E. SCHUETTE & N. DEDRICK.

RECORDING COMPASS.

APPLICATION FILED JUNE 22, 1908.

978,942.

Patented Dec. 20, 1910.

3 SHEETS—SHEET 1.

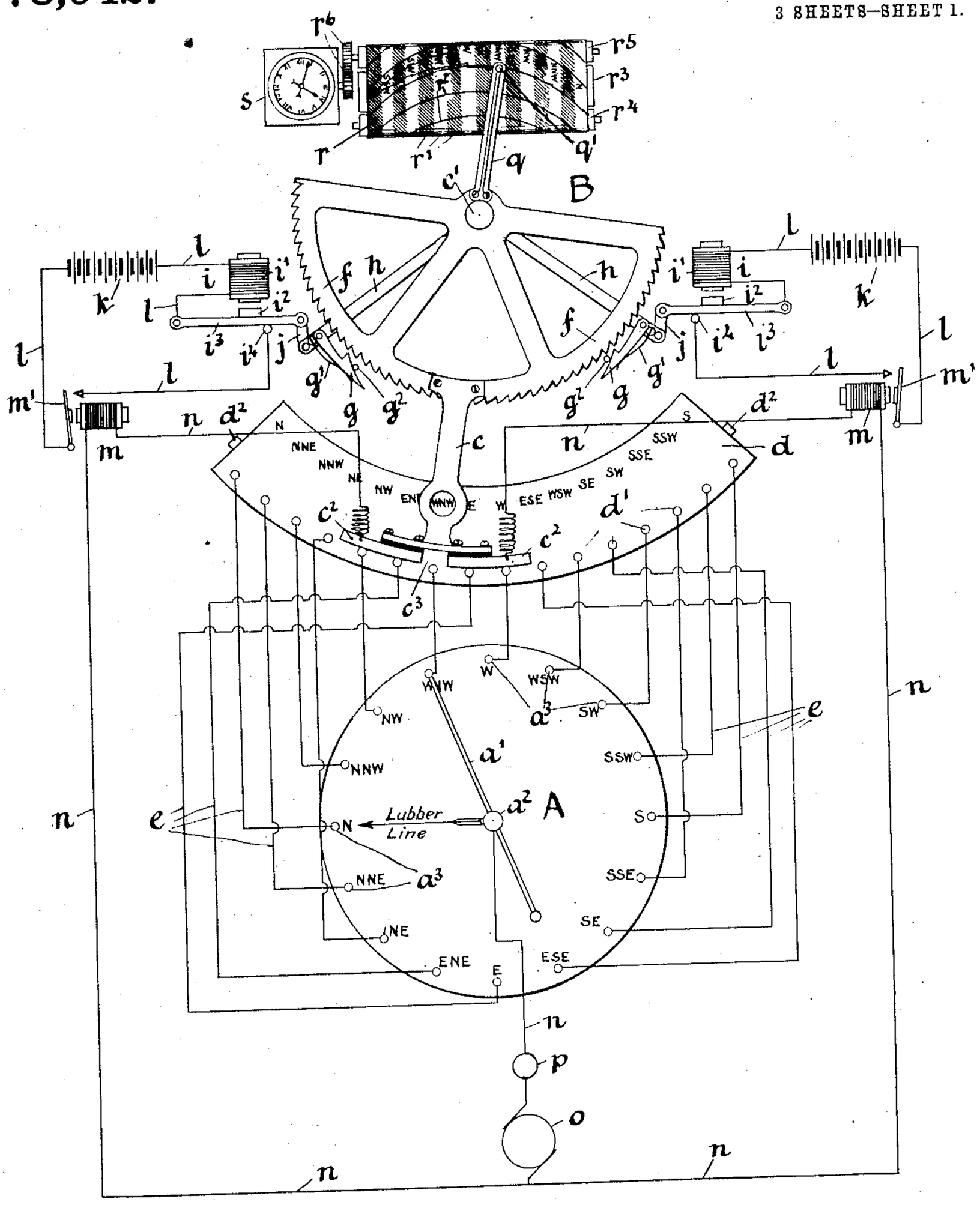

Fig. 1

Witnesses

A. P. Van Loghem

Minnie D. Schienbein

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By George Wetmore Colles

Attorney

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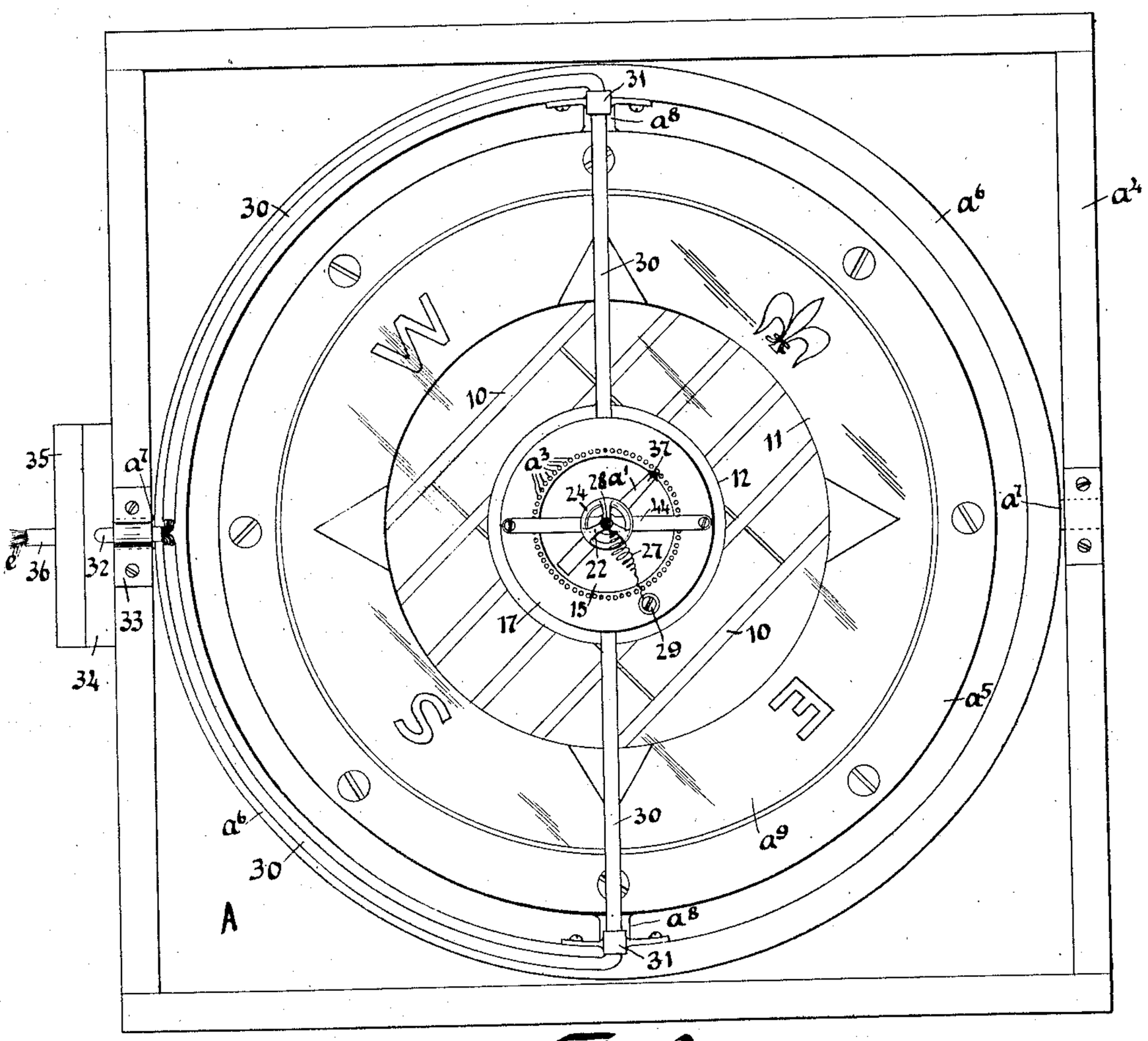


Fig. 2

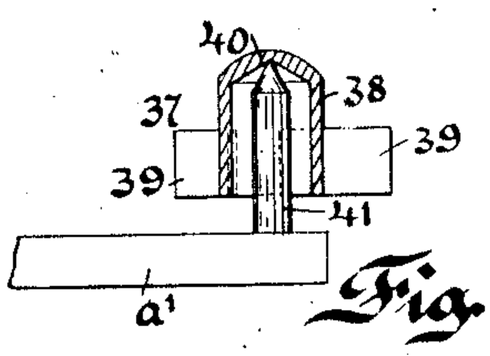
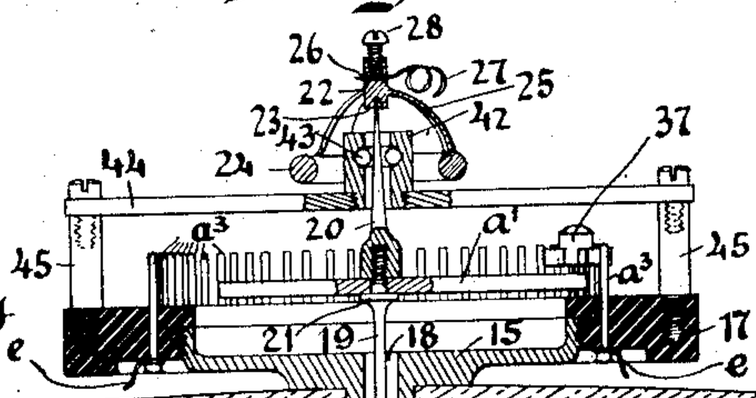


Fig. 4



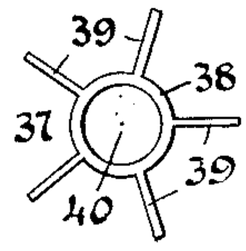


Fig. 5

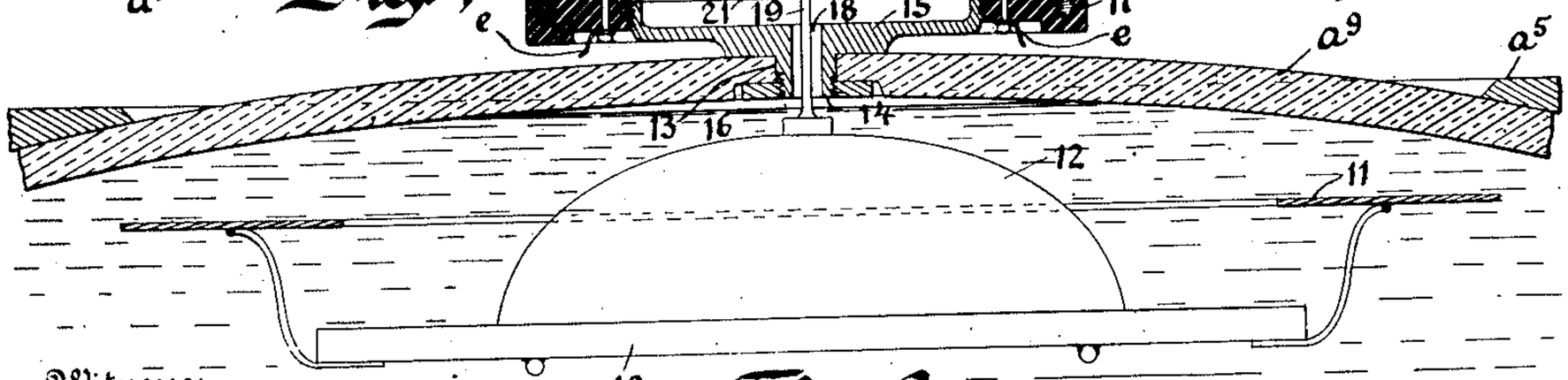


Fig. 3

Witnesses

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3 SHEETS—SHEET 3.

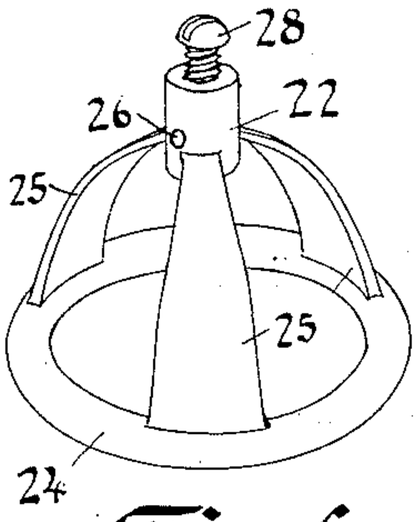

Fig. 6

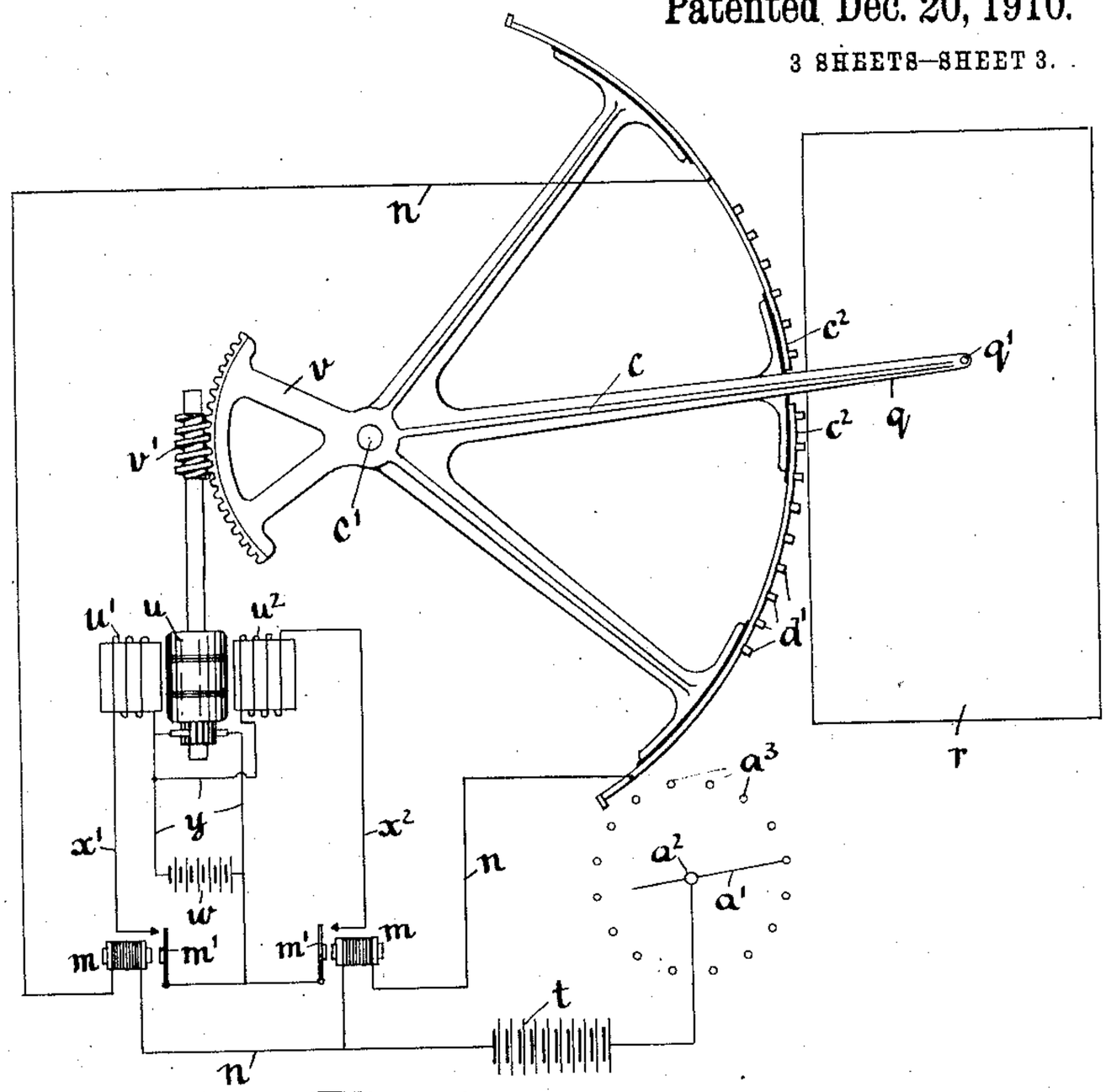

Fig. 7

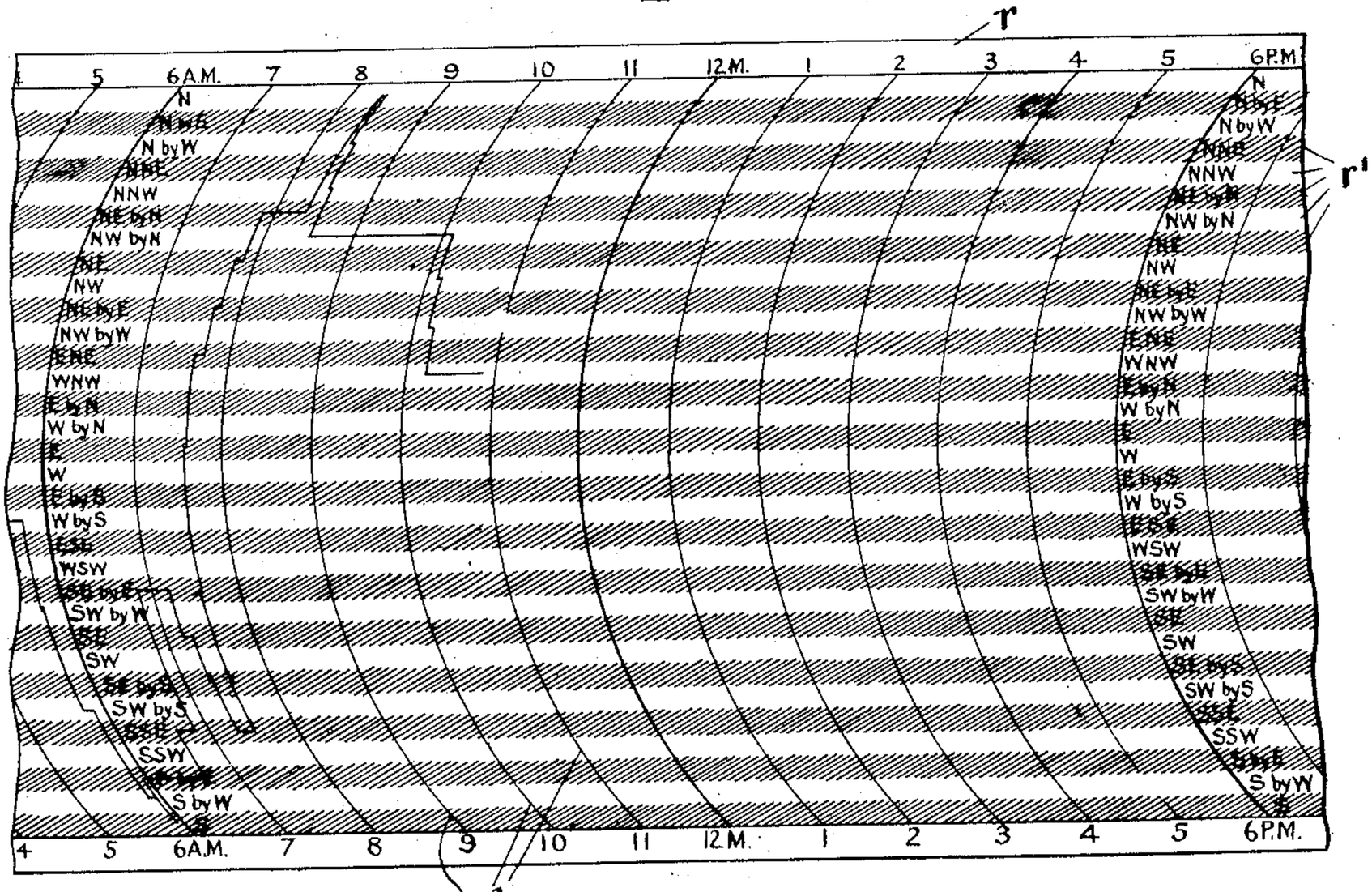

Fig. 8

Witnesses

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UNITED STATES PATENT OFFICE.

EDWIN SCHUETTE AND NICHOLAS DEDRICK, OF MANITOWOC, WISCONSIN; SAID DEDRICK ASSIGNOR TO SAID SCHUETTE.

RECORDING-COMPASS.

978,942. Specification of Letters Patent. Patented Dec. 20, 1910.

Application filed June 22, 1908. Serial No. 441,892.

To all whom it may concern:

Be it known that we, EDWIN SCHUETTE and NICHOLAS DEDRICK, both of Manitowoc, Wisconsin, have invented a Recording-Compass, of which the following is a specification.

This invention is a recording-compass or course-recording apparatus especially designed for use on board ship, and is designed to produce a continuous record of the direction of the ship with relation to time; so that the direction in which the ship was moving at any hour and minute can be determined at any time thereafter from an inspection of the record produced. Recording compasses of this character have been heretofore devised, and the extreme value of a perfect and successful recording compass is well recognized by navigators; but such recording compasses as have been heretofore invented have had certain practical or theoretical objections which, notwithstanding the great need of such instruments have prevented them from coming into use except in a limited way.

It is the object of our invention to produce a recording-compass which shall be free from the aforesaid objections; shall produce an absolutely continuous record; can be manufactured and sold at a reasonable cost; and shall not involve any cumbrous expensive or delicate machinery, apparatus or processes which will be liable to get out of order or which involve skilled attention such as is not likely to be found on board ship.

Perhaps one of the principal obstacles which has been encountered in all devices of this class is the extremely small directive power of the magnetic needle itself, especially on board ship where it is influenced largely by local attraction; such feebleness of directive power making it extremely difficult to devise a mechanism which can be used in connection with the needle (and therefore carried around by it) to record its direction, and yet which will not involve so much friction as to cause undue sticking or hesitation. In our apparatus we provide an almost entirely frictionless device for providing electric contact with a circle of electric contact-points; and said contact-device closes an auxiliary circuit which acts by means of relays to close an independent and main circuit which operates the recording device in accordance with the movements of the magnetic needle.

Another feature of this invention consists in the novel form of recording-chart and arrangement of the movement of the recording point or pencil, whereby the north and south points are at opposite ends of the chart, with the other points of the compass both of east and west bearing located between the same in appropriate order, and the points of the compass are equally spaced upon the chart.

Another feature of our invention consists in the arrangement by which the location of the recorder is independent of that of the compass, so that the two may be located in different parts of the ship; and moreover the form and dimensions of the chart are not in any way dependent upon the size or arrangement of the compass.

Our invention also comprises other constructions and combinations which will be hereinafter described and particularly set forth in the claims.

Our invention may best be understood from a consideration of the following description of the most improved form thereof taken in connection with the accompanying drawings, wherein,

Figure 1 is a diagrammatic view of the mechanical and electrical arrangements and connections of the entire apparatus; Fig. 2 is a plan view of the compass-box separately; Fig. 3 is a central vertical section of the central parts of the same, showing the compass-needle and connected apparatus. Fig. 4 is a side elevation and Fig. 5 a plan view on a magnified scale of the contact star-wheel; Fig. 6 is a perspective of the pivotal center-contact piece; Fig. 7 is a diagrammatic view similar to Fig. 1 of an alternative arrangement, and Fig. 8 shows a portion of the recording chart.

In these drawings every reference letter and numeral refers always to the same part.

In Fig. 1 are shown the general mechanical and electrical arrangements of the entire apparatus; but, so far as the mechanical arrangements herein shown are concerned, it is to be understood that these are somewhat modified in form and position for the purpose of enabling them to be exhibited upon a plane, and moreover that they may take various forms which will be readily apparent to those skilled in the

art. The compass is designated in a general way by the reference-character A and the recording-instrument by the reference-character B; the needle itself is not shown in this figure, but is represented by the contact-arm a', which is carried thereby and turns therewith about the pivot a^2 in the center of the compass-box, and is surrounded by a ring of contact-points a^3, with which one end of said contact-arm makes contact successively as it turns upon its pivot. The contact-points represent in their positions the several points of the compass, and are here designated respectively by the usual abbreviations for said points. The points a^3 being stationary with respect to the ship, the compass-directions are reversed. For the purpose of attaining sufficient accuracy there will preferably be sixty-four contact-points a^3; but to avoid unnecessary complexity of illustration we have shown in Fig. 1 sixteen points a^3, and it will be readily seen that any other number might be used with corresponding changes in the other parts. The recording-instrument B comprises a swinging contact-arm c, which turns about a pivot c' through a suitable arc, and has mounted thereon a pair of insulated contact-strips c^2 on opposite sides of the center, which are arranged to contact with a series of contact-points d' set in a suitable mounting d; these contact-points are the same in number as the contact-points a^3, with which they are electrically connected each to each by electrical conductors e. The arrangement of the contact-points d' upon the mounting d is a peculiar and an important feature of our invention. It will be seen that the north and south points are located at opposite ends of the board and that the intermediate points are arranged to alternate between east and west bearings in passing from north to south; so that the points north-northeast and north-northwest, northeast and northwest, east-northeast and west-northwest and east and west, for example, are located adjacent to each other in regular order. The contact-strips c^2 are separated by an open space c^3 which is sufficient to include one point between them and out of contact with both, and said contact-strips are preferably extended to cover and contact simultaneously with at least two points on each side of the middle point. It is preferable, however, that the contact-strips c^2 be extended so as to cover all of the points d' on either side of the central-point, as will be explained below in connection with Fig. 7; but for simplicity's sake and to avoid complicating the figure and explanation thereof, such extensions are omitted from Fig. 1. Stop-blocks d^2 or other means may be provided at the ends of the contact-board d for positively limiting the movement of the contact-arm c and preventing it from being carried by any chance beyond its proper limit of travel. With the contact-arm c are mounted a pair of ratchet-toothed arcs f which have teeth facing in opposite directions and are acted on by a pair of pawls g mounted on swinging arms h, said pawls g being pressed against the teeth of the arcs f by springs g', but in their normal inactive positions they are held out of engagement with said teeth by means such as pins g^2. Suitable vibrating motors i are connected with the arms h by links j; each of said motors as herein shown consisting of an electromagnet or solenoid i' attracting a core i^2 which is mounted upon an oscillating arm i^3 connected by the link j with the arm h. The motor is operated by a battery k and in the circuit l of the motor is included the arm i^3 and a contact-point i^4 which closes the circuit only when the arm is not attracted by the magnet i'; so that the effect when the circuit is closed is to keep the arm i^3 in vibration, in a manner common to this class of motors, and thus to vibrate the arm h and turn the arc f tooth by tooth in one direction or the other, thus shifting the contact-arm c in the corresponding direction. The circuits l of the motors i are arranged to be closed by means of relays m, which are located in branch-circuits n leading from the pivot a^2 of the contact-arm a' to the respective contact-strips c^2 as shown; thus forming in certain positions a closed circuit on one side or the other in connection with the contact-arm a' and one of the conductors e. This circuit is energized by a source of electricity such as a dynamo o located therein. It is preferred to employ a comparatively high voltage for this service in order to minimize the current necessary to pass through the arm a', and thus avoid undue sparking at the points a^3, and also undue influence upon the magnetic needle; we may conveniently use for this service the usual electric lighting pressure of 110 volts. A lamp p or like resistance is inserted in series with the dynamo o to avoid any excessive rush of current.

The relays m are so arranged in the circuits n that when a current is passed through either of these circuits the relay will attract its armature m' and this acts to close the circuit l of the corresponding motor i in the manner shown. The effect of the aforesaid arrangement is that, the two contact-arms a' and c being in corresponding positions, the movement of the contact-arm a' to another position, which it can only do by passing successively through the intermediate positions, sponding position. This action takes place as follows: So long as the two contact-arms are in corresponding positions, for example the position west-northwest as shown in the

drawings, the circuit is broken, because neither of the contact-strips c^2 connects electrically with the corresponding point d' which is midway between them. But suppose the contact-arm a' to move to another position, which it can only do by passing successively through the intermediate positions, which latter first close the circuit n through one of the adjacent contact-points n, one of the next-but-one adjacent contact-points d', and one of the contact-strips c^2; this in turn closes the corresponding relay m and sets in vibration the corresponding motor i, which in turn causes the corresponding pawl g to act on the corresponding arc f to move the arm c in a direction toward the contact-point d' through which the current is passing, and this movement will continue until the circuit is broken by said contact-point becoming central between the two contact-strips c^2 whereupon the circuit being broken the movement will stop. Thus the contact-arm c is bound to follow the movement of the arm a' through whatever series of positions it may successively take up. As the conductors e may be of any desired length, the position of the compass A is quite independent of that of the recorder B, which accordingly may be (for example) in the captain's room of the vessel while the compass is in the pilot-house; and the captain can therefore while in his room observe in what direction the ship is being steered at any moment. In so far therefore as no written record is desired the apparatus as thus far described would be complete. To produce a record of the course, a recording-arm q is mounted on the arm c or any other part which moves with it (it may be the arm c itself) which carries a recording pen or pencil q', which for the sake of brevity we shall here designate as the recording-point. Beneath the recording-point q' is mounted a continuous roll of paper r printed as shown in Fig. 8, that is, divided longitudinally into strips r' representing the several points of the compass arranged in the same order as the contact-points d', and with transverse lines r^2 at equal intervals representing equal intervals of time, for example an hour. The lines r^2 will of course be circular arcs of the same radius as that of the recording-point q', unless a different motion is given to the recording-point, in which case the lines r^2 will be changed to correspond. Beneath the point q' is a plate r^3 which supports the paper against pressure of the point, and the ends of the recording-sheet are wound upon rolls r^4, r^5, the latter of which is mechanically connected as by gears r^6 to the clock-work s which gives it an even time-advancement corresponding to the spacing of the lines r^2. The number of spaces r' is equal to the number of points a^3; the chart shown in Fig. 8 is for compasses having thirty-two points a^3, and one having sixty-four points, as in Fig. 2, would require twice as many spaces r'. The spaces r' designating west-bearings are, moreover, preferably distinguished from those designating east-bearings by shading or coloring the same, or in like manner, so that it may be seen at a glance whether the vessel is bearing east or west of north.

An element most essential to the proper and accurate working of the apparatus is the construction of the compass and connected mechanism, and we have illustrated the mechanical arrangement of these parts in Figs. 2 and 3. Fig. 2 shows a rectangular case a^4 wherein is suspended the compass a^5 by means of a gimbal-ring a^6 with pivot-mountings a^7, a^8 at right angles with one another, as customary in ships' compasses. The compass herein shown is provided with a glass top-plate a^9 which closes the interior of the box, which is filled with liquid and in which the needle, here shown as of the built up type formed of a large number of magnetized steel bars or wires inclosed in pontoons 10 and carrying the annular compass-card 11, is floated, said needle turning on a suitable pivot (not shown) and its weight largely removed from said pivot by means of a float 12. These features are illustrated merely by way of example and are not in themselves a part of my invention. The glass-plate a^9 is preferably domed so that any entrapped air shall converge to the center, and it is perforated by a hole 13 in which is inserted the stem 14 of a circular base 15 and secured thereto by a nut 16 on the under side of the plate a^9. The base 15 is threaded on its periphery and there is screwed thereto an annular block 17 of insulating material such as hard rubber, in which is set the ring of contact-points a^3, which here take the form of posts projecting through to the under side of the block 17, and the ends of the wires e are attached to their lower ends (see Fig. 3). The base 15 has a central passage-way 18, and an upright stem 19 mounted on the float 12 directly over the pivot passes through said passage-way and carries on its upper end the contact-arm a', which latter is secured thereto by means of a pivot-stem 20 which screws onto the upper end of the stem 19 over the contact-arm a' and clamps it down upon a shoulder 21 on the latter. The stem 20 projects upwardly above the arm a' and its end is pointed to receive a pivoted element 22, which, as shown in Fig. 3, has a conical recess 23 on its under side resting upon the point of the stem 20; said member being held in upright position by a weighted ring 24 below the point of the stem 20 and connected with the member by arms 25. The member 22 has a transverse perforation 26 adapted to receive the end of a fine connecting wire 27, which is secured in place in said hole by a binding-screw 28. The

other end of the wire 27 is connected with a binding-post 29 on the block 17, to which post on the lower face of the block is connected the conductor of the circuit *n*, the latter being bound up with the other 64 wires *e* belonging to the posts a^3. As means of getting these wires changed without interfering with the free movement of the compass on its gimbals, they are divided into two parts and carried out on opposite sides of the box a^5 in line with the pivots a^8, being preferably inclosed in small rubber tubes 30, and they are secured to the gimbal-ring a^6 by cleats 31 immediately over the pivots, and pass around said gimbal-ring to one of the pivots a^7, where they are united in an inclosing tube 32 and pass out parallel to and over the pivot a^7, being secured by means of a cleat 33, and thence leading to a multiple plug-switch 34 on the side of the box a^4. Said switch is in two halves, the free half 35 being readily disconnectible from the fixed half and carrying the wires as a whole through a tube 36 to the recording instrument. This arrangement is not essential to our invention, but provides a convenient means of attaching and detaching the recording-instrument wires to the box in a body. It should be understood that the wires *e* are very fine and flexible and therefore do not interfere sensibly with the swinging of the compass upon its gimbals.

The special means which we have devised for making frictionless contact between the arm a' and posts a^3 consists of a light star-wheel 37, comprising a light pivot-cap 38 and a set of equidistant arms 39 radiating therefrom; said cap 38 having a conical bearing 40 which turns upon a pointed pivot-pin 41 mounted on the end of the arm a'. The position of the arms 39 is such that one of them always projects between adjacent pins a^3 and therefore contacts with one or the other of said adjacent pins but never with both at the same time. The friction resistance of contact is therefore reduced to the sliding resistance of the arms 39 over the pins a^3 and the pivotal resistance of the bearing 40 upon its pivot 41; both of which are so slight as to be practically imperceptible, and which we have found do not interfere sensibly with the movements of the magnetic needle. As however the needle 10 is always subject to some rocking or swaying upon its pivot, such swaying would interfere with the central position of the arm a' and would cause the star-wheel 37 to be thrown against the pins a^3 or withdrawn therefrom so as to interfere with its proper action, and to avoid this we provide a side-bearing 42 for the stem 20, which said bearing as here shown is in the form of a hollow cylinder provided with antifriction balls 43 on its interior periphery. Said balls are so arranged that they do not closely confine the stem 20, but merely limit its lateral movement, so that said stem in swaying with the needle strikes the balls on one side or the other, which offer no resistance to rotation. The bearing 42 is suitably mounted on a bridge 44, which is supported on upright posts 45 mounted in the block 17 on opposite sides of the center.

Instead of the pair of reciprocating motors *i* shown in Fig. 1 we may use a single motor with suitable reversing-connections. This arrangement is illustrated in Fig. 7. The arrangement of the compass, contact-arms a' and *c*, contact-points a^3 and d', relays *m*, and circuit-leads *n* and *e* are the same as before (conductors *e* are here not shown), except that a battery *t* is substituted for the dynamo *o* and resistance *p* omitted; but instead of the motors *i* a single motor *u* is substituted and instead of the arcs *f* a worm-wheel arc *v* is mounted in connection with the contact-arm *c* and engages a worm v' turned by the motor *u*. Said motor has two field-coils u' and u^2 which are connected in opposite directions to the source of current, here shown as a battery *w*, by means of circuit-leads x', x^2, which are intercepted by the respective relays *m*; so that when one relay is closed the motor is turned in one direction and when the other relay is closed the motor turns in the other direction, the armature and one end of each field-coil being permanently connected to the battery *w* by leads *y*. It will be readily seen that this arrangement of motor operates in the same way as that of Fig. 1. Two batteries *k* are shown in Fig. 1 merely for simplicity's sake, as one can be used for both motors *i*, or instead of using batteries the motors could be connected to some other source of current, as that which supplies the circuits *n*. In Fig. 7 the contact-strips c^2 are also shown as extended to cover all the contact-points d' on each side of the arm *c*, as hereinabove referred to in connection with Fig. 1. This arrangement, though not theoretically necessary, is rendered desirable because of the possible temporary suspension of the electric current during an interval in which the compass might assume a different direction corresponding to one of the contact-points lying outside the range of the contact-strips c^2 if these were not so extended, and an extension of these strips enables the instrument in such a case to be brought back at once into proper registration with the compass. This is the arrangement which we propose to use and is omitted from Fig. 1 for simplicity's sake as previously observed.

While we have hereinabove described the most improved form of our invention, we wish it understood that it is not confined to the specific arrangements shown, but is sub-

ject to alterations in the mechanical and electrical details within the reasonable scope of our appended claims.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact-points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, an indicating instrument separate from the compass and having a traveling-member (c) indicating by its position the direction of the compass, a plurality of contact-points arranged adjacent to the path of movement of said traveling-member and connected severally with the first-mentioned contact-points, a pair of contact-pieces (c^2) mounted on said traveling-member and each adapted to make contact with said contact-points, said contact-pieces being spaced apart, an electrical circuit including as one pole said contact-arm and divided into two branches connected to the respective contact-pieces, means controlled by one of said branches adapted to move said traveling-member in one direction, and means controlled by the other branch for moving the traveling-member in the other direction.

2. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact-points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, an indicating instrument separate from the compass and having a traveling-member (c) indicating by its position the direction of the compass, a plurality of contact-points arranged adjacent to the path of movement of said traveling-member and connected severally with the first-mentioned contact-points, a pair of contact-pieces (c^2) mounted on said traveling-member and each adapted to make contact with said contact-points, said contact-pieces being spaced apart, an electrical circuit including as one pole said contact-arm and divided into two branches connected to the respective contact-pieces, means controlled by one of said branches adapted to move said traveling-member in one direction, and means controlled by the other branch for moving the traveling-member in the other direction; said second set of contact-points being arranged in a line with points corresponding to opposite rhumbs of the compass at opposite ends of the line and points corresponding to the other rhumbs of the compass arranged intermediately in serial order.

3. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact-points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, an indicating instrument separate from the compass and having a traveling-member (c) indicating by its position the direction of the compass, a plurality of contact-points arranged adjacent to the path of movement of said traveling-member and connected severally with the first-mentioned contact-points, a pair of contact-pieces (c^2) mounted on said traveling-member and each adapted to make contact with said contact-points, said contact-pieces being spaced apart, an electrical circuit including as one pole said contact-arm and divided into two branches connected to the respective contact-pieces, means controlled by one of said branches adapted to move said traveling-member in one direction, and means controlled by the other branch for moving the traveling-member in the other direction; said second set of contact-points being arranged in a line with points corresponding to opposite rhumbs at oppcsite ends of the line, and the points corresponding to intermediate rhumbs on opposite sides of the extreme rhumbs arranged in alternate succession, whereby those contact-points corresponding to rhumbs equidistant from an extreme point and on opposite sides thereof are placed adjacent to one another in said line of points.

4. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact-points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, an indicating instrument separate from the compass and having a traveling-member (c) indicating by its position the direction of the compass, a plurality of contact-points arranged adjacent to the path of movement of said traveling-member and connected severally with the first-mentioned contact-points, a pair of contact-pieces (c^2) mounted on said traveling-member and each adapted to make contact with said contact-points, said contact-pieces being spaced apart, an electrical circuit including as one pole said contact-arm and divided into two branches connected to the respective contact-pieces, means controlled by one of said branches adapted to move said traveling-member in one direction, and means controlled by the other branch for moving the traveling-member in the other direction; said second set of contact-points being arranged in a line of which the points corresponding to the north and south points of the compass are at opposite ends, and the succession of points on said line of contact-points in passing from the north end to the south end is as follows: the first point of

the compass on one side of north, then the first point of the other side, then the second point on the first side, then the second point on the other side, and so on until the south point is reached.

5. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact-points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, an indicating-instrument separate from the compass and having a swinging contact-arm, a line of contact-points disposed in the arc of a circle concentric with the pivot of said last named contact-arm, a pair of contact-pieces carried by said contact-arm adjacent to said line of contact-points and adapted to make contact therewith and separated by an open space equal to or less than the distance between the two outer of three successive points, a two branched electric circuit having one pole connected to said first-named contact-arm and the two branches connected to the respective contact-pieces aforesaid, motor-mechanism controlled by one branch of said circuit adapted to move said first-named contact-arm in one direction and other motor-mechanism controlled by the other branch of said circuit adapted to move said last-named arm in the other direction, and a plurality of electrical connections leading from the several points of said ring of points respectively to the several points of said line of points.

6. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact-points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, an indicating-instrument separate from the compass and having a traveling-member (c) indicating by its position the direction of the compass, a plurality of contact-points arranged adjacent to the path of movement of said traveling-member and severally connected with the first-mentioned contact-points, a pair of contact-pieces (c^2) mounted on said traveling-member and each adapted to make contact with said contact-points, said contact-pieces being spaced apart, an electrical circuit including as one pole said contact-arm and divided into two branches connected to the respective contact-pieces, a pair of relays mounted in the respective branches, a pair of secondary electric circuits arranged to be closed by the respective relays, and a motor-mechanism actuated by said secondary circuits alternatively to move said traveling-member in one direction when one of said circuits is closed and in the other direction when the other circuit is closed.

7. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact-points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, n indicating-instrument separate from the compass and having a traveling-member (c) indicating by its position the direction of the compass, a plurality of contact-points arranged adjacent to the path of movement of said traveling-member and connected severally with the first-mentioned contact-points, a pair of contact-pieces (c^2) mounted on said traveling-member and each adapted to make contact with said contact-points, said contact-pieces being spaced apart, an electrical circuit including as one pole said contact-arm and divided into two branches connected to the respective contact-pieces, a vibrating motor controlled by one of said branches and acting to move said traveling-member in one direction, and a second vibrating motor controlled by the other branch and adapted to move said traveling-member in the other direction.

8. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact-points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, an indicating instrument separate from the compass and having a traveling-member (c) indicating by its position the direction of the compass, a plurality of contact-points arranged in a line adjacent to the path of movement of said traveling member and connected severally with the first-mentioned contact-points, a pair of contact-pieces (c^2) mounted on said traveling-member and each adapted to make contact with said line of contact-points, said contact-pieces being spaced apart, an electrical circuit including as one pole said contact-arm and divided into two branches connected to the respective contact-pieces, two oppositely directed sets of ratchet-teeth being carried by said traveling-member, a pair of pawls acting on the respective sets of ratchet-teeth, and a pair of motors acting to vibrate the respective pawls, one of said motors being controlled by one of said branch-circuits and the other by the other branch-circuit.

9. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact-points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, an indicating-instrument separate from the compass and having a traveling-member (c) indicating by its position the direction of the compass, a plurality of contact-points arranged adjacent to the path of

movement of said traveling-member and connected severally with the first-mentioned contact-points, a pair of contact-pieces (c^2) mounted on said traveling-member and each adapted to make contact with said contact-points, said contact-pieces being spaced apart, an electrical circuit including as one pole said contact-arm and divided into two branches connected to the respective contact-pieces, two positively directed sets of ratchet-teeth being carried by said traveling-member, a pair of pawls acting on the respective sets of ratchet-teeth, and a pair of vibrating motors acting to vibrate the respective pawls, one of said vibrating motors being controlled by one of said branch-circuits and the other by the other branch-circuit.

10. A recording-compass comprising, in combination, a compass-needle, a contact-arm turning with said compass-needle, a ring of contact points concentric with the pivot of said arm and with which points said arm is adapted to successively make contact, an indicating-instrument separate from the compass and having a traveling-member (c) indicating by its position the direction of the compass, a plurality of contact-points arranged adjacent to the path of movement of said traveling-member and connected severally with the first-mentioned contact-points, a pair of contact-pieces (c^2) mounted on said traveling-member and each adapted to make contact with said contact-points, said contact-pieces being spaced apart, an electrical circuit including as one pole said contact-arm and divided into two branches connected to the respective contact-pieces, two oppositely directed sets of ratchet-teeth being carried by said traveling-member, a pair of pawls acting on the respective sets of ratchet-teeth, a pair of motors acting to reciprocate the respective pawls whereby to move said traveling-member in the corresponding direction, a pair of secondary electric circuits in which said motors are respectively included, and a pair of relays mounted in the respective branch-circuits and acting to close the respective secondary circuits when the branch-circuits are closed.

11. A recording-compass comprising, in combination, a magnetic needle, a contact-arm mounted thereon, a star-wheel pivotally mounted on the end of said contact-arm, a ring of contact-pins surrounding said contact-arm and adapted to contact with the arms of said star-wheel, a pivot-point surmounting said contact-arm, a counterbalanced pivot-member resting on said pivot-point, a traveling-member, a line of contact-points arranged in the path of said traveling-member, a pair of insulated contact-pieces carried by said traveling-member and adapted to make contact with said line of contact-points, said contact-pieces being separated by a distance not greater than the distance between two successive contact-points, a plurality of electrical conductors connecting the points of said ring of contact-points to the corresponding points of said line of contact-points, an electric circuit connected at one end with said counter-weighted pivot member and having two branches which are connected to the respective contact-pieces, a pair of relays mounted in the respective branches, motor-mechanisms acting on said traveling-member to move it in one direction or the other, and a pair of secondary circuits arranged to be closed by the respective relays and acting on the respective motor-mechanisms to move said traveling-member respectively in one direction or the other.

In witness whereof we have hereunto set our hands this 16th day of June, 1908.

EDWIN SCHUETTE.
NICHOLAS DEDRICK.

Witnesses:
LOUIS SCHUETTE,
EDWARD LARSON.