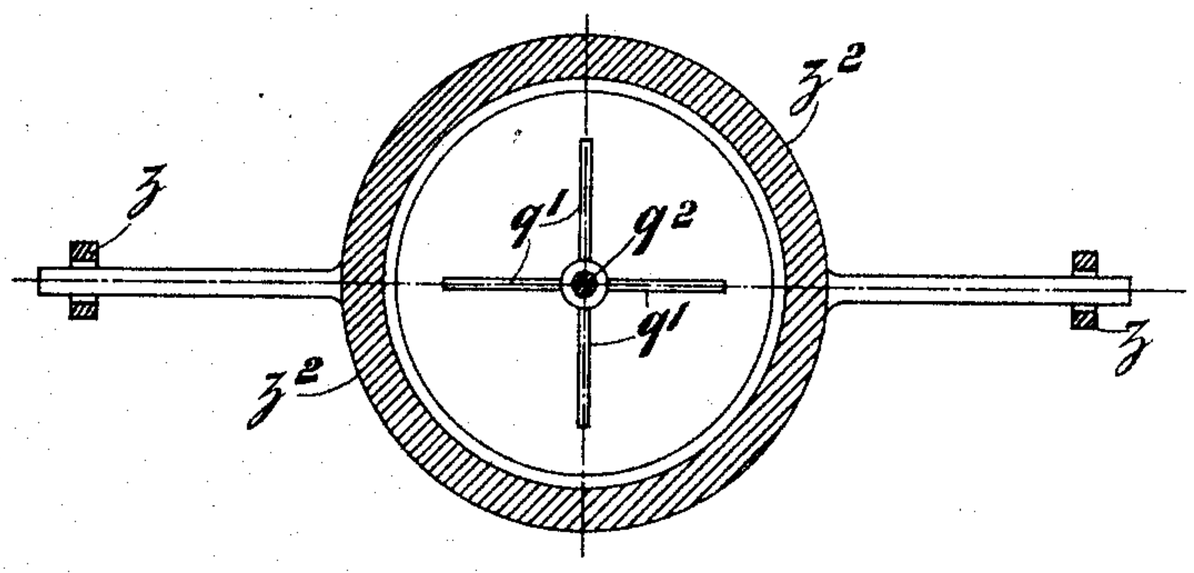


Fig. 15.

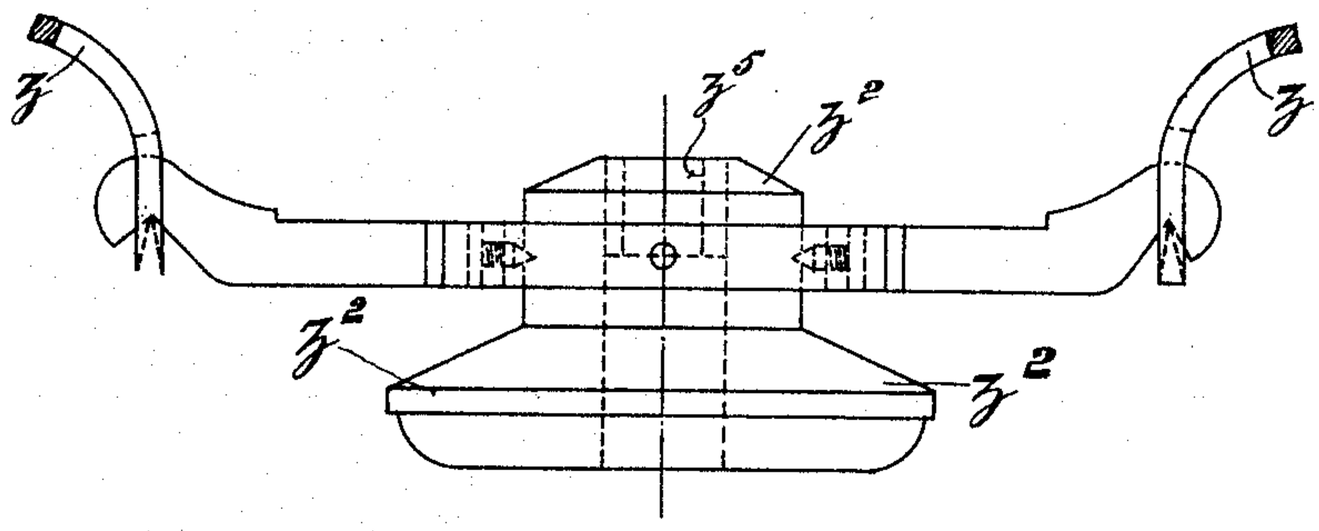
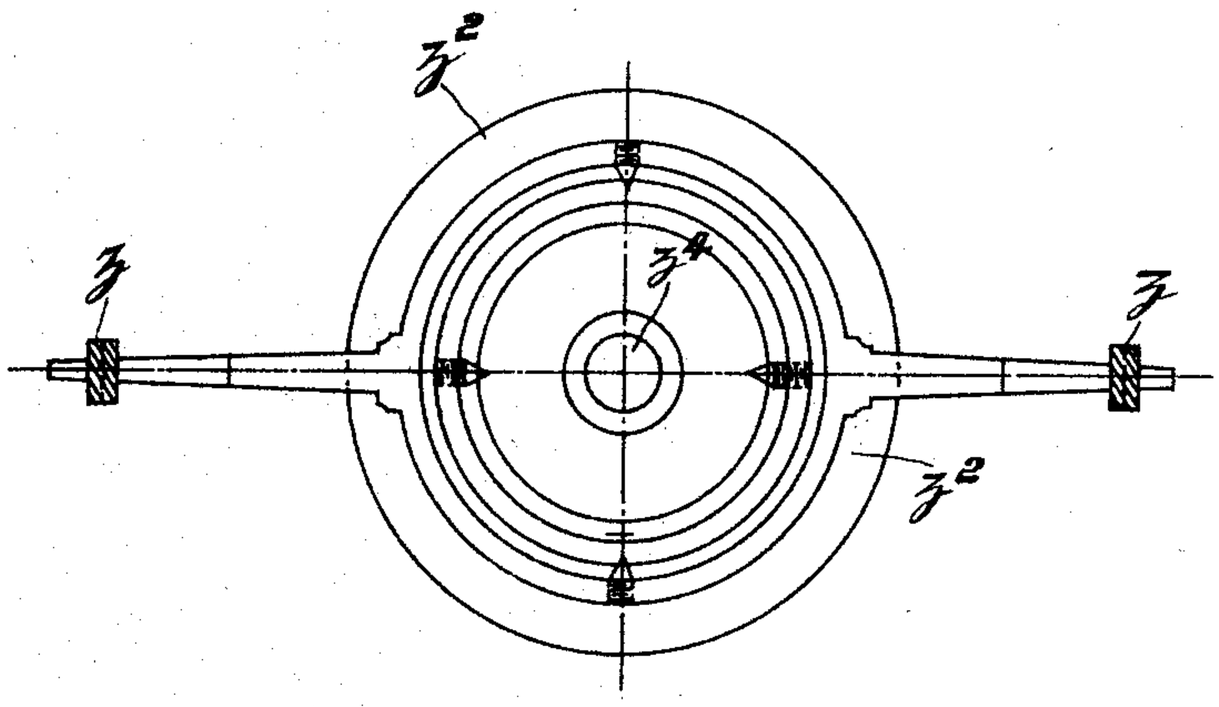


Fig. 16.



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SHIP'S RECORDING COMPASS.

No. 505,361. Patented Sept. 19, 1893.

Fig. 11.

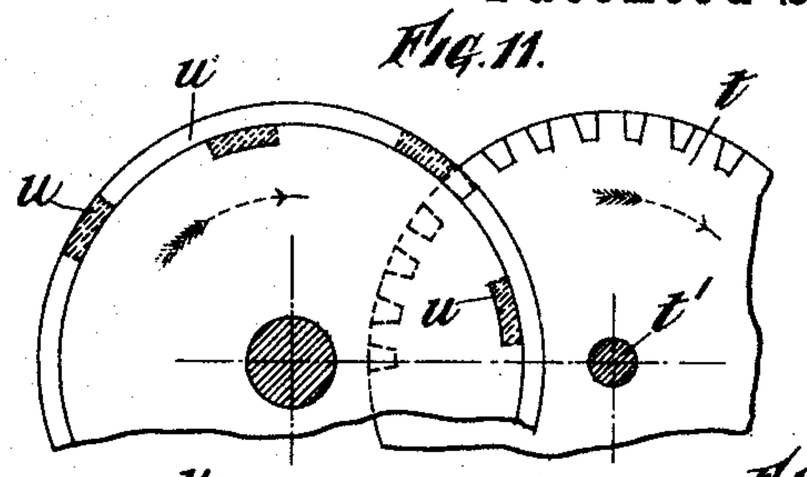


Fig. 11A.

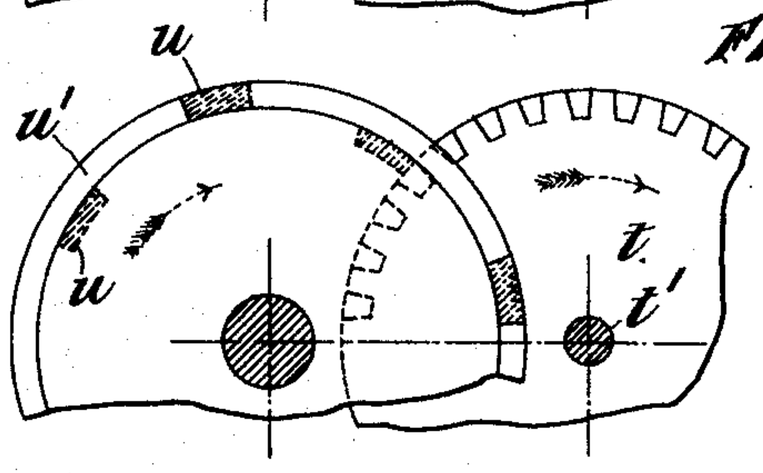


Fig. 12.

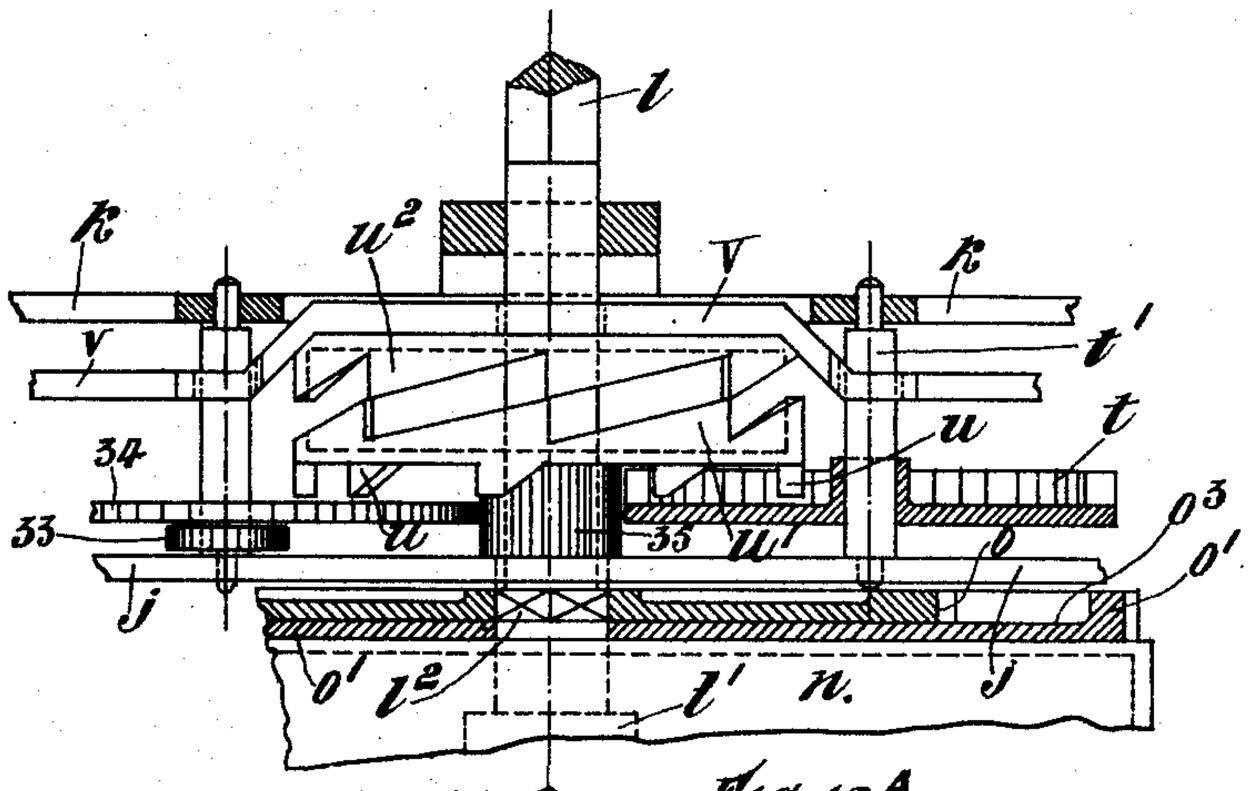
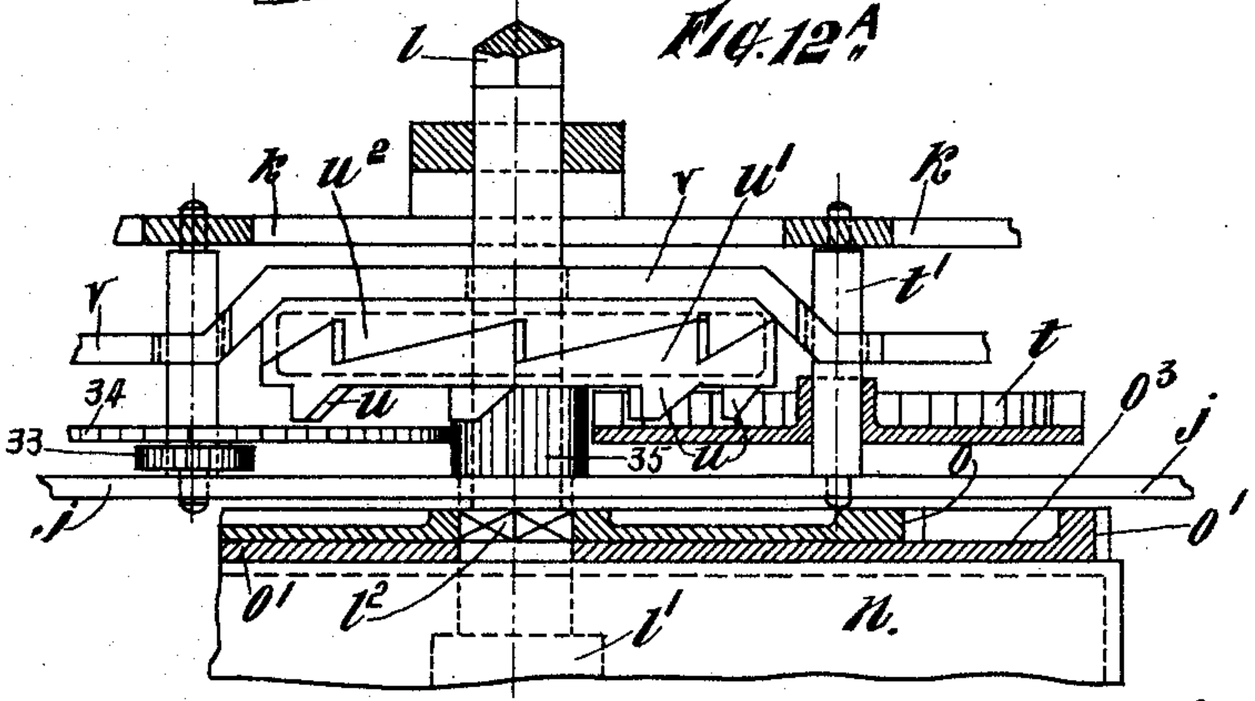


Fig. 12A.



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SHIP'S RECORDING COMPASS.

No. 505,361. Patented Sept. 19, 1893.

Fig. 14.

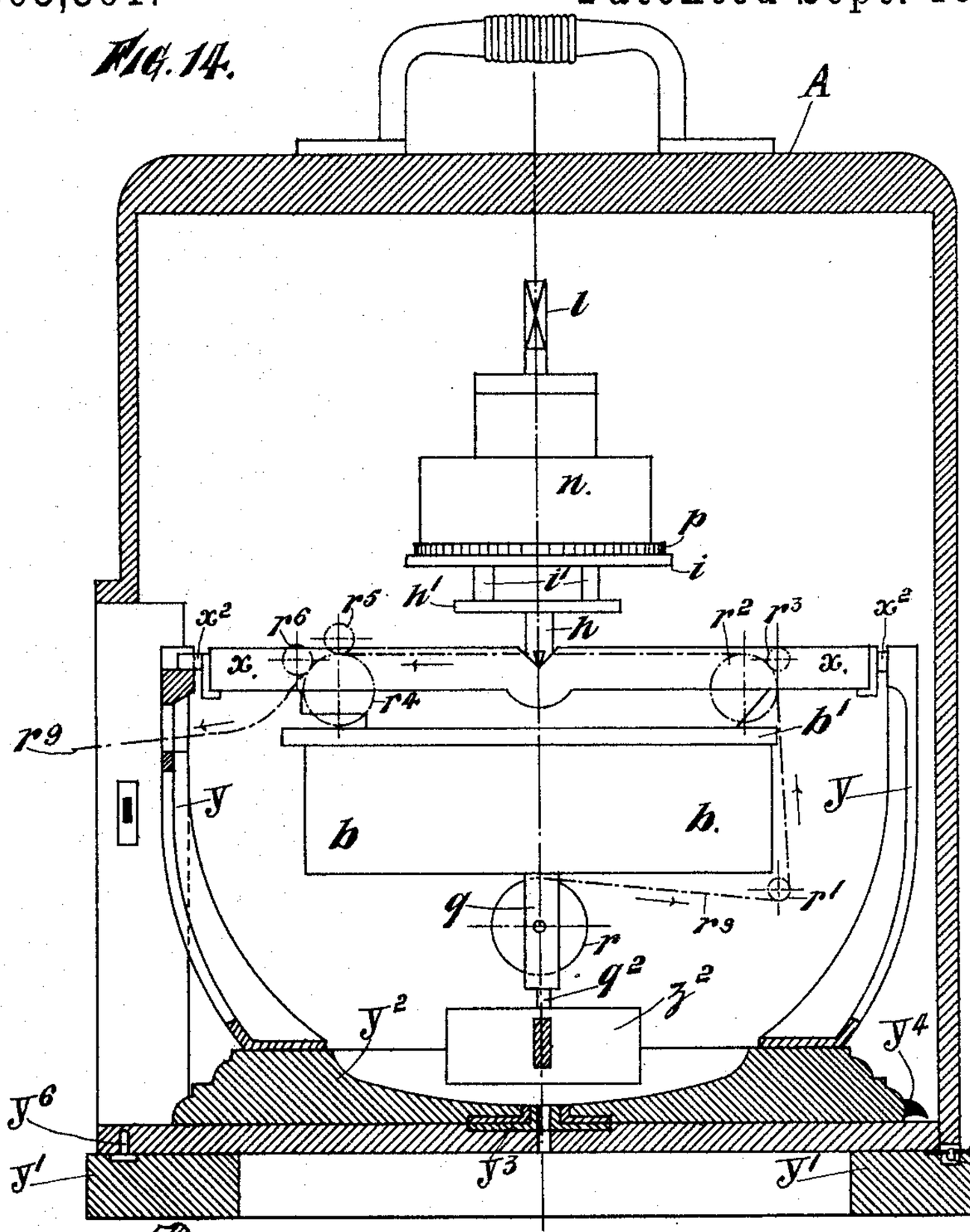
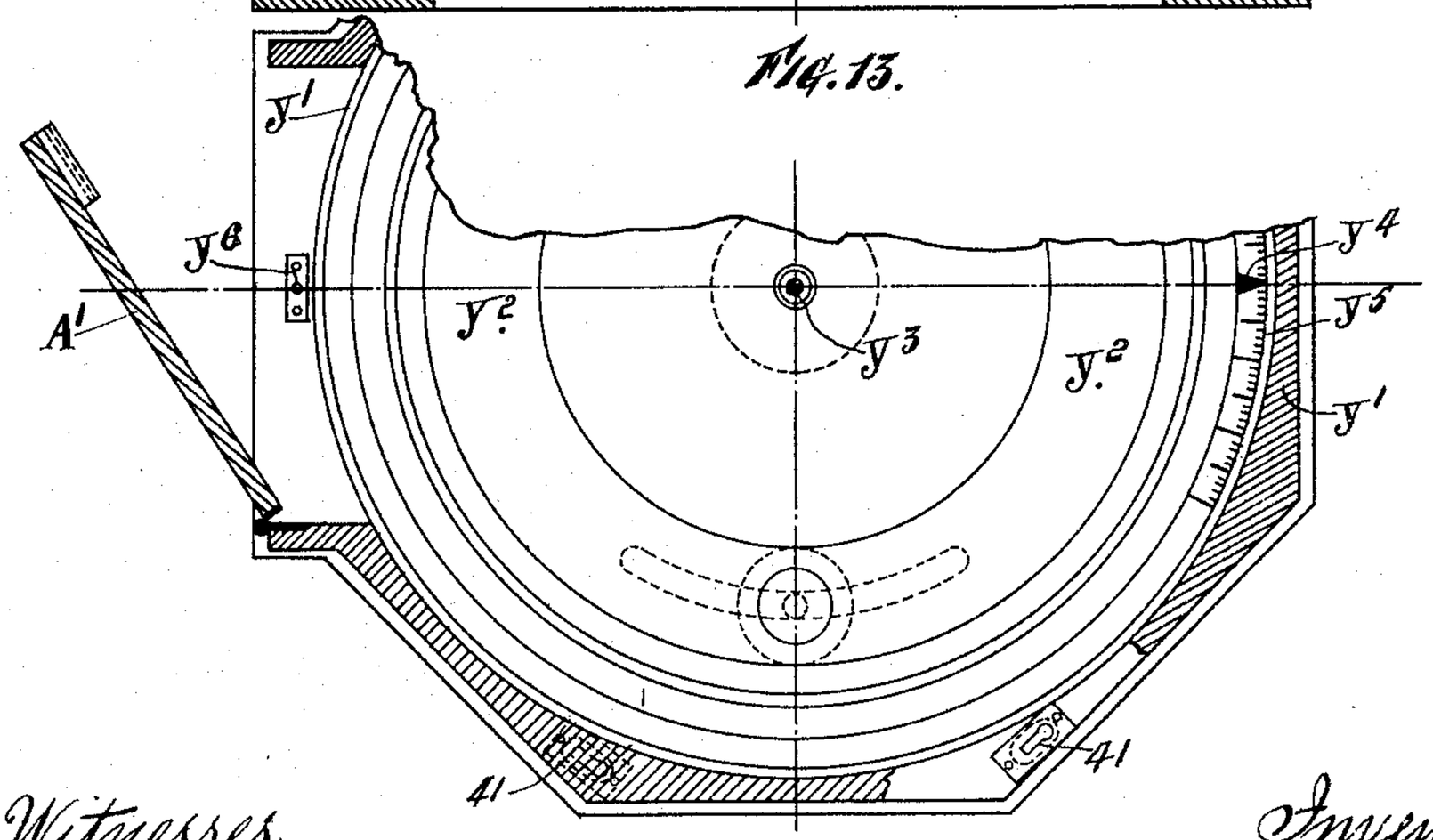


Fig. 13.



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SHIP'S RECORDING COMPASS.

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FIG. 17.

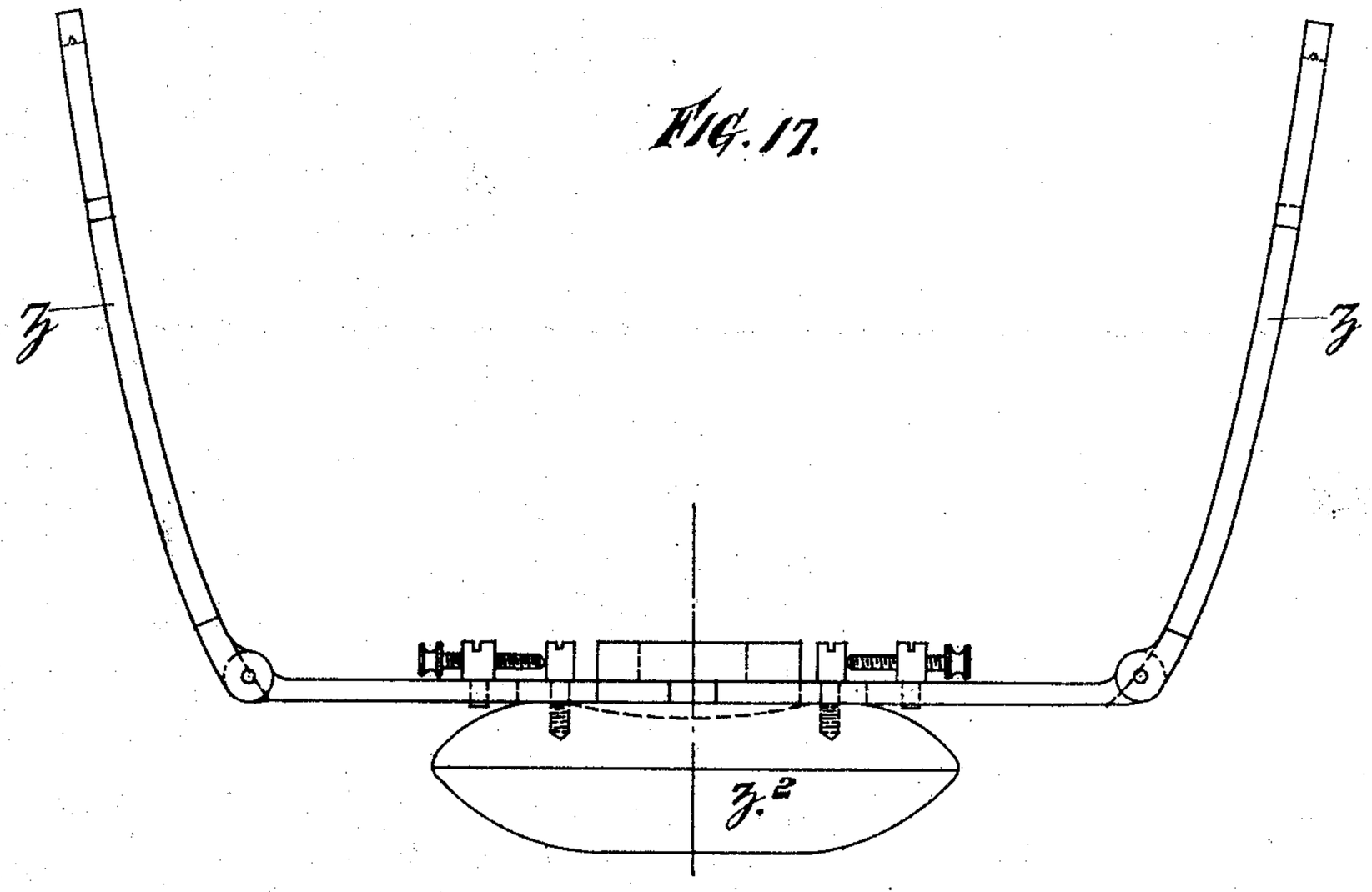
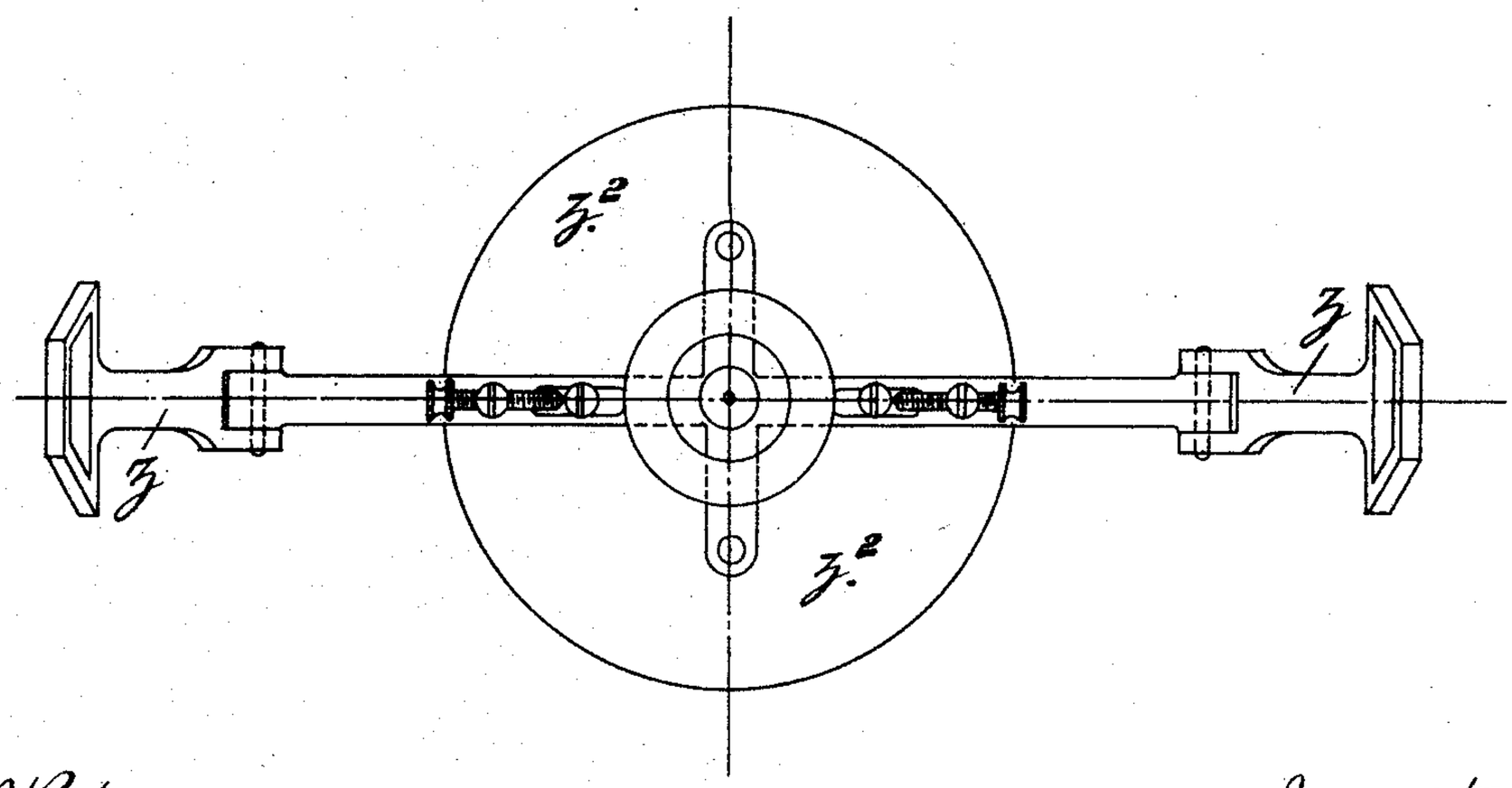


FIG. 18.



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UNITED STATES PATENT OFFICE.

JOHN HOPE, OF LIVERPOOL, ENGLAND.

SHIP'S RECORDING-COMPASS.

SPECIFICATION forming part of Letters Patent No. 505,361, dated September 19, 1893.

Application filed December 2, 1892. Serial No. 453,841. (No model.) Patented in England June 8, 1891, No. 9,675.

To all whom it may concern:

Be it known that I, JOHN HOPE, a subject of the Queen of Great Britain and Ireland, residing at Liverpool, in the county of Lancaster, England, have invented new and useful Improvements in Ships' Recording-Compasses or Course-Recording Apparatus, (for which I have obtained Letters Patent in Great Britain, No. 9,675, bearing date June 8, 1891,) of which the following is a specification.

In a ship's course recording compass or apparatus according to this invention, there is employed a clockwork or other motor for actuating the different parts, a traveling chart, a marking mechanism such as a pricker, and magnets, the said parts being supported on suitable gimbals or equivalent bearings. The chart or strip of paper is marked at suitable intervals of time by the marker, and the marker is actuated by the motor.

In the drawings hereto annexed is illustrated a ship's course recording apparatus according to this invention, that is to say, showing one way of carrying out the invention.

In these drawings the same letters and numerals of reference are used to denote the same or like parts wherever they occur in the different figures.

Figure 1 is an end elevation of the apparatus. Fig. 1[A] is a detail showing the mounting of an anti-vibrator pendulum. Fig. 2 is a side elevation in section of the apparatus. Fig. 2[A] shows a detail to a larger scale of the pricker and pricker actuating bar or ring. Fig. 3 is a plan of the apparatus. Figs. 3[A] and 3[B] are details showing the gear for operating the chart paper moving roller. Fig. 4 is a view of the mechanism in plan between the upper and second plates, showing the escapement mechanism for controlling the action of the pricker marker. Fig. 5 is a sectional plan taken at the line A A in Fig. 2. Fig. 6 is a sectional plan taken at the line B B in Fig. 2, namely, through the spring case. Fig. 7 is a sectional plan taken at the line C C in Fig. 2, and illustrates the going train of wheels and escapement mechanism of the clockwork for time keeping purposes. Fig. 8 is a plan in section of the apparatus with all the motor mechanism removed, viz., at the line D D in Fig. 2, and showing the table and pricker mechanism in full plan. Fig. 9 is a sectional plan taken through the bowl at the line E E in Fig. 2. Fig. 10 is a plan being a section through the apparatus at the line F F Fig. 2, and showing a detail of part of the vibration interrupting mechanism, or what may be called, for convenience, the anti-vibrator mechanism. Figs. 11 and 11[A] are plans showing the pricker actuating controlling escapement mechanism to a larger scale and in two positions; and Figs. 12 and 12[A] are elevations of this mechanism also shown to a larger scale. Fig. 13 is a plan of the base of the apparatus. Fig. 14 is an elevation partly in section of the base, and showing also the cover. Fig. 15 is an elevation and Fig. 16 a plan illustrating a modification of the anti-vibrator mechanism shown in Figs. 1, 2, and 10; and Figs. 17 and 18 are respectively an elevation and plan of a further modified form of anti-vibrator.

Referring now to the drawings, *a* are the magnets, and *a'* pontons in which such magnets are contained.

b is the bowl in which a liquid such as spirit of wine, or other suitable liquid is contained, and in which the pontons *a* containing the magnets are disposed and work.

c, *c'* represent two markers consisting of pricker points.

d are the bifurcated ends or jaws in which the pricker points *c c'* are fixed.

d' are the arms supporting the jaws *d*, and d^2 d^3 are gimbal rings, the outer one of which carries the arms *d'* and also counterbalance weights d^4, and supporting arms d^5, the inner one carrying the outer ring and being itself mounted on or supported from the bearing socket a^2.

a^3 are suspension bars by which the pontons *a'* are supported from the socket a^2.

e is the angle bar ring by which the prickers *c c'* are actuated, the upper flange of which ring lies within the bifurcated ends or jaws *d*.

f is the table over which the chart or slip of paper to be marked passes, said table being supported from the cover *b'* of the bowl by side frames *f'*.

g is a ring disposed above the chart and secured to the table *f* by thumb screws *g'* which are so adapted and disposed as to be easily taken off or placed in position, said ring serving as a means of holding the chart papers up to the prickers *c c'* in the act of pricking

as well as a protractor as hereinafter explained. The whole mechanism above the table *f* is supported from this table by two columns *h*, one on either side of the apparatus, said columns being mounted on a table *f* and supporting plates *h'* and *i* through which said columns are passed. This arrangement provides a clear space above the paper chart by which the diagram being marked can be easily seen and read, at any time, and also affords easy access to the ring *g* and its fastening screws *g'*.

The motor mechanism and time keeping mechanism are supported upon and between the plate *h'*, the plate *i*, the plate *j*, and the plate *k*. Between the plates *h'* and *i* the going train and time keeping mechanism of the apparatus is disposed. Between the plates *i* and *j*, the springs and winding mechanism are arranged; and between the plates *j* and *k* the marker actuating mechanism is situated. The plate *i* is supported from and fixed to *h'* by columns *i'*. The plate *j* is mounted on *i* and secured thereto by fixed columns *j'*; while the plate *k* is fixed to *j* by the fixed columns j^2. These columns are not shown in Fig. 1 for the sake of clearness or better illustration of the mechanism.

The columns *h* by which the whole superstructure or mechanism is secured to the aforesaid plates, is fixed to the table *f*, are each of two different diameters, and the shoulder thereby formed serves as a seat on which the plate *h'* rests. The plates *h'* are each provided with apertures through which the upper parts of the columns *h* pass easily, and they (with the other parts specified) are held down in position by thumb screws i^3. These thumb screws can be readily put on and taken off; and this construction and arrangement provides a means by which the whole mechanism above the table *f* can easily be removed and fitted.

Of the motor mechanism, *l* is the arbor, which is supported at the top by the plate *k* and at the bottom by the lower edge or shoulder of the swollen part *l'* thereof resting upon the upper side of the plate *i*.

m m' represent two intercoiled springs of the motor mechanism the inner ends of which are attached to the hooks l^3 of the arbor *l*, while their outer ends are attached to the hooks *n'* fixed on the inner side of the case and opposite each other, said case being designated *n*. In this arrangement these two springs lie in the same horizontal plane.

o is the winding ratchet wheel, which is fixed upon the square part l^2 of the arbor *l*; and *o'* is one of the main driving wheels of the mechanism—mounted loosely on the arbor—to which motion is imparted from the springs by the ratchet wheel *o* through the pawls o^2, which are mounted upon the web o^3 of the toothed wheel *o'*. This wheel drives the mechanism, hereinafter fully described, which actuates the pricker marker.

p is another main driving wheel of the motor mechanism, that is, all the mechanism between the plates *i* and *h'*; also the mechanism shown on the right hand side of Figs. 1, 4, and 11 by which the operation of the aforesaid marker actuating mechanism is controlled; and also the chart paper feeding actuating roller. By means of the connections of the two springs *m m'* with the arbor *l* and the case *n*, and by the arrangement and connection of the driving wheels *o'* and *p*, these wheels will both revolve and their movement will be opposite in direction; at the same time their movements are not interrupted by the winding of the springs through turning the arbor *l* and the ratchet wheel *o* thereon.

r is a roller on which the blank strip of paper or chart r^9 to be marked is coiled and stored, this roller being mounted by the bracket frame *q* to the bottom of the bowl *b* and directly beneath the center of the pivot; that is, the axis of this roller and its center of gravity (including the paper r^9 upon it) is coincident with the vertical axis of the center of the apparatus, and said pivot.

r' is a guide roller for steering the paper. r^2 is another guiding roller over which the paper passes, the upper edge of which is on the same level practically as the surface of the table *f*, r^3 being a roller to retain the paper on r^2.

r^4 is the driven roller (actuated as hereinafter described), by which the paper is drawn over the table *f*, its upper edge being also level with the upper surface of the table.

r^5, r^6, are duplex rollers connected together at their ends by coupling bars r^7, in which their journals run freely; while r^8 are rods projecting from r^7, and fitting loosely in slots in the end f^2 of the side frames *f'*. The spindles of both rollers r^2, r^3, and r^4 are mounted in the side frames *f'*, the spindles of r^2 being disposed within slots in said side frames, so that these rollers can be readily taken out and placed in position when desired.

The paper moving roller r^4, is, as above stated, driven by the clockwork mechanism from the main driving wheel *p* on, or forming part of, the spring case *n*, and the following is the gear through which power is transmitted from the main driving wheel *p* to the roller r^4. A toothed wheel 1, mounted on the vertical spindle 2, gears with the main driving wheel *p*, and on the lower end of said spindle are fixed an upper and lower wheels 3 of different sizes. Gearing with one of the wheels 3, are provided wheels 4, also of different diameter, and on the end of the shaft 5, which carries the wheels 4, is provided a miter wheel 6, gearing with a miter wheel 7 fixed or mounted upon one of the side frames *f'*. Connected to this miter wheel 7 is a toothed wheel 8 gearing with an idle toothed wheel 9, which in turn gears with a toothed wheel 10 fixed on the paper driving roller r^4 or its axle. The spindle 2 is not continuous, but has upon it a coupling $2^{\times}$—of ordinary tongue and groove construction as shown—by which the upper gear of the ap-

paratus can be removed from the lower without making any mechanical disconnections as far as the driving mechanism for the roller r^4, just described, is concerned.

The two different sized wheels 3 and the corresponding wheels 4 constitute a means for driving the chart paper at different velocities. When the upper wheels 3 and 4 are in gear, the speed is half of that when the lower wheels 3 and 4 are in gear. The purpose of this provision is that it affords a means of regulating the velocity of the feed of the chart, and is useful in going long voyages for diminishing the length of chart marked, and for regulating the rate of speed according to that of the vessel. For instance, when a steam ship is going full speed, the higher speed wheels may be in gear, while when it is going at say half speed the lower speed wheels may be made to gear with each other.

The changing of the speed wheels is effected by the mounting shown in Figs. 3^A and 3^B consisting of a forked supporting bearing 11 which grasps or spans the boss of the wheels 4, such fork having upon its outer end a screw pin 12, which passes through a slot in the supporting bracket 13 and has fitted over it, and working upon it, a milled nut 14, by the turning on or off of which the bearing 11 is fixed or clamped at any part of the bracket 13, and released, at will. The shaft 5 has a flattened part or keyway, and the wheels 4 are correspondingly made (or such parts are equivalently constructed), so that this shaft will be revolved whenever the wheels 4 are rotated, no matter what their position is. This differential speed mechanism may be provided or adapted to give more than two ates of speed if desired.

The going train or timing mechanism is driven also from the spindle 2, from a wheel 15 thereon, through the following train of wheels, namely, 16 to 23, the latter wheel of which is on the scape-wheel spindle of the escapement. This escapement may consist of an ordinary escapement mechanism, and is of special construction only in so far that it is a self-contained escapement movement (including the wheel 23), that is, the parts thereof are all mounted in a bracket frame *s*, the lower limb of which is pear shaped as shown in Fig. 7, and which limb fits into a corresponding aperture in the plate *h* and is held therein by screws *s'*. By this means the escapement which is the most delicate part of the apparatus, can be readily taken from the apparatus, examined, repaired, if necessary, and put back, without disturbing the other parts of the mechanism; or it may be replaced by another escapement.

Through the spindle 2, yet another mechanism is operated, namely, the mechanism which rotates a crown wheel which controls the action of the pricker actuating mechanism. This mechanism is driven from the spindle 2 by the toothed wheel 24 fixed thereon, toothed wheel 25, and toothed wheel 26, mounted on the same spindle as the crown wheel. The crown wheel is designated *t* and its spindle is *t'*. It will be seen that as the rate of rotation is timed by the escapement in *s*, the rate of rotation of the crown wheel *t* and the rotation of the chart paper feeding roller r^4 are also timed, and that rate is kept constant by the escapement.

The parts of the mechanism of the pricker actuating mechanism which the crown wheel *t* controls, and serves as an escapement device to, are, the lower of the two wheels $u'\,u^2$, on the under side of u' of which projecting parts *u* are provided. The leading edges of these projections *u* engage with the teeth of the crown wheel, and then pass through the aperture between such teeth. The projections *u* are arranged on the under side of u' in a circular arrangement, there being two rows of them at different radii from the axis of $u'\,u^2$, the projections forming the inner ring being disposed in the circle, midway between those of the outer set. The effect of this is, that as the crown wheel *t* revolves and releases one projection *u*, so that it can pass between its teeth, the following projection in the other row will strike the outer face or periphery of the next tooth on the crown wheel, and will be retained by it until the crown wheel releases it; and thus alternately does the wheel retain and release successively the successive projections of the two rows of projections on the under side of u'. The motion of the wheel u', which takes place in the manner just described, is imparted to the angle bar ring *e*—which actuates the pricker marker—through the upper edge of the wheel u', which consists of a number of inclined planes, and the corresponding under edge of the wheel u^2, which also consists of a number of inclined planes; a crosshead *v* connected to u^2; and side rods *w* connecting *v* and the ring *e* together and serving to transmit the motion imparted to u^2 by u'. The lower ends of the rods *w* are connected to the ring *e* by the projecting arms *e'* thereon. The rods *u* are guided at the top by the upper plate *k*, nipples *v'* fixed upon the upper side of the crosshead sliding through said plate; while at their lower parts they are guided by the plates *i* and *h'*, and the table *f*, through which they pass. The rods *w* are fixed to the crosshead *v* by the set screws *w'*, and between the plates *j* and *i* they pass through hollow columns w^2.

The mechanism by which the lower wheel u' is rotated consists of a toothed wheel 30 engaging with the main driving toothed wheel *o'* (which, as above stated, is operated through the arbor *l*), toothed wheel 31 on the same spindle as 30, and toothed wheels 32, 33, 34, and finally the toothed wheel 35, which is connected to or mounted on the under side of the wheel u'. This wheel revolves loosely upon the arbor *l*. This mechanism is the only one driven from the large toothed driving wheel *o'*.

The whole mechanism or apparatus is supported from the gimbal ring x by the knife edge supports x' fixed to the bowl b, while the ring x is supported in the side brackets y by knife edges x^2, the said brackets being fixed upon the base.

The means for reducing the degree of vibration of ships' recording apparatus, or ships' compasses, or for neutralizing same, as illustrated in Figs. 1 and 1^A, consists of links z suspended from the knife edge support x' by the adjustable screw pivots z', and a mass or weighted body z^2, having on it arms, the ends of which are supported from the lower ends of z. The ends of the arms of the mass z^2, and the part of the link z on which they rest, are formed as knife edges so that the point of contact is extremely small and a freedom of movement is provided for. The body z^2 acts as mass on one end of the pendulum, and, in this example, is hollow as shown, for the purpose of containing liquid, and serving as a chamber in which the vanes q' on the under side of the bracket q are disposed and work. The purpose and action of these vanes in the liquid (which say is glycerine) in z^2, is that the effect of the vibrations of the two pendulums on one another, is accentuated, and the vibrations of the whole apparatus are the more quickly subdued. The liquid in z^2 is inclosed by half covers z^3 with the exception of an aperture in the center which allows for sufficient movement of the vanes q', and the mass z^2, in relation to each other. The screws z' serve as pivots, supporting the hooks forming the upper ends of the links z; and the adjustment thereby provided is to enable the length of the pendulum supported on these pivots, and its rate of vibration, to be regulated at will, so as to give it a relative rate of vibration to that of the main apparatus, in order to obtain the effects desired. Consequently they serve for different adjustments according to the difference of weight of different instruments, and their centers of gravity, which will necessarily, in many cases, to some extent, be unequal or different.

In the modifications shown in Figs. 15 to 18, of this anti-vibration mechanism, no liquid is employed, and in such cases the vanes q' would not be used, but the stem q^2 in Fig. 1 would work within the space z^4 in the mass or weight z^2.

z^5 represents a rubber ring forming the inside lining of the aperture z^4, and constitutes a buffer against which the stem q^2 may strike. The liquid in the weight or mass z^2 in Fig. 1 serves a similar purpose with respect to the vane q', but its action is more effective than the action of those shown in Figs. 15 to 18, in so far that the reduction and neutralization of the vibration of the apparatus is much more quickly produced by it, than by those of the latter construction. It will be seen in Figs. 15 and 16 that the mass z^2 is supported by gimbals while that in Figs. 17 and 18 is a fixture. I find that the former arrangement, namely, that in Figs. 15 and 16, is somewhat superior in effect to the latter arrangement.

It is obvious that in the recording apparatus illustrated, the whole apparatus supported to the gimbal knife edge supports x' constitutes one pendulum, whose length is that of the distance between the supporting edge of the said knife edge support, and the center of gravity of the whole; while the other pendulums' length is the distance between the planes of the points of support of the links z, and the center of gravity of the mass comprising the parts z, and the weight or body z^2, and parts connected therewith. These different lengths of pendulums and their weights will always be unequal, and in consequence their rates of vibration will also be unequal: upon these differential rates of vibration of this compound pendulum (or these duplex pendulums) the self neutralization or destruction of oscillation rests, and by them the instrument is quickly brought to a steady state, after it has been set in vibration. The application of this mode or means of reducing or neutralizing the vibrations to ships' compasses will be easily understood, by assuming that the whole mechanism on and above the cover of the bowl b of the instrument shown to be removed, and a compass card suitably fitted on or in connection with the magnets; of course the parts such as the rollers r and r' may be assumed to be removed also. At the same time it will be plain that this anti-vibrator mechanism may be applied to ordinary ships' compasses other than those wherein the magnets work in a liquid.

The apparatus is adapted to be covered in for the purpose of conveyance and protection, as shown in Figs. 13 and 14, the cover being designated A; the cover is provided with a door A' and is adapted to be fitted to and taken away from the base y' by the bolts 40, which engage with and disengage from the plates 41, by slots, as shown therein. This is a well known device for connecting and disconnecting parts together.

The base illustrated in Figs. 13 and 14 is shown in two parts, an upper and an under one. The upper part y^2 works on a pivot y^3, and has a pointer y^4 on its edge, while on the lower part of the base the scale y^5 marked with degrees is provided; hence when desired at any time the instrument can be set for a given course. This is particularly useful in cases where only one pricker marker is used, as in such a case the nearer the marker pricks the chart to the center line thereof, the better the diagram is, and so in such cases when a ship is about to sail a straight, or fairly straight course, it may become advantageous for the sake of clearness of the chart, and to show the qaulity of the steering, as well as to provide distinctiveness between the different punctures, to set the instrument on the course required to be steered, so that the single pricker will lie directly in the vertical plane

which passes through the center line of the chart. When a course has been set, the upper part and the lower part of the base may be clamped together by clamping screws y^6.

I will now describe the modes of operation, and the particular effects produced by the different mechanisms, the effects and purposes of the relative dispositions of certain parts herein described, and generally the apparatus as a whole.

The general operation of the apparatus is as follows: The motor springs being wound up, and the chart on the store roller r being passed over the rollers r', r^2, and between r^4, r^5 and r^6, the operation commences; that is to say, the chart is moved forward past the pricker marker, and at the same time at certain periods the marker is actuated and punctures the chart, the position of the pricker or prickers being maintained by the magnets. The operation of the roller r^4 by which the paper is fed forward past the marker, has been already fully described. The actuation of the pricker is effected by the releasing of the wheel u' by the crown wheel t, namely, as the crown wheel t revolves at a settled rate of speed (it being driven from the main driving toothed wheel b through the gear already described) it releases one of the projections u on the wheel u' through the space between its teeth, while the following projection u on u', following the one released comes into contact with the face of the succeeding tooth of the crown wheel t, and so stops u'. This amount of movement of u' will just equal the length of the distance apart of its inclined planes on its upper surface, and in that movement the inclined planes of u' acting upon the inclined planes of the fixed upper wheel u^2, raises same to a height equivalent to the depth of the inclined planes, and then releases it. The upward limit of movement of u^2 and the crosshead v connected to it is illustrated in Fig. 12 to a larger scale, while the normal or lower position thereof is shown in Fig. 12^A and Fig. 1. The wheel u' is, as above stated, primarily driven from the large driving toothed wheel o', which is driven from the arbor l (to which the inner ends of the springs m m' are connected), and the intermediate gear already described. The time taken in traveling from one projection u to another is about one six thousandth ($\frac{1}{6000}$) of a minute, and hence the time occupied in the lifting and lowering of the pricker marker actuating ring e (motion being transmitted to it through the rods w), and the pricker is one one-hundredth of a second; that is to say, the action of the ring e upon the pricker marker pressing it up through the paper and withdrawing it is practically instantaneous. It is important that this should be so, since any prolonged contact between the markers and the part which operates them, would set them oscillating in the horizontal plane, which obviously would be a serious defect. The pricker marker shown in the drawings is, as already described, in duplicate, that is, there are two prickers c, c'. This feature was designed and introduced to render more clear or distinguishable the puncturing or marking of the chart; for instance, if one pricker only be employed, (assuming the ship were sailing upon a course with this pricker action upon or about the center line of the chart,) if the ship were to change her course to the extent of say ninety degrees, then the small irregularities of the ship's course due to steering, or other cause, would not be so easily read or distinguished as those when the pricker was acting and puncturing on or about the middle portion of the chart. But when the double arrangement herein shown and described is used, one marker being set say about ninety degrees from the other, if one marker be acting upon the extreme edge of the chart, that is, as far as the marker can mark, the other will be acting upon and puncturing the center part of the chart and irregularities are easily seen; whereas if the part of the chart being marked is between the extremes, the variations of the course (that is minute variations) are also, under any circumstances, very plain and easily read. I prefer to make these two markers distinguishable from one another in the forms of punctures, so that no matter what course or direction the ship is sailing in, if one of these differential markers be used or identified solely in relation to one direction of variation, say the starboard variations, no mistakes can be made, and the direction of the course of the ship can always be ascertained. These differential markers can be produced by making one of the points of split, or of duplex form, and the other a single point; or any other equivalent differentiating plan by which the two can be distinguished in effect upon the chart may be adopted.

It is important that the points of the prickers, and the point of the pivot a^4, be substantially in the same horizontal plane in order to avoid oscillations of the marker and magnets after each actuation of the former; also the center of gravity of the whole marking device is kept well down below the point of the pivot which supports it, by bending down the bars d' and d^3, on the ends of which the jaws d and the balance weights d^4 are mounted, these parts constituting the bulk of the mass of the marking device.

A further means in connection with the pricker marker, by which I prevent lateral oscillations of it, and of the magnets, is also important. It consists in having the part of the pricker upon which the actuating device thereof impinges, of rounded form or of small surface. I find that by making this provision, lateral oscillations of the marker, due to the impact of said actuating device, are prevented. In the construction of the pricker shown in the drawings, this provision is effected by prolonging the stem of the pricker's points c c' which pass through the upper member of the jaw or bifurcated end d, and rounding its lower end, so that the upper sur-

face of the angle bar *e*, when elevated, and in the act of pressing the marker up through the paper, comes into contact with a very small area or surface of the marker, and imparts a purely vertical thrust, *i. e.* without any oblique resultant of any kind.

The construction and arrangement of the marker and parts connected with it, shown in the drawings, are those which provide for a complete revolution of the markers, and puncturing to take place throughout the whole part of the circle. This is caused by providing the part *e* as a complete ring, and a complete circular gap in the table *f*, and by having a free and unrestricted path for the markers.

The connection of the magnets with the marker is made, as above stated, by supporting the two pontons *a* in which the magnets are disposed, from the pivot support a^2 (on which the markers are mounted and fixed) by suspension bars a^3; hence the magnets and the mounting of the markers are, for all practical purposes, rigid, as regards all lateral movements or positions, but the markers are absolutely free as regards vertical oscillations or movement from the horizontal plane in which they lie, by mounting them on the double gimbal rings d^2, d^3 which connect the marker arms of the pivot mounting a^2. Thus, any movement of the latter kind, of the markers, does not in any way affect the position of the pontons and magnets, or disturb them.

As regards the magnet pontons, and the liquid in which they work, the level within the bowl is ascertained through the filling tube b^2, which is partially of glass and through which the level of the liquid can be seen.

The pontons *a* in which the magnets are disposed, are provided in order to render the apparatus as true and sensitive as possible, that is, to take off or remove as much friction as possible between the point of the pivot a^4 which supports them, and the stone of the magnet mounting a^2 which bears upon it. I find that a workable arrangement by which this may be carried out consists in constructing the pontons to have a capacity that will give buoyancy just sufficient to support about nine tenths of the weight of themselves, and the magnets they contain, together with the other mountings and parts connected with them, leaving thus only one tenth to be supported by the pivot. The fractions nine tenths, and one tenth, are approximate only, and are here used mainly to explain the method of mounting; but the exact mode which I adopt by preference, is to use methylated spirits of wine (or proof alcohol), and to construct the pontons to have sufficient buoyancy to just float them and the parts connected with them when placed in water, so that afterward, when placed in this spirit (the specific gravity of which is about .916, water being 1) the pontons will sink. I, however, may adjust the weight upon the pivot by making the liquid more or less buoyant by adding more water, or more spirit.

The ring b^3 which surrounds the neck b^4 of the cover b' of the bowl, is provided to catch any liquid which may flow over the lip of b^4, or pass over same by capillary attraction.

The pivotal point of the pivot a^4 is substantially in the exact horizontal plane in which the gimbals supporting the apparatus lie, so that the point of said pivot has no motion, no matter what oscillations may be given to the instrument; and consequently the oscillations of the instrument are not transmitted to the marker, and it therefore always remains at rest and undisturbed.

Regarding the chart, the roller r on which the blank chart paper (or ruled paper as the case may be) is stored, is disposed directly beneath the central axis of the instrument for the purpose of avoiding the unbalancing of the apparatus as the weight of paper becomes reduced, due to its being drawn off r. If the coil or store of paper be disposed outside of the center of gravity of the instrument, the uncoiling or removal of the paper from it, unbalances the instrument somewhat, which is objectionable. The drawing off roller r^4 has a rough surface at each end, namely, at the parts r^{10}, where it is slightly of larger diameter than the central portion. These rough parts of course are the propelling parts of the roller, the paper being pressed on to them by twin rollers r^5, the largest and operative parts at the ends thereof, and which lie over the parts r^{10} of r^4, being also roughened. These duplex rollers are introduced to effect the better regulation and guidance of the chart, and at the same time keep it properly down upon the parts r^{10}. The roller r^4 at its extreme ends is larger still than the parts r^{10}, and these enlarged parts form flanges, between which the paper lies, and by which it is partially guided. The outside edges of the rollers r^5, r^6, that is the part of these rollers which bear upon the paper, just lie within the flanges formed by the enlarged ends of the roller r^4 just referred to, and thus these rollers r^5, r^6 are kept within their proper place by the said enlarged parts.

To indicate upon the chart "time" marks, I provide upon one of the parts r^{10} of the roller r^4 (say the starboard side) a number of points r^{11} (say four) in order to show the distance of chart moved by each revolution of r^4. This will show upon the chart the duration of time any given number or lengths of markings (*i. e.* puncturings) has taken to be impressed in the paper, and serve as a mark of identification as to which is the port and which is the starboard side of the chart. As a modification, these parts r^{11} may be provided on both ends of the rollers to equalize matters, and they help also to move the chart. In this case one of the points is of double form (or equivalently formed) in order to identify the port and starboard sides of the chart.

In Fig. 3 the rollers r^5, r^6 are shown recessed near their outer edges. These recesses would come or lie over the course traversed by the points r^{11}, and by them the points are free to puncture or pass through the paper without injury.

A pointer r^{12} is fixed on the side frames f' directly above the center of r^4, and a scale is provided on one end of r^4 (as shown in Fig. 8). The division shown is in twelve parts, representing five minutes for each division, so that the roller r^4 will make one revolution in one hour.

The purposes and effects of the ring g are to form a surface of resistance or a backing to support the paper, and prevent it being lifted when the pricker points c, c' are passed upward into the paper. But it also serves as a protractor, it being provided with a scale of degrees, (as shown in Fig. 8,) or points, by which the exact degree or point which the ship is sailing can be seen and read off, while the instrument is going; and the parts of the apparatus above this ring are so elevated and out of the way, and so arranged, that this reading of the scale and chart can the more easily be done. Also, the pricker or its effects can thereby be examined and seen with facility; and further, the thumb-screws g' which hold the ring g in position can, by this arrangement, be quickly and readily unscrewed and the ring g removed, and replaced, whenever desired, and with facility, as no obstructions whatever exist, the only parts connecting the upper structure of the apparatus with the table f, being the supporting columns h. It will be seen by Figs. 1, 2, and 2^A that the under side of the ring g stands a little above the surface of the table f, while its wings g^4 (Figs. 1 and 8) which support it, and fix it upon the table, come into contact with the table f. Hence a space is provided between g and the surface of the table f to allow a free passage of the paper through the machine. With respect to the springs m, m' (which are by preference of steel), it will be observed that they are respectively connected at one of their ends, *i. e.*, their outer ends, to the case n exactly opposite each other, while their other, namely, their inner ends, are connected to the arbor l exactly opposite each other, the connections being effected by providing holes in the springs, and projecting hooks l^3 and n' on the arbor and case, respectively. By so arranging the two springs, intercoiled one within the other, as described, and fixing them in relation to each other as described, any unbalancing due to eccentric projection of a spring in uncoiling is balanced exactly by the other; and consequently not only is a perfect balancing of the whole apparatus preserved, but the possible error of the instrument which might accrue by such an eccentric unwinding of one spring, through its influence upon the magnets, (although said spring were mounted over the axis of the magnets,) is obviated; that is to say, when the duplex arrangement is used, the eccentric uncoiling and subsequent projection of the center of the mass of the spring without the center line or axis of the magnets, and its effect upon the magnets, are neutralized by an equal and opposition or counter projection of mass, by simultaneous eccentric uncoiling of the second spring, and so errors due to such causes, are absolutely prevented.

Although the springs are shown in the drawings, one within the other (and this is the arrangement I prefer), still they may be disposed one above the other if desired, so long as they are adapted to uncoil and act in the manner just described.

I prefer to finish the outside of the bowl and its cover bright, as I find that by so doing the heat rays are absorbed at a far smaller rate than if these parts are left dull, or have any dark color upon them; and in consequence of this, the rate of evaporation of liquid in the bowl is kept as small as possible. Probably about one tablespoonful is evaporated in lieu of the two or three or more in the same given time. It may be also here remarked that all the metallic parts of the instrument with the exception of the springs m, m', and the arbor are made of non-magnetic metal, that is to say of metal which has no influence upon the magnets.

I wish it to be understood that although at present I prefer to have the mechanism herein described of the forms shown, yet it is to be understood that these particular forms may be modified without departing from their general principle of construction and purposes. As an instance, I may mention the marking device. This need not necessarily be provided with puncturing points, since any form of marking point or device which would record an impression upon the paper, may be used in substitution thereof; nevertheless, I prefer the puncturing form of marker.

It is also to be understood that the different features according to this invention herein described and shown (that is, the features claimed in the claiming clauses concluding the specification) may be used individually in connection with ships' course recorders which differ otherwise radically from that which I have described and illustrated in the drawings.

Having now described this invention, I declare that what I claim in respect thereof is—

1. In a ship's course recording apparatus, the combination of a diagram sheet or chart; magnets adapted to retain a north and south position, and inclosed in a ponton or chamber; a vessel containing liquid, in which said pontons work; and a marking device connected to said magnets, and by which said diagram or chart is marked.

2. In a ship's course recording apparatus, the combination of a diagram sheet or chart; a bowl or vessel for containing liquid; a marking device adapted to mark said chart or sheet; and magnets connected with said

marking device, and controlling the position thereof, and contained in a ponton or pontons, immersed in said liquid at a constant depth the buoyancy of which is sufficient to carry the weight of the magnets, whereby the pressure on the supporting point of the marker is rendered small; substantially as herein described.

3. In a ship's course recording apparatus, the combination of a bowl *b* adapted to contain a liquid; magnets *a* disposed within the said liquid in pontons *a'*, immersed at a constant depth in said liquid and connected with a marker supported upon a central support a^4; a cover *b'* over the bowl *b*, and a motor mechanism supported upon said bowl, and adapted to operate a diagram chart or sheet, and the marker; substantially as described.

4. In a ship's course recording apparatus, the combination of a bowl adapted to hold liquid; a pivot on which the magnets are mounted and supported; pontons containing said magnets and disposed in the said liquid; a marking device separate from the magnets connected by suspension bars to the pontons containing said magnets, said pontons being below the point of support of said marking device; substantially as and for the purposes set forth.

5. In a ship's course recording apparatus, the combination of a diagram sheet or chart, magnets adapted to retain a north and south position, and a marking device disposed in a plane above that of the magnets, but connected thereto and mounted upon a central pivot, and having two pricking or puncturing points by which two lines of punctures are marked and recorded on the diagram sheet, substantially as and for the purposes set forth.

6. In a ship's course recording apparatus, the combination of a diagram sheet or chart; magnets adapted to retain a north and south position; a marking device connected with the magnets, consisting of two arms with puncturing points; a pivot on which said marking device is supported; weights on said marking device opposite to and on the opposite side of said pivot whereby said arms are both counterbalanced; and a loose joint connection between said arms and the magnets.

7. In a ship's course recording apparatus, the combination of a diagram sheet or chart; a table over which said diagram passes; a marking device mounted upon a pivot below said diagram, and retained in a north and south position by magnets; and a ring mounted above said diagram sheet or chart, and serving as a protractor and as a means of keeping the said diagram on the table; substantially as set forth.

8. In a ship's course recording apparatus, a marker pivotally mounted upon a fixed or immovable pivot, and whose position is retained by magnets, in connection with a circular bar engaging with the end of said marker and adapted to be raised and depressed by suitable operating or motor mechanism on the apparatus, to actuate said marker, throughout the whole circle; substantially as and for the purposes set forth.

9. In a ship's course recording apparatus, the table *f* over which a recording chart moves, a marker pivoted centrally below said table, the complete ring *e* for actuating said marker at its end, the side rods *w* disposed diametrically opposite each other and connected to said ring at each side thereof, the cross head *v* mounted centrally above said ring and connected to said rods *w*, the wheels w' w^2, and suitable motor mechanism disposed above said ring and adapted to operate one of said wheels and to raise and let fall the cross-head *v*, the upper of said wheels being fixed to said cross head, and meshing with and operated by said motor actuated wheel, substantially as and for the purposes set forth.

10. A ship's course recording apparatus; a table over which the recording chart or paper is moved; a marker controlled by magnets disposed and operating below said table; a motor spring or springs disposed above said table and supported thereon; a going train or time keeping mechanism directly under said spring or springs but disposed above said table and said going train, whereby access to the table below the motor can be had; and a mechanism disposed directly above said motor spring or springs and connected with the marker actuating device, and adapted to actuate and control said marker; substantially as set forth.

11. In a ship's course recording apparatus, a spring or springs disposed centrally above the marking device; an actuating device engaging with the end of said marker adapted to operate same; and a pair of wheels w', w^2, having inclined teeth or planes meshing with each other, one of which is adapted to be rotated by said spring, and the other is fixed and connected with said marker actuating ring, whereby, when the operative toothed wheel is rotated said corresponding wheel and the said marker actuating device is first raised and then lowered; a cross-bar *v* mounted centrally across the wheel w^2; and side rods *w* connecting the cross bar *v* with the marker actuating device substantially as set forth.

12. In a ship's course recording apparatus, the combination of the wheels w' and w^2, by which the marker actuating device is operated; a spring connected to and adapted to operate one of said wheels, w'; projections or teeth *u* on w', comprising two annular rows of detents; and the crown wheel *t* operated also through said spring or other spring, and adapted to stop and release said wheel w^2 and act as an escapement, whereby the marker actuating mechanism is controlled and intermittently operated; substantially as set forth.

13. In a ship's course recording apparatus, two motor springs arranged centrally with the pivot of the magnet, and adapted to uncoil

on opposite sides of the center of the motor mechanism, said springs being connected through suitable mechanism with the marker of the apparatus and the recording chart or diagram feeding device; whereby the center of gravity of the apparatus remains undisturbed when the springs uncoil and the action of said springs upon the magnets is neutralized; substantially as set forth.

14. In a ship's course recording apparatus, the combination of two springs disposed within a case and centrally over the pivot of the magnets thereof, the outer ends of which springs are connected to the inside of the case, and their inner ends to the arbor of the motor mechanism; two driving toothed wheels, one fixed or formed on the outside lower part of said case, and the other fixed to the arbor and disposed at the top of said case; the said two wheels being moved in opposite directions one being adapted to drive the going train or time mechanism, the paper feeding roller, and the mechanism which controls the marker actuating mechanism, and the other being adapted to drive said marker actuating mechanism; substantially as described.

15. In a ship's course recording apparatus, a marker with magnets connected therewith by which a north and south position thereof is retained, a pivot supporting said marker and magnets, and mounted in a gimbaled or swinging frame, a chart or paper storing roller mounted directly beneath said magnets, marker, and pivot, and guiding and feeding rollers over which the said chart paper is fed in a horizontal direction past said marker, and suitable motor mechanism adapted to drive or actuate said feeding roller, whereby the center of gravity of the apparatus is maintained when the paper is moved off said roller, and the magnets and marker retain their horizontal position, and the apparatus does not become tilted in its gimbaled or swinging frame, substantially as described.

16. A ship's course recording apparatus, having the recording mechanisms comprising a motor mechanism, a marker and magnets, mounted as a whole at each side upon a gimbal ring or equivalent support upon which said apparatus is free to oscillate in one plane; and a pendulum in combination therewith having different rate of vibration, whereby the variations or oscillations of the apparatus are diminished or neutralized; substantially as described.

17. A ship's course recording apparatus having the recording mechanism comprising a motor mechanism; a marker and magnets mounted as a whole in a suitable gimbal ring on pivots, and which when oscillated acts as a pendulum; a mass or weight suspended by a free joint connection from said apparatus and acting as a secondary pendulum, and having a vessel filled with suitable liquid; and a vane or vanes on the apparatus and disposed within the liquid in the said vessel; substantially as and for the purposes described.

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

JOHN HOPE.

Witnesses:
T. RYDER MAWDSLEY,
Notary Public, 2 Cook Street, Liverpool.
JAMES A. COUBROUGH,
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