

April 22, 1924.

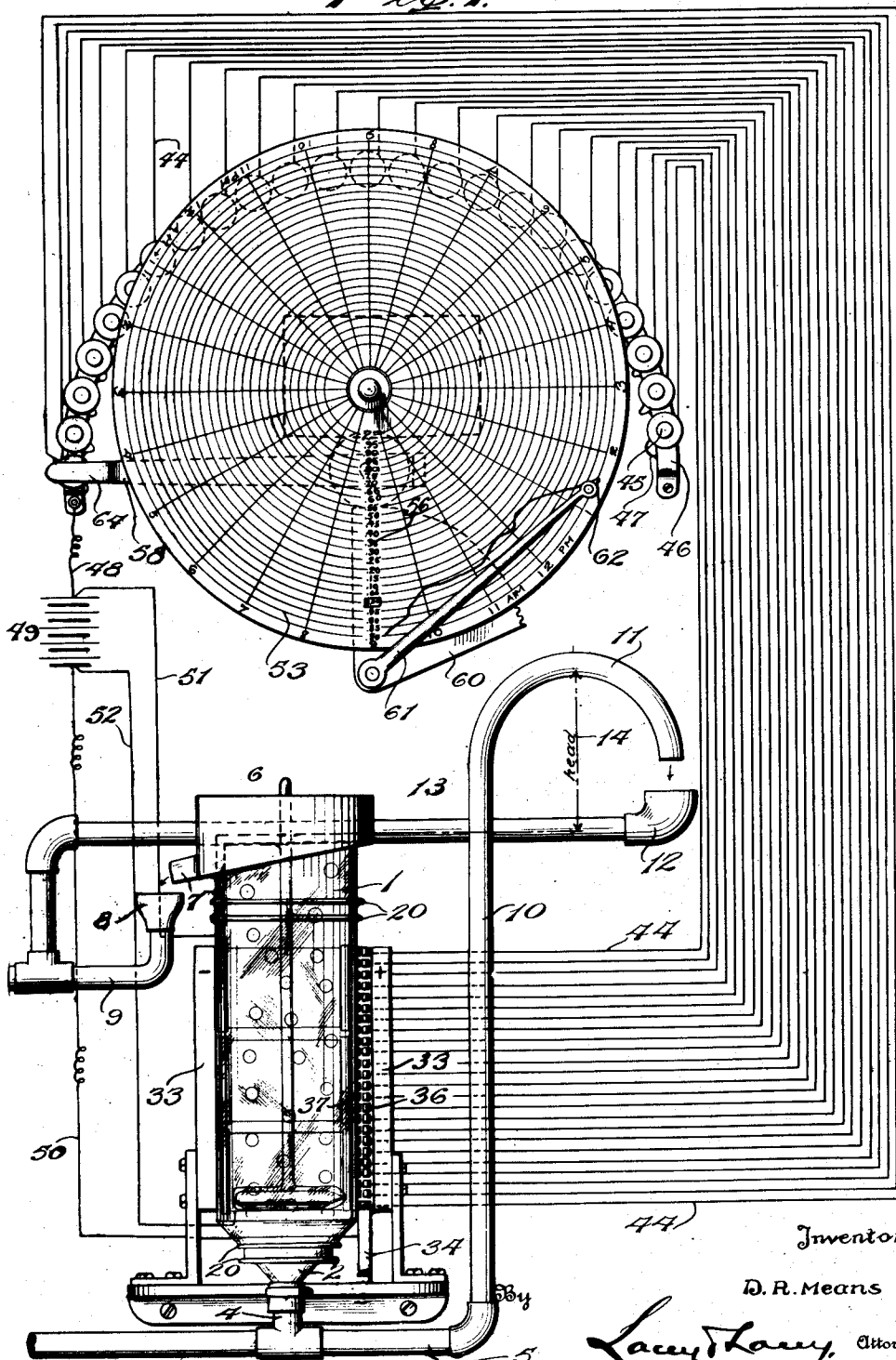
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D. R. MEANS
RECORDING HYDROMETER

Filed Nov. 8, 1922

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Fig. 1.



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Fig. 2.

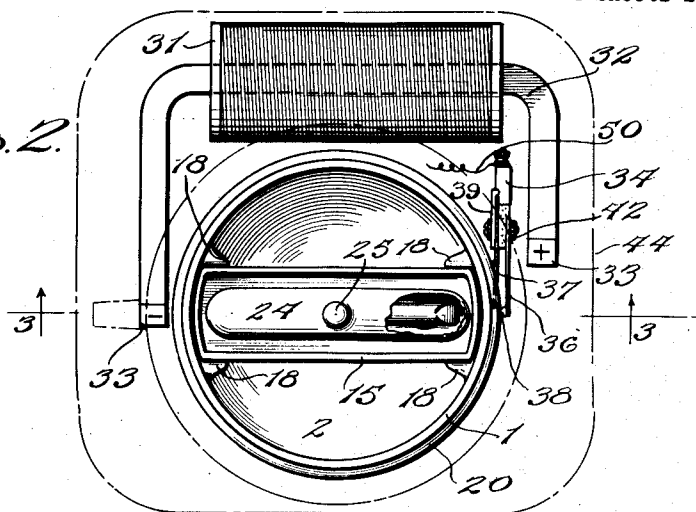
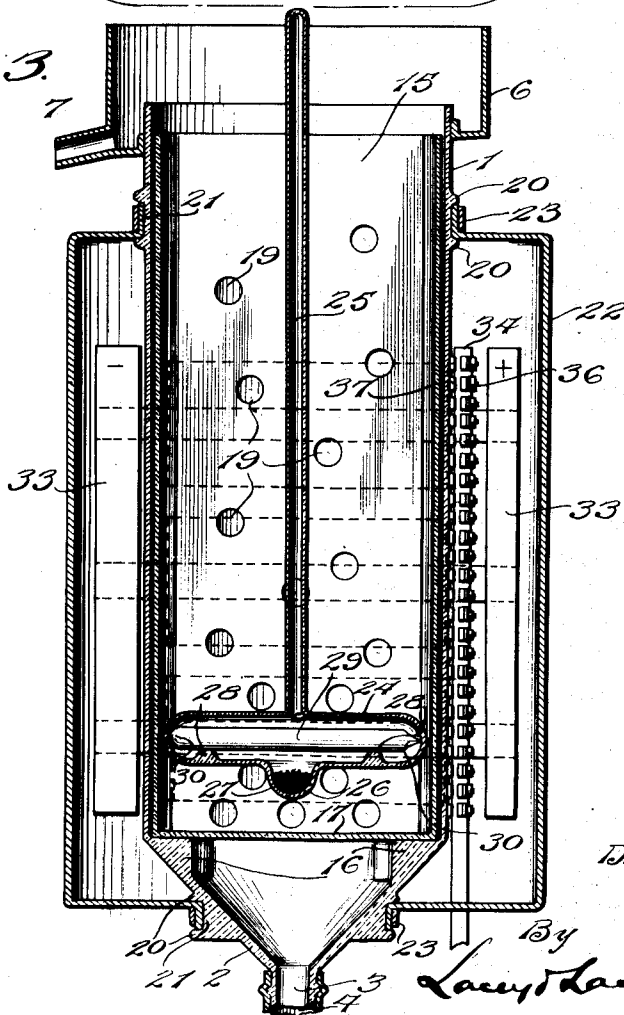


Fig. 3.



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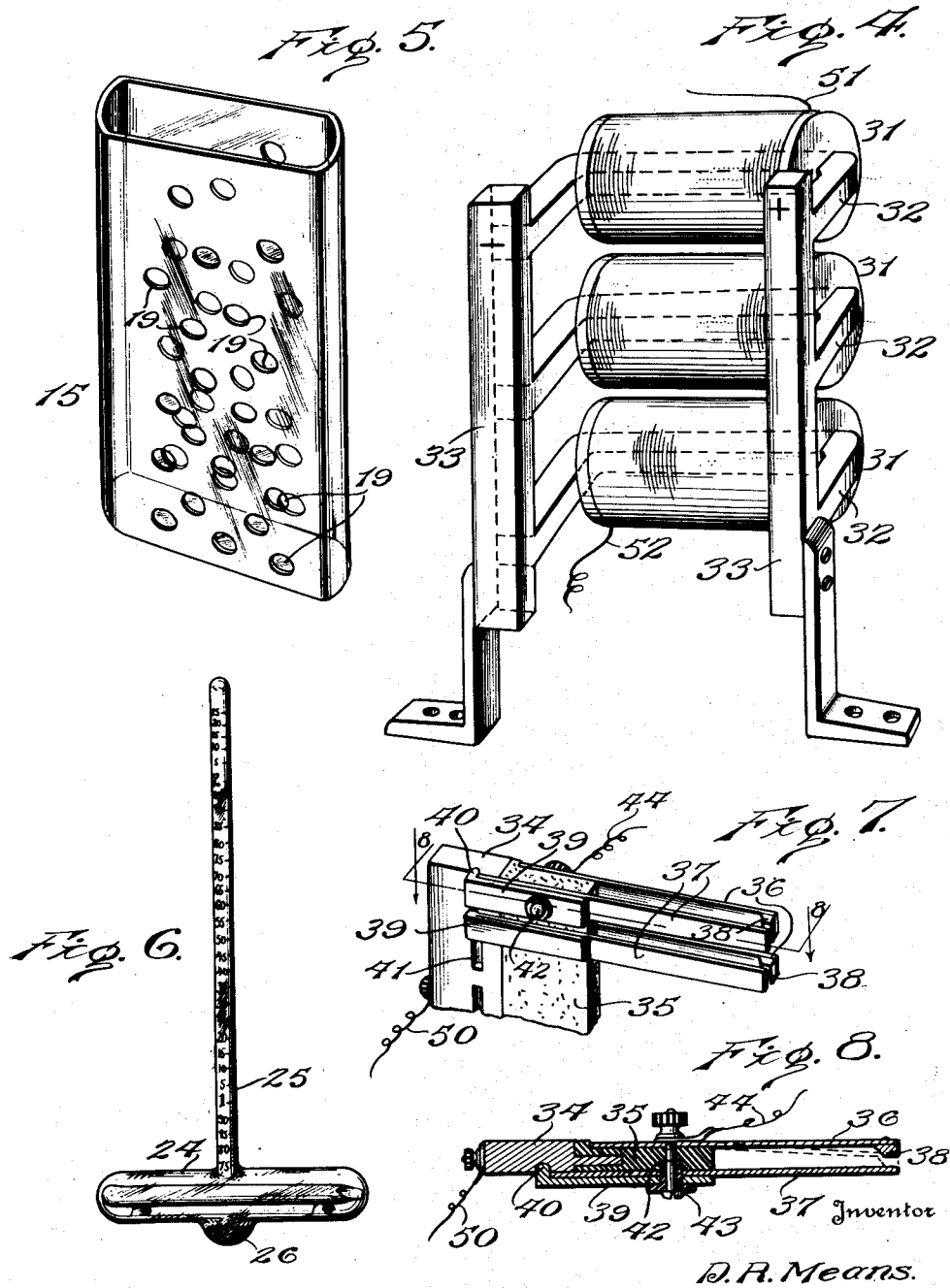
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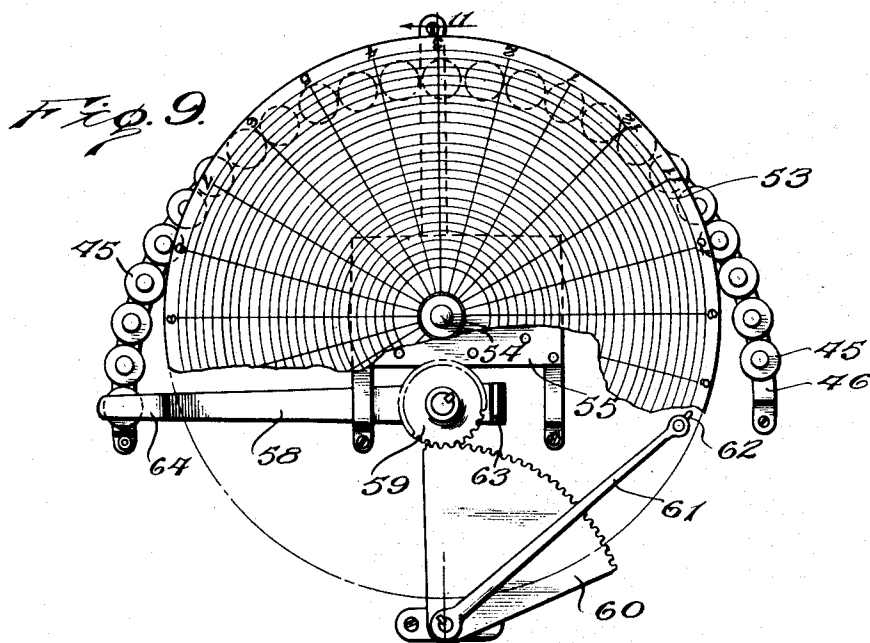
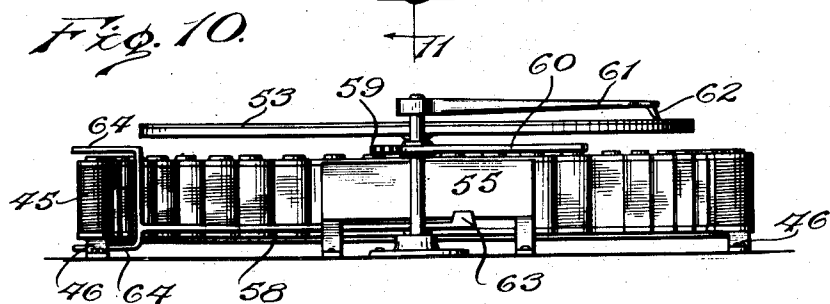
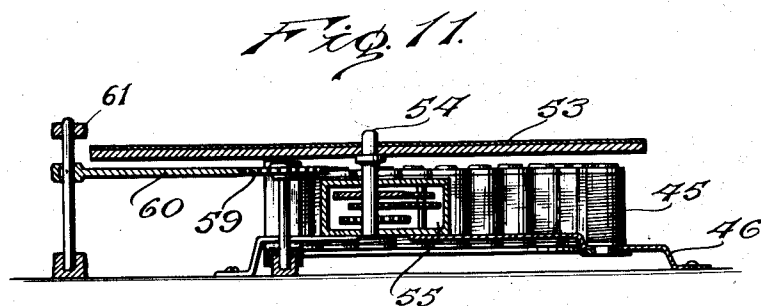
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RECORDING HYDROMETER

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4 Sheets-Sheet 4



Inventor

D. R. Means

By

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UNITED STATES PATENT OFFICE.

DWIGHT R. MEANS, OF KANSAS CITY, KANSAS.

RECORDING HYDROMETER.

Application filed November 8, 1922. Serial No. 598,702.

To all whom it may concern:

Be it known that I, DWIGHT R. MEANS, a citizen of the United States, residing at Kansas City, in the county of Wyandotte and State of Kansas, have invented certain new and useful Improvements in Recording Hydrometers, of which the following is a specification.

The primary object of this invention is to provide an apparatus whereby to obtain a continuous record of the specific gravity of flowing liquids, and a further object of the invention is to provide a hydrometer which will operate magnetically to close various electric connections and thereby record its movements. Other objects of the invention will appear incidentally in the course of the following description, and the invention resides in certain novel features which will be particularly pointed out in the appended claims.

In the accompanying drawings:—

Figure 1 is a diagram of an apparatus embodying the invention;

Fig. 2 is a plan view of the hydrometer, the enclosing casing being omitted in both Figs. 1 and 2;

Fig. 3 is a vertical section taken upon the line 3—3 of Fig. 2;

Fig. 4 is an enlarged detail perspective view of the group of magnets which are disposed adjacent the hydrometer cylinder;

Fig. 5 is a detail perspective view of the inner vessel;

Fig. 6 is a detail view of the hydrometer bulb and stem;

Fig. 7 is a detail perspective view of two circuit closers;

Fig. 8 is a detail section taken longitudinally through one of said circuit closers on the line 8—8 of Fig. 7;

Fig. 9 is a plan view, partly broken away, of the recording mechanism;

Fig. 10 is an edge elevation of the same, and

Fig. 11 is a section on the line 11—11 of Fig. 9.

In carrying out my invention, I employ an open-ended cylinder 1 which is disposed in an upright position and has a tapered lower end 2 terminating in an inlet spout 3 which is coupled in any convenient or preferred practical manner with a nozzle 4 leading laterally from a sample line 5. Upon the upper end of the cylinder 1 is mounted an overflow vessel 6 having a de-

livery spout 7 at one side which spout is disposed over a funnel 8 provided on the end of a return pipe 9. The sample line 5 has a vertical branch 10 disposed adjacent the cylinder 1, and this branch 10 extends above the cylinder and the vessel 6 and has a goose neck terminal 11 discharging into a receiver 12 which is connected by a pipe 13 with the return pipe 9, as shown. The liquid flows through the pipe 5 from the main body of liquid and part of it will rise through the nozzle 4 and spout 3 into the cylinder 1 and flow upwardly through said cylinder, eventually overflowing into the vessel 6 and returning through the pipe 9 to the main supply, as will be readily understood. The vertical branch 10 of the sample line will be large enough to carry all the liquid the sample line will deliver without building up a frictional head of any consequence, and it will be readily understood that the liquid in the cylinder 1 will be under a constant head, indicated by the line 14 in Fig. 1, as long as any liquid is flowing through the vertical branch. Any lifting effect caused by the flow of the liquid will be constant and can be corrected for in calibrating the instrument. To reduce the lifting effect of the liquid, an inner vessel 15 is provided, which vessel is oblong or in the form of an ellipse having flattened sides so that it will accommodate the hydrometer bulb and stem and prevent twisting or turning movement of the same. The lower end of the cylinder 1 is provided with shoulders 16 upon which the closed lower end 17 of the vessel 15 may rest, and ribs 18 are provided on the inner wall of the outer cylinder to maintain the inner vessel against twisting movement, as will be readily understood on reference to Fig. 2. Through the sides of the vessel 15 are formed openings 19 in any desired number so that the liquid will be admitted to the vessel and diffuse quickly around the hydrometer, while the current of the liquid will be held to the spaces between the flattened walls of the said inner vessel and the circular walls of the outer vessel. The outer cylinder 1 and the inner vessel 15 are of non-corrosive, non-magnetic material and will generally be of glass. The inner vessel is preferably made removable for ease in manufacturing and cleaning or repairing, but it may, of course, be made as a part of the outer vessel or cylinder. Upon the

outer surface of the outer vessel 1 are formed beads or ribs 20 disposed in pairs at the upper and lower ends of the vessel to receive the flanges 21 at the upper and lower ends of an outer casing or box 22 which is of moisture-proof material so as to protect the magnets and circuit closers from the action of any corrosive fumes which may be present. The outer casing or box is secured upon the vessel 1 by clamping bands or similar devices 23 fitted about the flanges 21 so as to secure them firmly between the beads 20, as will be readily understood.

The hydrometer comprises a bulb 24 and a stem 25 of glass, the bulb being provided with a pocket 26 on its under side to receive ballast, indicated at 27. The stem is calibrated in the usual manner and the stem and bulb are placed within the inner vessel 15 so as to rise or fall freely therein according to the density of the liquid in the usual manner of hydrometers. The bulb is provided with internal lugs 28 constituting supports for a soft iron core 29 which not only serves as an additional ballast for the hydrometer but also co-operates with magnets, presently mentioned, to establish a flow of magnetic flux which will, in turn, close circuit closers as the hydrometer rises or falls. One end of the core 29 is tapered or wedge-shaped, as shown at 30, so as to concentrate the flux into a horizontal plane, while the opposite end of the core is blunt, this construction minimizing the magnetic resistance through the core. At one side of the cylinder 1, I provide electromagnets 31, three being shown in the present instance. These magnets are supported upon cores or armatures 32 which are formed integral with or rigidly secured to pole pieces 33 disposed at opposite sides of the cylinder 1, as shown most clearly in Fig. 2. The magnets are wired so that like poles are in the same direction and they are connected in parallel so that the pole pieces 33 are continuous poles of opposite polarity. Obviously as the hydrometer bulb rises and falls, the core 29 will be carried vertically between the pole pieces 33, and whatever the position of the said core 29, the permeability of the same will be so much greater than any other path between the pole pieces that there will be a heavy flow of magnetic flux through the core. This flow of magnetic flux is utilized to close circuit closers and thereby energize magnets forming a part of the recording apparatus so that a recording member will be actuated, as will presently more fully appear.

Adjacent the cylinder 1 is a standard or frame member 34 which is utilized as an electric conductor but must be non-magnetic. This frame member 34 has secured to it a strip of insulating material 35 and at opposite sides of said insulating strip are circuit-closing members 36 and 37. These circuit-closing members are interposed between the positive pole piece 33 and the end of the core 29, as shown most clearly in Fig. 2, and the member 37 is disposed nearer the side of the cylinder 1 and, therefore, nearer the core. The said member 37 is a leaf spring which is of some material, such as brass, which is a conductor of electricity but is non-magnetic, while the member 36 is a steel spring and has secured to its free end on the side facing the spring 37, a soft iron weight 38. The spring 36 terminates against the side of the insulating strip 35 but the spring 37 extends beyond the said strip so as to bear against the frame member 34 and it may be further connected with and held to said frame member by a cap piece 39 having a lug 40 engaging a notch or groove 41 in the side of the frame member. A binding post 42 is fitted through the strip 35 and both circuit-closing members but is insulated from the spring 37 by a bushing 43, as clearly shown in Fig. 8. A conductor 44 is secured against the spring 36 by the binding post 42 so as to make electric contact therewith, and one of said conductors 44 is provided for each circuit closer so as to connect them, respectively, with electromagnets forming a part of the recording mechanism. It will now be readily understood that the circuit closers 36, 37 are provided in any desired number according to the size or capacity of the apparatus and extend in a vertical series adjacent the side of the cylinder 1. When the core 29 is alined with any one of the circuit closers, the flow of magnetic flux through the core will act upon the soft iron block or weight 38 to draw the same against the non-magnetic spring 37 and thereby close the electric circuit so that the corresponding magnet 45 of the recorder will be energized. As soon as the movement of the hydrometer carries the core 29 beyond the range of the circuit closer, the magnetic attraction will be destroyed and the weight or block 38 will be carried from the spring 37 by the resiliency of the steel spring 36 so that the electric circuit will be broken.

The electromagnets 45 are provided preferably in an arcuate series, as shown in Figs. 1 and 9, and they are mounted upon a frame 46 which is an electric conductor but is non-magnetic, as a brass plate or rail. Each magnet 45 is connected by a conductor 44 with one of the circuit closers and the opposite end of the magnet wiring is grounded to the frame 46 by a wire 47. A ground wire 48 establishes electric connection between one end of the frame 46 and one side of the battery 49 or other source of electric energy, while the opposite side of said source of energy is connected by a ground wire or conductor 50 with the frame member 34, thereby establishing the circuit through the

several magnets of the recording mechanism. Conductors 51 and 52 lead from opposite sides of the source of energy 49 to the opposite ends of the magnets 31 so as to energize the said magnets.

The recording mechanism includes a chart 53 preferably of circular form carried by any convenient form of table which is secured upon the arbor 54 of a clock mechanism 55 which is shown in a conventional manner only. This chart is divided by radial lines into divisions corresponding to periods of time and, preferably, these divisions will correspond to the twenty-four hours of a day. There is also marked upon the chart a scale 56 corresponding to the calibrations of the hydrometer stem, and this scale is spaced according to circular lines 57 marked upon the chart. The armature of the magnets 45 is in the form of a pivoted arm 58, upon the pivot of which is secured a pinion 59 meshing with a segmental gear 60, the pivot of which carries a pen arm 61 having a marker 62 at its free end adapted to travel over the chart 53, as will be readily understood upon reference to Figs. 9 and 10. To insure steadiness in the movement of the armature 58, a counterbalance weight 63 is provided upon the inner end of the same, while the outer end thereof is formed into a yoke 64 having its side members disposed at opposite ends of the magnets 45. When any one magnet 45, therefore, is energized, it will attract the armature 58 which, in swinging into axial alinement with the said magnet, will rotate the pinion 59 and thereby rock the segmental gear 60 and the movement will be transmitted through the pivot of said gear to the pen arm 61 so that the marker 62 will be vibrated or oscillated and will make a jog or curve extending laterally from the regular curved line which it would make if remaining at rest. It will be understood that the chart 53 is rotated constantly by the clock mechanism 55 and, if there is no variation in the position of the hydrometer bulb, the marker will simply make a circular line upon the chart. Should the liquid passing through the hydrometer vessel or container increase in density or decrease in density, a corresponding movement of the hydrometer bulb will be effected and, consequently, the previously closed electric circuit will be broken and a different circuit established through a different magnet 45 so that the armature 58 will be actuated and, consequently, a break in the uniform record line will be made. The record will be permanent and will show that at a certain period of the day there was a variation, either an increase or a decrease, in the density of the liquid.

It will be readily noted that I have provided an exceedingly simple and compact ap-

paratus by the use of which a record of the specific gravity of flowing liquid will be automatically made. The apparatus will give a continuous record of the specific gravity of liquids flowing from concentrators, condensers, or stills, or of acids flowing in the process of manufacture, as, for example, sulphuric acid flowing from the chambers in the chamber process. The hydrometer can be read in the customary manner and by comparing this reading with the recorder, there will be an accurate and quick check on the accuracy of the recorder. If re-calibration is necessary at any time, the parts can be easily adjusted, the ballast may be changed in the hydrometer, the circuit closers may be differently spaced, or the magnets in the recorder may be moved so that the instrument can be changed to cover an entirely different range of specific gravities than that for which it was first set. The instrument is, therefore, easily convertible, and, if no longer needed at one point in the plant, it can be easily re-adjusted for another use. As all the exposed parts are preferably made of glass, it may be used on corrosive liquids so that it is available for use with acids, alkalies, and any other liquid which will attack metals, except the rare metals, such as platinum. The device has no packing joints to corrode or leak, or to give other form of trouble, and the hydrometer and recorder may be at any desired distance from each other. If desired, two recorders may be operated at different locations from the same hydrometer so that the operator or experimenter may have the benefit of one recorder while the other may be located in the office of the plant foreman or other official responsible for the operation.

Having thus described the invention, what is claimed as new is:

1. The combination of a hydrometer, a recorder, a plurality of electromagnets controlling the movement of the marking member of the recorder, and means carried by the hydrometer for establishing a flow of magnetic flux through circuit closers controlling the electromagnets of the recorder.

2. The combination of a hydrometer, a magnet disposed adjacent the hydrometer, fixed pole pieces connected with the magnet and disposed at opposite sides of the hydrometer, a core carried by the hydrometer and establishing a flow of magnetic flux between the said pole pieces, a recorder, a plurality of magnets controlling the recorder, and a plurality of circuit closers connected with the respective magnets and disposed in the path of the flow of magnetic flux whereby said flow will operate said circuit closers to make or break circuits through the respective magnets of the recorder.

3. The combination of a hydrometer, fixed

pole pieces at opposite sides of the hydrometer, a magnetic core carried by the hydrometer and disposed between said pole pieces whereby to establish a flow of magnetic flux
 5 between the same, a recorder including a plurality of electromagnets, and circuit closers each connected with one of said magnets and comprising a non-magnetic member and a magnetic member adapted to be
 10 drawn to the non-magnetic member by the said flow of magnetic flux.

4. The combination of a hydrometer, fixed pole pieces disposed at opposite sides of the hydrometer, a core carried by the hydrometer and disposed between said pole pieces whereby to establish a flow of magnetic flux between the same, a recorder including a plurality of electromagnets, and a plurality of circuit closers interposed between one of said pole pieces and the said core and each controlling one of said electromagnets, said circuit closers each comprising a resilient member having a soft iron weight on one end and a non-magnetic member disposed between said core and said soft iron weight whereby the flow of magnetic flux will draw the said weight against said non-magnetic member and close the circuit.

5. The combination of a hydrometer, fixed pole pieces disposed at opposite sides of the hydrometer, a magnetic core carried by the hydrometer and disposed between said pole pieces whereby to establish a flow of magnetic flux between the same, a recorder including a series of electromagnets, and a series of circuit closers disposed between one of said pole pieces and the said magnetic core and each controlling one of the said electromagnets, said circuit closers each including a frame member of conducting material, an insulating strip secured to said frame member, a leaf spring secured upon the said insulating strip, a second leaf spring of non-magnetic material secured against the opposite side of said insulating strip and overlapping the frame member, a soft iron block carried by the free end of the first-mentioned spring, and a cap piece overlapping the end of the non-magnetic spring and engaged with the frame member.

6. The combination of a hydrometer, a recorder including an arcuate series of electro-

magnets, a chart continuously rotatable adjacent said magnets, a swinging armature for the said magnets, a marker operating on said chart and operatively connected with the said armature, a plurality of circuit closers disposed adjacent the hydrometer and each controlling one of said electromagnets, fixed pole pieces disposed at opposite sides of the hydrometer with the circuit closers between the hydrometer and one of said pole pieces, and a magnetic core carried by the hydrometer between the pole pieces and establishing a flow of magnetic flux between the pole pieces and through the circuit closer aligned with the core whereby to close said circuit closer.

7. In a hydrometer, the combination of a container, an inner vessel having flattened sides and provided with openings through said sides, a hydrometer bulb and stem disposed freely within the said vessel, a recorder, and means whereby the recorder will be actuated by the rise and fall of the hydrometer bulb and stem.

8. In a hydrometer, the combination of a container, a hydrometer bulb and stem having free movement within the container, a sample line connected with the lower end of the container to admit liquid thereto, an overflow vessel at the upper end of the container, a return pipe receiving the discharge from said vessel, a vertical branch rising from the sample line to a point above the said overflow vessel, and a return line receiving the discharge from said branch.

9. The combination with a hydrometer, and a recorder, of means for establishing a magnetic flow across the hydrometer, and means whereby said magnetic flow will actuate the recorder.

10. The combination of a container, means for admitting a liquid through the bottom of the container, an inner vessel within the container having openings through its sides and spaced from the wall of the container, a hydrometer bulb and stem free in said vessel, a recorder, and means whereby the recorder will be actuated by the rise and fall of the hydrometer bulb and stem.

In testimony whereof I affix my signature.

DWIGHT R. MEANS. [L. S.]