W. E. BUTLER.
TELEPHONE RINGING APPARATUS.
APPLICATION FILED APR. 30, 1910.

1,016,546.

Patented Feb. 6, 1912.

4 SHEETS—SHEET 1.

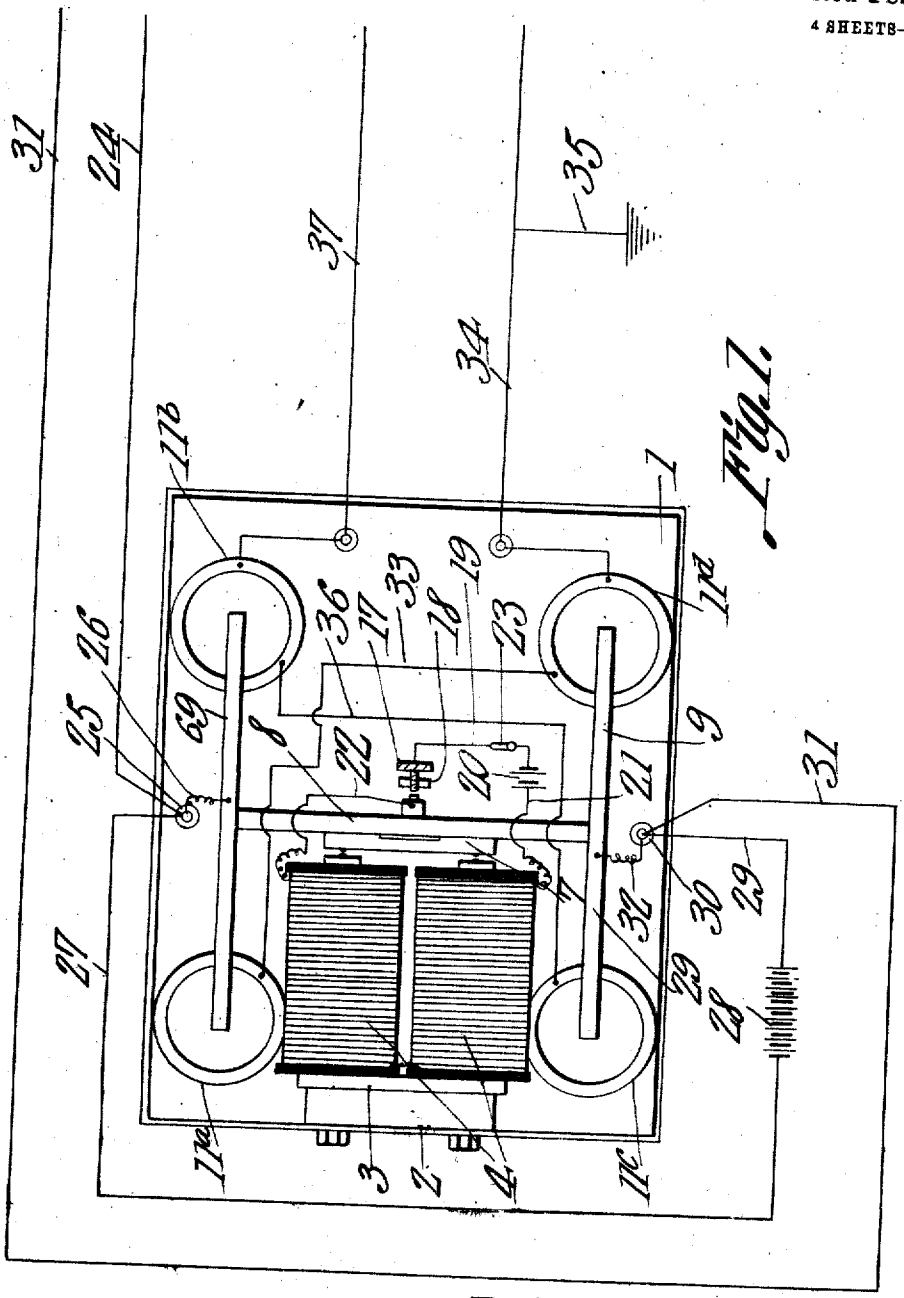

Fig. 1.

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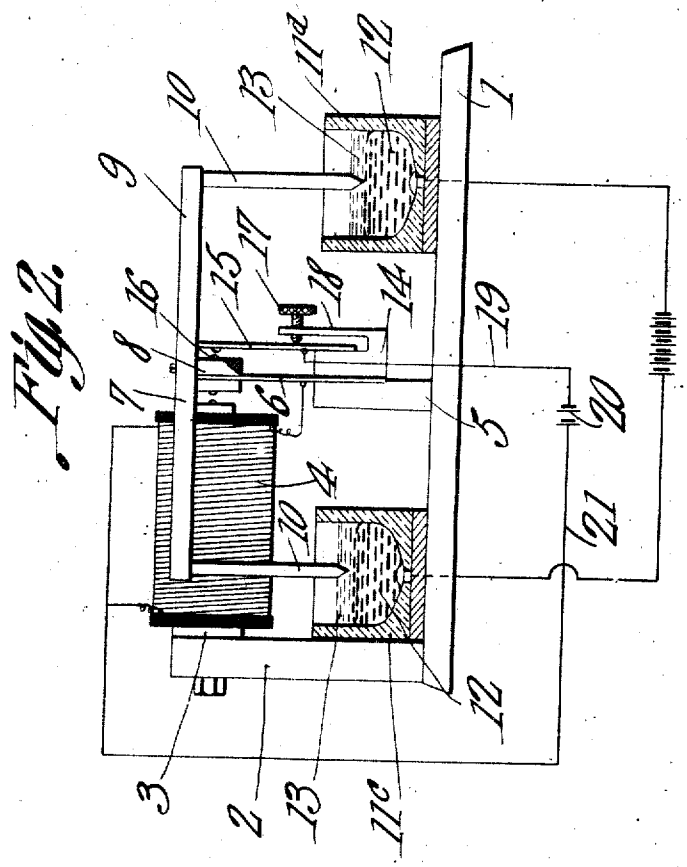
4 SHEETS—SHEET 2.

Fig 2.



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4 SHEETS—SHEET 3.

Fig. 3.

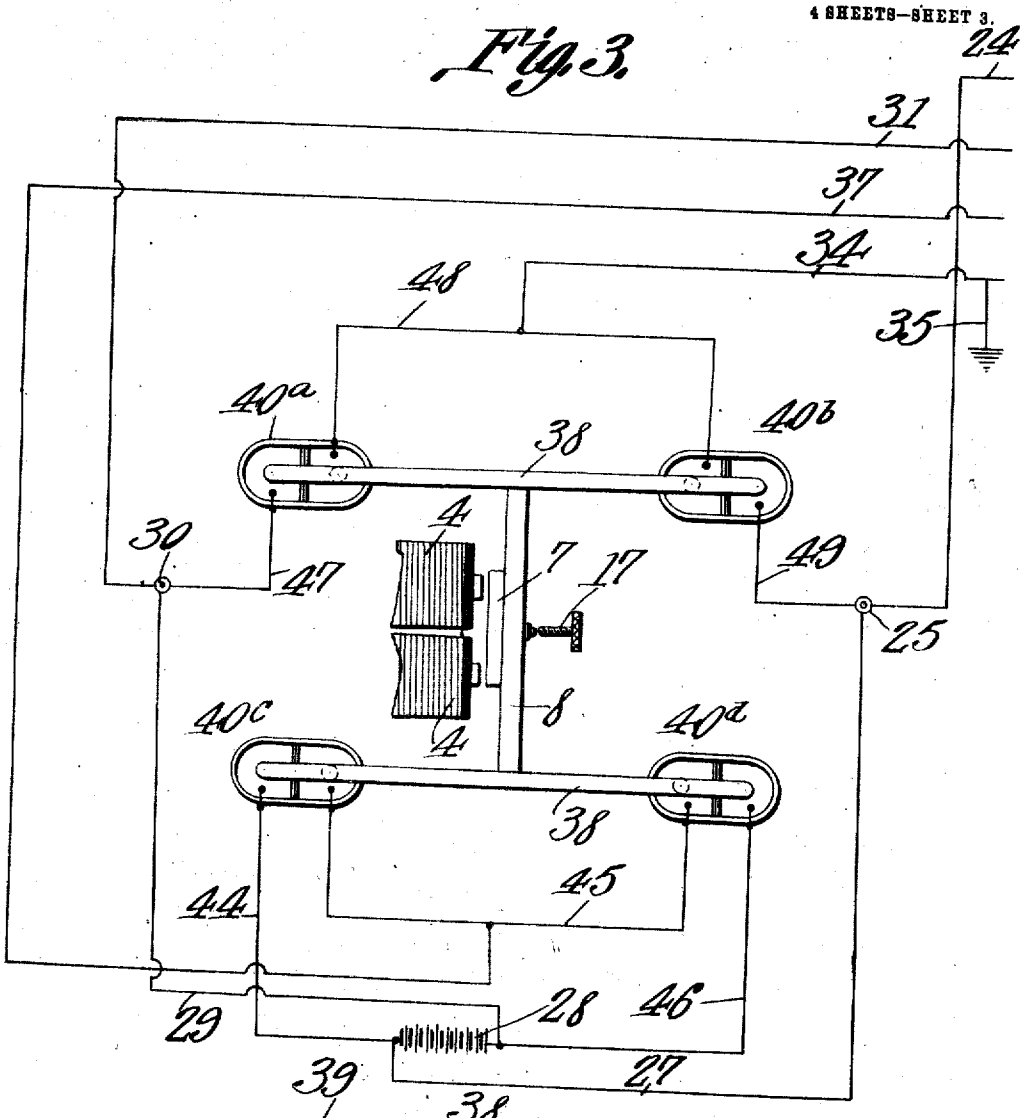
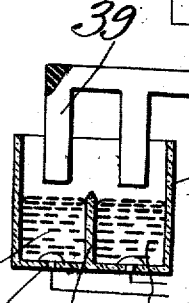


Fig. 4.



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4 SHEETS—SHEET 4

Fig. 5.

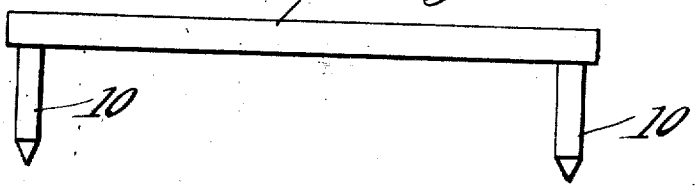


Fig. 6.

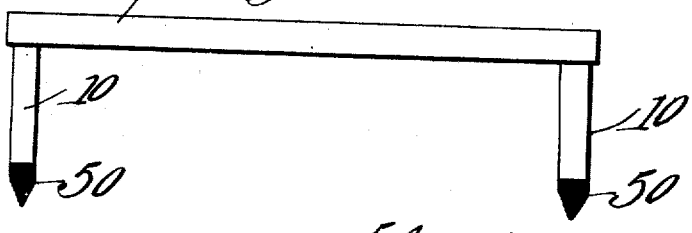


Fig. 7.

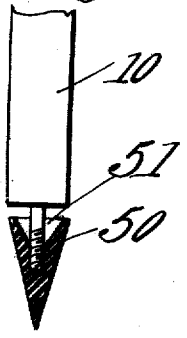
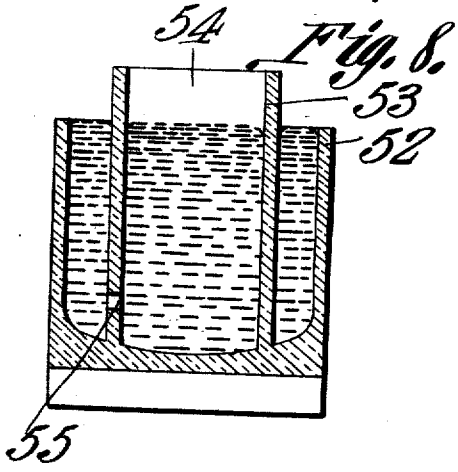


Fig. 8.



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UNITED STATES PATENT OFFICE.

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TELEPHONE RINGING APPARATUS.

1,016,546. Specification of Letters Patent. Patented Feb. 6, 1912.

Application filed April 30, 1910. Serial No. 558,597.

To all whom it may concern:

Be it known that I, WILLIAM E. BUTLER, a citizen of the United States, residing at David City, in the county of Butler and State of Nebraska, have invented a new and useful Telephone Ringing Apparatus, of which the following is a specification.

This invention has reference to improvements in telephone ringing apparatus and is designed more particularly for use in connection with telephone switch boards for the production of ringing currents of various characters whereby selective signaling is obtained.

The present invention relates more particularly to the generator of such currents whereby positive and sharp makes and breaks of a circuit charged by a generator of constant currents are obtained to cause the generation of alternating or pulsating currents which may be utilized for selective signaling.

The invention will be best understood from a consideration of the following description taken in connection with the accompanying drawings forming a part of this specification, in which drawings,

Figure 1 is a plan view of a generating apparatus embodying the present invention. Fig. 2 is a side elevation, with parts in section, of the structure of Fig. 1. Fig. 3 is a plan view of a somewhat different form of apparatus than that shown in Fig. 1. Fig. 4 is a detail view of a portion of the apparatus of Fig. 3. Figs. 5, 6 and 7 are detail views of different forms of circuit making and breaking devices. Fig. 8 is a sectional view of a mercury cup showing a means of preventing over filling of the cup.

Referring to Fig. 1 there is shown a base or support 1, which however is only indicative and may be varied as desired or even omitted, since the parts carried by the base may be carried by other structures. Fast on the base 1 is an upright 2 to which may be secured the yoke 3 of a horseshoe electromagnet 4, this form of electromagnet being the specific form illustrated in the drawings, but it will be understood that other forms of magnets may be used if desired. On the base there is also erected a post 5 to which is secured a spring arm 6 projecting above the post and carrying at its upper free end an armature 7 in operative relation to the polar ends of the magnet 4. The spring arm 6 also carries a strip 8 extending across the base parallel therewith and at the ends carrying arms 9 about midway the length of the latter, these arms being substantially at right angles to the length of the strip 8.

The ends of the arms 9 carry downwardly extending fingers 10. The strip 8 is made of insulating material and the arms 9 may be made of conducting material, or the strip 8 and the arms 9 may be made of conducting material and the arms 9 may be suitably insulated from the strip 8. Each finger 10 at the lower end enters a cup 11 made either of iron or of insulating material such as glass or porcelain and each cup contains a quantity of mercury indicated at 12, the end of the finger 10 entering the cup being normally slightly above the upper surface of the mercury 12, and overlying the latter is a layer 13 of oil or other suitable non-conducting material adapted to prevent sparking. In Fig. 1 four cups 11 are shown and for convenience of description these cups will be designated 11^a, 11^b, 11^c, and 11^d.

Carried by the standard 5 is a block 14 to which is secured a contact spring 15 in the path of a contact 16 on the cross piece 8. The spring 15 is controlled by a back stop screw 17 on a bracket 18 carried by the block 14. Extending from the contact 15 is a conductor 19 leading to a battery 20 or other suitable source of current and from this battery leads a conductor 21 to the electromagnet 4 and from the latter there leads a conductor 22 to the contact 16 carried by the strip 8. The magnet 4 with its armature 7 and the contacts 15 and 16 and the circuit included therein constitute a rheotome which, so long as the circuit of the battery 20 is closed through the magnet 4 by way of the rheotome, as by a suitable switch 23 in the conductor 19 or elsewhere in the circuit, will cause a vibratory movement of the strip 8, the spring 6 tending to maintain the contacts 15 and 16 in closed relation and the attractive force of the magnet 4 tending to open the circuit at these contacts. In this manner a rapid vibratory movement of the strip 8 is brought about, the rate of vibration depending upon the proportions of the parts. Each time the strip 8 is moved toward the magnet 4 the fingers 10 at the magnet end of the arms 9 dip in the mercury in the cups 11^a and 11^c and when the strip 8 is

returned by the spring 6 to its position wherein the contacts 15 and 16 are brought together again the fingers 10 at the other ends of the arms 9 dip into the mercury in the cups 11^b and 11^d.

In the particular arrangement shown in Fig. 1 there is a line wire 24 which may lead to the switch board and this line wire is connected to a binding post 25 which in turn is connected by a flexible conductor 26 to the arm 9 at the corresponding ends of the strip 8. The binding post 25 is also connected by a conductor 27 to one side of a battery 28 or other suitable source of electric energy. The other side of this battery is connected by a conductor 29 to a binding post 30 on the other side of the base from the binding post 25 and this binding post is connected by a conductor 31 leading also to the switch board. The binding post 30 is also connected by a flexible conductor 32 to the other arm 9. The mercury cup 11^a is connected by a conductor 33 to the mercury cup 11^d and the latter connected by a conductor 34 to the switch board and this conductor may also be connected to ground by a branch conductor 35. The cups 11^b and 11^c are connected together by a conductor 36 while the cup 11^b is connected by a conductor 37 to the switch board. The battery 28 or other source of constant current is of sufficient power to actuate the ringing devices designed to be energized from the central station. The battery 20 need only be powerful enough to operate the rheotome on the base 1.

In Fig. 2 the parts are shown in the intermediate position, that is with both fingers 10 at the two ends of each arm 9 out of engagement with the mercury 12, but in operation the fingers 10 at the corresponding ends of the arms 9 are at one instant in the mercury in the cup 11^a and 11^c and the next instant the other pair of fingers are in the cups 11^b and 11^d. Let it be assumed that the fingers at the magnet ends of the arms 9 are dipping in the mercury in the cups 11^a and 11^c then the circuit may be traced as follows: from the battery 28 by way of the conductor 27 to the binding post 25 then by way of the conductor 26 to the corresponding arm 9 and from the latter through the finger 10 then dipping in the mercury in the cup 11^a to the latter, then by way of the conductor 33 to the cup 11^d, and thence by the conductor 34 to the switch board or to ground by the conductor 35, the circuit returning by way of the conductor 37 to the mercury cups 11^b and 11^c, these two cups being connected by the conductor 36, thence to the other arm 9 by the finger 10 dipping in the mercury in the cup 11^c thence by way of the conductor 32 to the binding post 30 and returning to the battery 28 by way of the conductor 29. If it be assumed that a positive impulse is directed from the batter; 28 by way of the conductor 27 then a positive impulse will pass by way of the conductor 24 and the return circuit will be by way of the conductor 37. At the next instant the fingers dipping in the cups 11^a and 11^c have been removed from these cups and the fingers entering the cups 11^b and 11^d are moved into the mercury therein. There is then established a circuit from the battery 28 by way of the conductor 27 to the binding post 25 and by way of the conductor 26 to the arm 9 but in this instance the circuit is completed to the cup 11^b and the positive impulse passes to the switch board by way of the conductor 37, the circuit returning by way of the ground 35 and the conductor 34 or solely by the conductor 34 to the cup 11^d thence by the finger 10 to the corresponding arm 9 and thence by way of the conductor 32 to the binding post 30 and finally by way of the conductor 29 back to the battery 28. It will be observed that the conductor 27 is connected directly to the conductor 24 and that the conductor 29 is connected directly to the conductor 31 so that there is a constant and unchanging difference of potential between the conductors 24 and 31 and therefore constant current may be passed to the switch board through these conductors, the outgoing or positive side being assumed to be by the conductor 24 and the return side of the circuit by the conductor 31. Constant current may be transmitted through the conductors 24 and 31 to suitable ringing devices controlled from the switch board in the usual manner while alternating impulses will traverse the conductors 34 and 37 or the ground 35. By the utilization of mercury contacts it is found in practice that the impulses are sharp and clear cut with resultant increase in efficiency and a sharpness of response from the signal devices not obtainable with currents as usually generated

In the structure shown in Fig. 3, which figure is largely diagrammatic, the general arrangement is such as illustrated in Fig. 1, but the arms 9 are replaced by other arms 38 which are not designed to carry any current. These arms 38 terminate in downwardly extended pairs of fingers 39 best shown in Fig. 4. Instead of the mercury cups 11 there are provided mercury cups 40 either of insulating material or lined with insulating material. In the particular structure shown these cups are elongated and are each provided with a central partition 41 preferably brought to a comparatively sharp edge on the upper end and of less height than the walls of the cup. The partition 41 divides each cup 40 into two compartments designed to receive a sufficient quantity of mercury so that the highest point of each body of mercury will be sub-

stantially level with or slightly above the top of the partition 41, but because of the characteristic of mercury to depress at the edges where engaging certain substances, the edges of the mercury where engaging the partition 41 will not be quite to the top of such partition. It is not mandatory that these compartments be so completely filled with mercury, but they should be sufficiently filled so that when a displacing body is introduced into the compartments the rise of the mercury due thereto will cause an overflow at the partition 41 so that the two mercury bodies are brought into electrical coalition. It is the office of the fingers 39, which are made of insulating material in the particular construction shown, to enter the bodies of mercury in the compartments of each cup 40, these mercury bodies being indicated at 42, and to cause such a rise of the mercury by displacement as to unite the two mercury bodies over the edge of the partition 41. The rocking movement of the arms 38 under the action of the magnet 4 is sufficient to cause this action of the fingers 39. Since the cups 40 may be made of insulating material, electrical connection with the mercury contents of the cups may be had through conducting studs 43 passing through the walls of the cups to the interior thereof. Since the cups are in effect twin cups each cup constitutes terminals of electric conductors to be bridged by the overflow of the mercury above the partition 41. This necessitates a somewhat different arrangement of the conductors than in the form shown in Fig. 1. The battery 28 is connected to the conductors 27 and 29 and by way of the latter to the conductors 24 and 31 respectively in the manner illustrated in Fig. 1. One end of the battery 28 is connected by a conductor 44 to one side of one of the cups 40, which cups are four in number and in Fig. 3 are designated by the numerals 40^a, 40^b, 40^c, and 40^d as in Fig. 1 for the cups 11. The conductor 44 is therefore connected to one compartment of the cup 40^c while the other compartment of this same cup is connected by a conductor 45 to one compartment of the cup 40^d and the other compartment of this last named cup is connected by a conductor 46 to the other side of the battery 28. The conductor 37 leading to the switch board is connected to the conductor 45. Branched off from the binding post to which the conductors 29 and 31 are connected is a conductor 47 leading to one compartment of the cup 40^a while the other compartment of this same cup is connected by a conductor 48 to one compartment of the cup 40^b. The binding post connecting the conductors 27 and 24 is connected by a conductor 49 to one compartment of the cup 40^b, this being the other compartment than the one connected to the conductor 48 and the latter conductor is coupled to the conductor 34 leading to the switchboard.

With the arrangement shown in Fig. 3 let it be assumed that the magnet ends of the arms 38 are depressed so that electrical connection is had through the cups 40^a and 40^c, then the circuit may be traced as follows. From the battery 28 the current will flow by way of the conductor 44 to the cup 40^c and from the latter by way of the conductor 45 to the conductor 37, returning by way of the ground 35 or the conductor 34 to the conductor 48 thence through the cup 40^a and finally by way of the conductors 47 and 29 back to the battery 28. If the arms 38 be rocked in the other direction, then the circuit may be traced from the battery 28 by way of the conductor 46 to the cup 40^d, thence by way of the conductor 45 to the conductor 37, this being assumed to be a negative impulse, while the circuit is completed through the conductor 34, conductor 48, cup 40^b, conductors 49 and 27 back to the battery 28.

In the arrangement shown in Fig. 3 constant current will flow from the battery 28 by way of the conductors 27 and 24 and by way of the conductors 29 and 31 as in Fig. 1.

In Fig. 5 there is shown an arm 9 with fingers 10 where the arm and fingers are both made of conducting material so that they all may be included in the circuit. In Fig. 6 the fingers 10 are provided with insulating extremities 50 which may at all times dip in the mercury and it is only when the fingers 10 reach the mercury surface that the circuit is completed. Or this same construction may be utilized for displacement purposes where for mechanical reasons it is preferred to make the arm 9 and fingers 10, or the latter, of metal and it is not desirable that the current pass through these fingers. Again the point of the fingers may be made of insulating material as indicated at 51 in Fig. 7 where the points are conical and at their upper or facing ends are each formed with a cavity 51 designed to receive a small quantity of mercury when the finger is first dipped into the mass of mercury and this mercury will maintain constant contact with the stem holding the insulating point 50 so that when the finger is finally dipped into the mercury there is already good contact between the mercury in the cup end 51 and the stem supporting the same while the circuit is readily completed by the coalescence of the mercury within the cup end 51 and that within the main cup 11.

In Fig. 8 there is shown a cup which may only be filled to a certain height. In this structure the cup body is shown at 52 and may be considered as cylindrical or any other suitable shape. This cup may be made of insulating material or of iron or

of other suitable material as may be desired. Within the cup 52 in concentric relation to the walls thereof is another wall 53 inclosing a compartment 54 and a passage 55 through the wall 53 near the bottom thereof serves as a means of communication between the exterior chamber within the cup 52 and the chamber 54 within the wall 53. With this cup mercury is poured into the exterior chamber and finds its way into the interior chamber through the passage 53 but may only rise within the interior chamber to the level of the walls of the cup 52, which walls are of less height than the wall or partition 53. By this means the mercury within the compartment 53 which compartment is assumed to be entered by a finger 10 or 39, may never reach a greater height than the outer walls of the cup 52 so that in pouring mercury within the cup no adjustment further than the initial adjustment is required for the fingers 10 or 39 as the case may be.

In the operation of the apparatus the magnet 4 and arms 9 controlled thereby constitute an engine or motor which is assumed to be active whenever it is desirable to transmit current, and under ordinary circumstances this motor will be constantly active, making and breaking the circuit at the mercury cups and only consuming the small amount of current necessary to keep it in operation. The ringing circuits only become complete when closed by the operator at the switch board in the usual manner.

What is claimed is:—

1. In a system such as described, a mercury terminal cup provided with a division wall dividing the cup into adjacent mercury compartments; and displacement means, at times out of contact with the mercury, but adapted to enter the mercury, within the cup, for causing the overflow of the mercury with relation to the division wall.

2. In a system such as described, a source of direct current; a plurality of mercury cups diagonally connected in pairs; means for alternately coupling opposite ones of the cups of each pair to the respective terminals of said source of current; and a source of current, independent of the first named source, for actuating said means.

3. In a system such as described, a mercury cup having a compartment for mercury within and spaced from the walls of the cup and communicating with the space between the compartment and the walls of the cup, said compartment being of greater height than the walls of the cup.

4. In a system such as described, a mercury cup; a conducting finger adapted to dip into said cup; and an insulating element upon the finger, having a cavity adapted to receive the mercury from the cup.

In testimony that I claim the foregoing as my own, I have hereto affixed my signature in the presence of two witnesses.

WILLIAM E. BUTLER.

Witnesses:
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C. J. HARMER.