June 26, 1928. 1,675,205

K. BAYERLE

TILTABLE MULTIPLE CONTACT SWITCH

Filed March 6, 1925 3 Sheets-Sheet 1

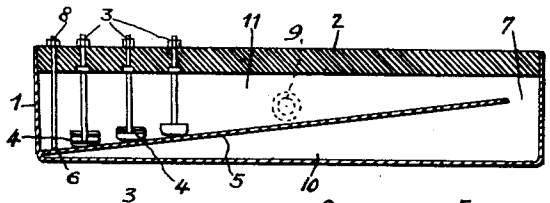


Fig. 1.

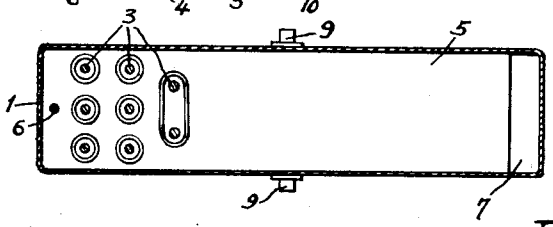


Fig. 2.

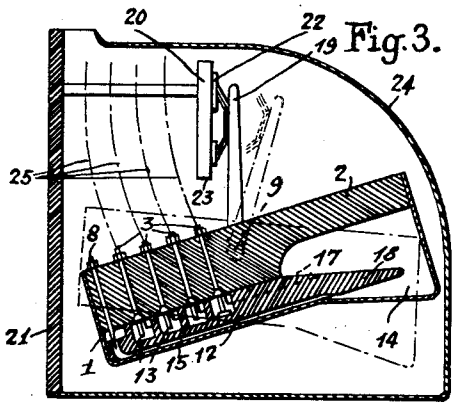
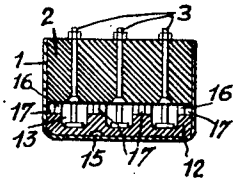


Fig. 3.

Fig. 4.



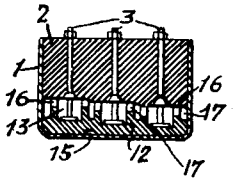


Fig. 5.

Fig. 7.

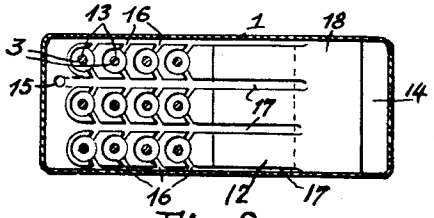


Fig. 6.

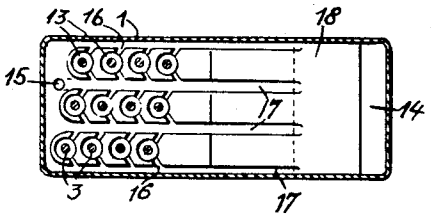
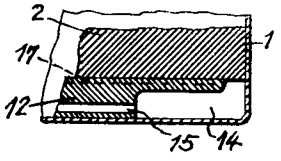


Fig. 8.



Inventor:

Karl Bayerle,

By Byrnes Townsend & Brickenstein,

Attorneys.

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K. BAYERLE

TILTABLE MULTIPLE CONTACT SWITCH

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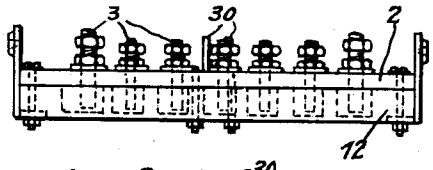
Fig.9.



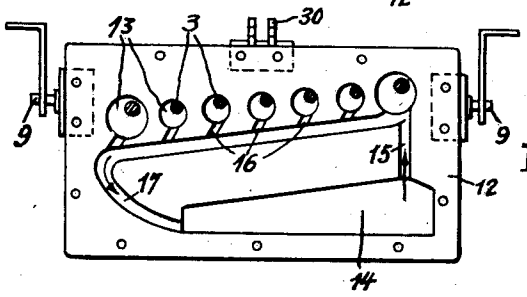


Fig.11.

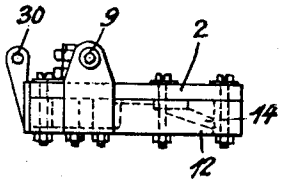


Fig.10.

Fig.12.

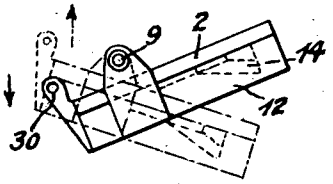


Fig. 13.

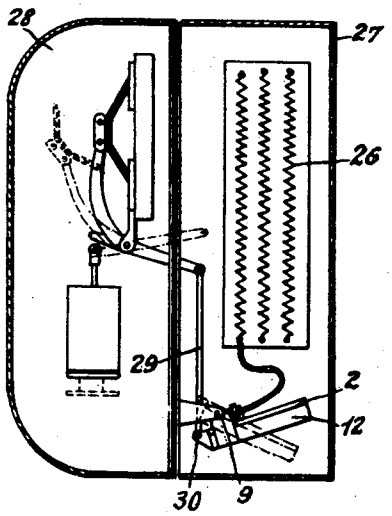
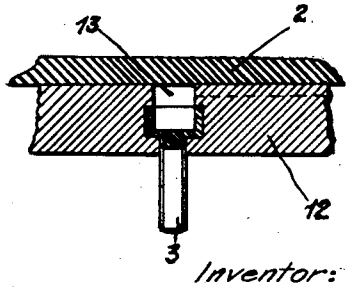


Fig.14.



Inventor:
Karl Bayerle,
By Byrne, Townsend & Brickenstein,
Attorneys.

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Filed March 6, 1925 3 Sheets-Sheet 3

Fig.15.

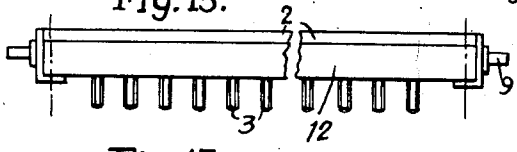


Fig.18.

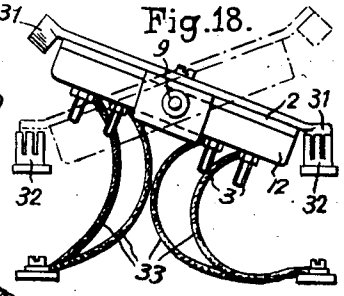


Fig.17.

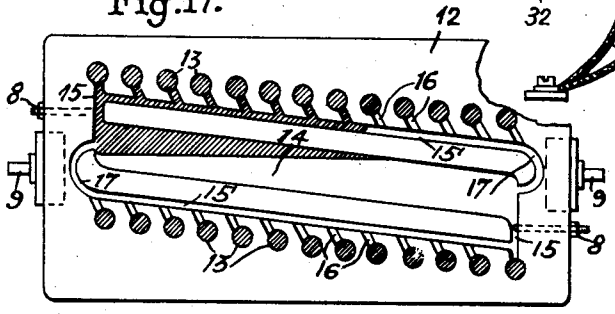


Fig.16.

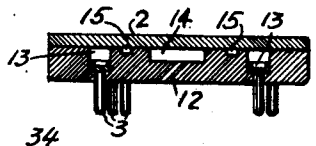


Fig.19.

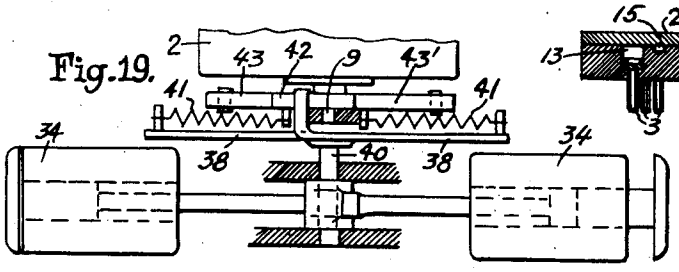


Fig.20.

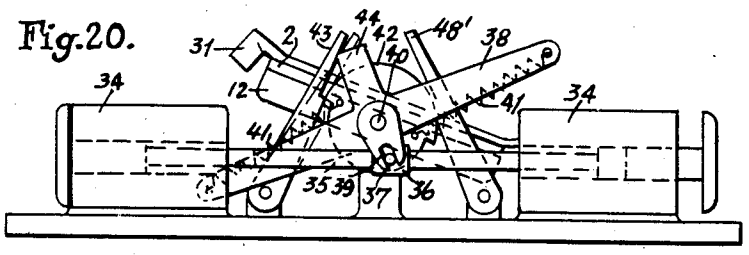
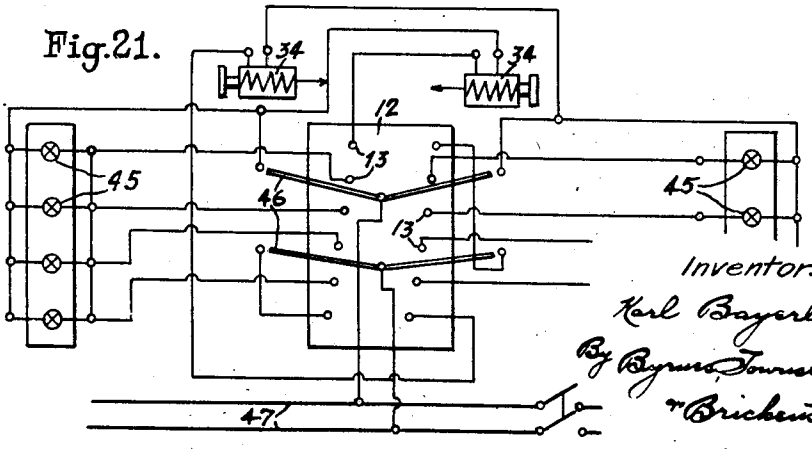


Fig.21.



Inventor:
Karl Bayerle,
By Byrnes, Townsend
& Brickenstein,
Attorneys.

Patented June 26, 1928. 1,675,205

UNITED STATES PATENT OFFICE.

KARL BAYERLE, OF FRANKFORT-ON-THE-MAIN, GERMANY, ASSIGNOR TO LURGI APPARATEBAU-GESELLSCHAFT M. B. H., OF FRANKFORT-ON-THE-MAIN, GERMANY, A CORPORATION OF GERMANY.

TILTABLE MULTIPLE-CONTACT SWITCH.

Application filed March 6, 1925, Serial No. 13,588, and in Germany March 6, 1924.

The invention relates to a tiltable multiple-contact switch working with an electric conducting liquid, particularly with mercury. In such step switches the channel for the conducting liquid into the outwardly projecting contacts of the individual contact stages protrude, was hitherto generally of cylindrical or tubular shape as described for example in British specification No. 190,940. It has now been found that this cylindrical shape presents constructional difficulties, especially in connection with the prevention of leakage and the maintenance of the insulation between the individual contact steps. The present invention aims at overcoming these difficulties.

To this end, according to the invention, a relatively flat trough-like or box-like container is employed, which is provided with passages for the inlet and outlet of liquid to and from the contact stages. Such a trough or box has the advantage not only of being easily and cheaply produced (it may for example be produced without difficulty from thin sheet metal by pressing or stamping), but it also affords the possibility of arranging the individual contact stages transversely in relation to the longitudinal direction of the liquid channels. In the cylinders and tubes of previous constructions, the contact stages may only be arranged individually one behind the other, so that especially in three phase alternating current switches, inordinately long tubular bodies had to be provided in order to house all the contacts. In the present construction however, the trough offers room for two or more contact stages side by side, which enables the length of the tilting container to be considerably reduced. At the same time, for electrical reasons the transverse arrangement of several contact stages offers the advantage that in the case of polyphase current, the individual phases are simultaneously switched-in, which was impossible in tilting containers of cylindrical or tubular shape.

The transverse arrangement of the contact stages may be effected in several different ways. Thus, for example, the contact of a transverse series may be staggered or situated at different heights in relation to each other. In both cases all the contact stages of a transverse step are reached by the contact liquid in proper sequence of time, which especially in the case of direct current offers the possibility of increasing the number of contact stages to an extent which is not possible in tilting containers of cylindrical construction.

The tightening of the box-like tilting container—which may advantageously be produced as a stamping—does not present any difficulties. The container may be closed by a stopper or a lid carrying the contacts of the contact stages. This lid may co-act with an insulating insertion at the bottom of the box, in such a way that the contacts in the lid part protrude into recesses in the bottom part, so that only the necessary inlet and outlet channels for the contact liquid remain free, thereby effecting a considerable economy in contact liquid. This economy may be considerably increased if only that part of the container is used as a collecting space or well for the contact liquid which is remote from the contact points. For this purpose it is sufficient to provide a bulging portion at this end by bending the bottom of the box outwardly.

The compact construction provided by the invention enables the tilting axis to be arranged parallel to the rear wall of the knife switch or the like with which the tilting container co-acts. With the long cylindrical tilting containers of the former construction, this arrangement of the tilting container transversely to the base plate of the switch was impossible.

Further characteristics and advantages of the invention will be apparent from the following description and from the accompanying drawings, which illustrate by way of example several embodiments of the invention.

In said drawings:—

Figs. 1 and 2 are a longitudinal section and plan respectively of a tilting apparatus

formed as a trough or box with transversely arranged contact steps.

Fig. 3 shows a further embodiment of tilting container operating in conjunction with a switch, in which the tilting axis is arranged parallel to the base plate of the switch.

Fig. 4 is a plan of the arrangement of the contact steps of the tilting container shown in Fig. 3.

Fig. 5 is a cross-section through the tilting apparatus.

Fig. 6 is a plan showing a further arrangement of the transverse series of contact steps.

Fig. 7 is a sectional elevation of a further modification;

Fig. 8 is a fragmentary sectional view of a detail;

Fig. 9 is an elevation of another form embodying the invention;

Fig. 10 is a plan view of the construction shown in Fig. 9, without the cover, certain parts being shown in section;

Fig. 11 is an end view of the construction shown in Fig. 9;

Fig. 12 is a view similar to Fig. 11, showing the apparatus in two different positions;

Fig. 13 is a diagrammatic representation illustrating an application of an apparatus according to the invention;

Fig. 14 is a fragmentary sectional view of a modification of a detail;

Figs. 15, 16 and 17 represent still a further embodiment of tilting switch in side elevation, cross-section and plan respectively.

Fig. 18 shows a switching arrangement of a tilting container.

Figs. 19 and 20 illustrate an accelerating device for tilting a tilting container in plan and side elevation respectively; and

Fig. 21 is a circuit diagram.

In the embodiment illustrated in Figs. 1 and 2, the tilting container consists of a box 1 of sheet metal, pressed-fibre board, glazed cardboard or other suitable material adapted to be easily pressed into the shape shown. The container 1 may however obviously also be produced by casting. An insulating lid carrying the contacts 3 of the contact stages is fitted into said container 1 for the contact liquid such as mercury. These contacts protrude into the interior of the container 1, and are provided at their lower end with receptacles or catch-pots 4. The free space of the container 1 is divided longitudinally by an inclined partition 5, provided at 6 with a small opening for the admission of contact liquid, and at 7 with a large opening for the out-flow of contact liquid. The cross-section of the inlet opening 6 is adapted to be regulated by a pin 8 mounted in a lid 2, and adjustable from the outside thereof. The container is also provided externally with trunnions 9 enabling same to be tiltably mounted.

As illustrated in Fig. 2, the contact stages 3 are arranged in series not only longitudinally of the container, but also transversely thereof, as sufficient space is available for this purpose.

On tilting the container 1 towards the left, the contact liquid gradually flows through the chamber 10 through the opening 6 into the space 11 above the partition 5, and suddenly fills the receptacles or catch-pots 4 of consecutive contact stages in serial order of time. The switch steps of each transverse series come simultaneously into contact, which is of considerable importance for polyphase current.

In the embodiment shown in Fig. 3, the container 1 is provided with a base insertion 12 of insulating material carrying the recesses or cups 13. The contacts 3 of the lid 2 protrude into these cups so that essentially the same effect is attained as with the cups 4 of the embodiment illustrated in Fig. 1. The bottom insertion 12 leaves free for the admission of the liquid from the collecting space a small channel 15 the outlet cross-section of which is adapted to be regulated by a regulating pin 8 adjustable from the outside, similarly as in the embodiment shown in Fig. 1. Two or more recesses 13 are arranged in each transverse row corresponding to the arrangement of the contacts and are connected together by transverse channels 16, Fig. 4. These transverse channels 16 also connect with the exit channels 17, which return the contact liquid to the well 14. The rear end 18 of the base insertion 12 protrudes slightly into the well 14 and is tapered off towards the latter in the continuation of the discharge channels 17. As shown in Fig. 3, the well 14 may be constructed in a most simple manner by bending the bottom of the box.

The lid insertion 2 rests upon the base insertion 12 so that according to Fig. 5 only the inlet and outlet channels 15, 16, 17 remain free. The transverse arrangement of the contacts may also be effected in the way shown in Fig. 6 by staggering the contacts of each series. By this means it is possible for the contact liquid to reach the contact points of a transverse series in serial order of time. This may also be effected in the manner illustrated in Fig. 7 by forming the surface of the bottom insertion 12, as a series of steps of different levels. The contact points in this embodiment are arranged at different heights along each transverse series.

As shown in Fig. 3 the tilting container 1 may be fixed to its knife switch or the like 19 with the tilting axis 9 parallel to the base surface 20, 21 of the switch contacts 22, 23.

The whole arrangement including the resistance leads 25 may be easily covered by a cover 24.

The bending over of the bottom of the container in order to provide the well 14 shown in Fig. 3 may be avoided, and the manufacture may be simplified by employing the arrangement illustrated in Fig. 8. In this construction the bottom of the box is plane, but the insertion 12 which forms or carries the trough 15 and the channels 17, is hollowed at the end opposite to the contact points, in such a manner as to form also in this case a well 14 for the contact liquid. The lid 2 covering the insertion 12 extends over the well 14, that is, the lower side of the lid forms a continuous plane, without being stepped as shown in Fig. 3. It is considered essential in the formation of the bottom as illustrated in Figs. 3 and 8 that the well 14 is emptied with certainty when the tilting vessel is switched-in.

The flat construction of the tilting vessel enables the outer casing illustrated in the embodiments represented in Figs. 1 to 8 to be entirely dispensed with. An example of this construction is illustrated in Figs. 9 to 12. In this case the cups 13 for the contacts 3, the well 14, the inlet and outlet channels 15 and 17, as well as the connecting channels 16 for the cups 13, are formed in a rectangular slab of insulating material, said slab corresponding to the bottom insertion 12 of the tilting containers illustrated in Figs. 3 and 8. Upon this insulating slab is mounted a stamped or the like lid 2, likewise of insulating material, which carries the contacts 3. The contact pins may be pressed into the lid 2.

As shown especially in Fig. 10 the transverse channels 16 connecting the cups 13 with the liquid channel 17 are arranged in a rearwardly inclined manner, in such a way that on tilting the vessel into the "on" position, the liquid running into 17 runs a short way past the cups 13 before entering into the channels 16, and thus into the cups. Moreover the entry of contact liquid to the cups or recesses is delayed or hindered by the interposition of a step or bar in the entry channels to said cups so that said liquid must rise to a certain height in the feed channel 17 after which it will suddenly shoot over the aforesaid steps or bars in the channels 16 into the cups. These measures obviate the danger of the admitted contact liquid (preferably mercury) owing to its surface tension, drawing out the contents of the receptacles 13, and thus breaking the continuity of flow, and leading to the formation of arcs and consequent burns.

In order to prevent the contact liquid flowing into the cups 13 from knocking against the inserted contacts 3, the latter are arranged eccentrically for example in the manner shown in Fig. 10. Moreover, the inlet channels 16 to the cups 13 run substantially or almost tangential thereto. This insures the inflowing mercury every time only knocking against the liquid remaining in said cups and thus producing the required rapid and prefect contact.

As illustrated in Fig. 14 the contacts 3 may also be inserted through the bottom instead of through the lid, in which case the eccentric arrangement may be dispensed with.

In order to ensure that the leads to the contacts 3 are moved as little as possible when tilting the vessel, the trunnions 9 are so arranged that the tilting axis runs in the direction of the liquid channel supplying the cups 13. The tilting axis may be similarly disposed also in the embodiments illustrated in Figs. 1 and 3. It has been found that the turning moment is very small in relation to the tilting axis in the arrangement of Fig. 10, so that the accelerating forces on tilting become extremely small. Thus a small magnetic pull is sufficient to carry out the switching operation in remote control types working in conjunction with the tilting container.

As can be seen from Figs. 11 and 12, the well 14 is tapered in such a way that on tilting the container into the "on" position (indicated in full lines in Fig. 12), the bottom thereof lies at least horizontally. This ensures the reliable emptying of the well when switching-on.

As shown in Fig. 13 the tilting member may be combined with starting resistances 26 as a special box or the like 27 on an already existing switch 28 of any construction. The connection between the tilting element and the switching member is effected by rods 29 which act at 30 upon the tilting element. These rods 29 may be provided with a snap spring or any other similarly acting accelerating device, for the purpose of suddenly jerking the tilting container into one or other of the final tilting positions independent of the speed at which the switching operation is initiated or carried out.

It has been found that a tiltable switch of the herein described type is adapted to be used in connection with illuminated advertisements, particularly those in which the lamps forming the word or device advertised are switched-on singly in succession (i. e. "spelling or crawling" system) and after illuminating the whole word or device, are all switched-off together. For this purpose, all that is necessary is to connect the several lamps to the contact stages of the tilting container. In comparison with the rotary contact cylinder switch apparatus hitherto used for this purpose, the use of a tilting container presents the advantage of greatest simplicity and increased reliability, since

the contact stages are not subjected to any wear, are completely protected against external influences, and need no attention or cleaning. Besides the tiltable switch can be adapted with great ease to various conditions of supply. In order to illuminate a second device after the first word or device has been extinguished, and thus to utilize both inclined positions of the tilting vessel, a series of contact stages is provided on both sides of the pivotal axis, and these contact stages are connected with a common well by means of the inlet and outlet channels.

Since the row of contact stages is arranged obliquely in relation to the pivotal axis, a larger number of contact stages can be provided on a given superficial area than is possible when said stages are parallel to the pivotal axis, and therefore a correspondingly increased number of lamps can be switched on and off.

The tilting of the container, for alternately switching the contact stages on and off, can be effected in a variety of ways, either mechanically by means of clockwork, in which case the same type of tilting container is suitable for any kind of supply, by an electromotor, with or without reduction gear, by electromagnetic means. When an electromotor or electromagnet is used, the arrangement may be such that the tilting of the vessel reverses the motor or cuts out the magnets. The most reliable method is to employ two electromagnets which are switched in and out alternatively.

By providing the tilting arrangement with an accelerating device (constituted by springs or the like), released by ratchet and pawl mechanism, the tilting vessel can be turned over rapidly into either end position. This prevents any jamming at the moment of tilting, and any irregularities arising from mercury remaining in the passages which are liable to have injurious effects for the contact steps.

As illustrated in Figs. 15–18, the tilting container for the contact liquid, such as mercury, consists—as previously described—of a base plate 12 provided with cup-shaped recesses or metal cups 13 for the leading-out contacts 3, a collecting chamber 14 for the mercury and the inlet and outlet channels 15, 15', 16 and 17, and is provided with a cover 2 fitting closely into or over the recesses in the base plate 12. The parts 2 and 12 are preferably made of an insulating material which can be shaped by pressing and in which the recesses can be easily cut or pressed. As can be seen, two parallel rows of mercury cups 13 are provided, running obliquely in relation to the pivotal axis 9. Each cup 13 is arranged to connect up to a contact 3. The flow of mercury from the shallow well 14 to the cups 13 takes place through a narrow feed channel (adapted to be throttled for example by means of the screw 8), opening into the feed main 15' which is connected to the cups 13 by the distributing channels 16. As previously described, these channels 16 are provided with interposed steps or bars and point obliquely rearwards, so that the oncoming fluid must flow a certain distance beyond the channel 16 before it can pass through same into the cups 13. This method of distribution is indicated in Fig. 17 by the hatching, which shows that a certain quantity of mercury is always left in the cups 13. After the switching-on is completed, the tilting of the vessel into the opposite position (Fig. 4) allows the mercury to drain away, without restriction, through a curved channel 17 into the well 14, whence it flows into the other row of cups. In this way, by tilting the vessel alternately in opposite directions, the two rows of cups are periodically filled in succession and rapidly emptied, so that in conjunction with the switch members two advertisement words can be alternated, each being illuminated, letter by letter, and then extinguished all at once.

As shown in Fig. 18, the tilting vessel 2, 12 is provided with two contact blades 31, coacting with fixed contacts 32. The connection between the cup contacts 3 and the lamps for the various letters is established by means of flexible cables 33.

The oblique arrangement of the rows of cups 13 in relation to the pivotal axis enables a large number of contact cups 13 to be accommodated on a small superficial area, so that words or devices having a comparatively large number of letters or elements can be reproduced in the simplest manner.

Figs. 19 and 20 represent a typical embodiment of the electromagnetic tilting device. The cores of two electromagnets 34 are coupled together by a rod 35. This is provided with a central cross head 36, the pin 37 of which tilts a balance lever 38 alternately in opposite direction by means of a guide slot 39. The pivotal axis of this lever is coaxial with that of the tilting container 2, 12, and the two axes are maintained in flexible connection by means of two tension springs 41 attached to the lever 38 on the one hand and to a ratchet disc 42. When the magnet cores are pulled in the one or other direction, these springs 41 are put under tension alternately, since the tilting container 2, 12 is held back by one or other of the two pawls 43, 43' coacting with the ratchet disc 42.

It is only when the full stroke has been completed, that is to say, when the lever 38 has reached the one or other end position, that an attached stop 44 knocks away the locking pawl 43 (Fig. 6) and the tilting vessel 2, 12 is quickly swung over into the new end position (following the movement of

the balance lever) under the pull of the released spring 41, and is locked in that position by the descent of the pawl 43'.

The method of connecting the magnet coils 34 with the mercury contacts 13 can be seen from the circuit diagram in Fig. 21. The magnet coming into action for the tilting operation to be effected receives current only after the mercury in the vessel 12 has reached the last contact cup 13, and is at once switched-off again by the tilting of the vessel. During the whole of the period the successive contacts are being made, the magnets therefore are not energized and consequently the heating of the magnet windings is slight.

It is only during the actual tilting operation—a matter of about a second or less—that either of the magnets is energized. Apart from the current required, in any event, for the lamps 45, the current for operating the switching device is practically negligible. In relation to their pull, the magnets may be small in size and may be of the iron-clad type, since there is no risk of overheating. To start the device, all that is needed is to connect to the electric supply 47, by a plug contact or switch 46, whereupon the alternate switching on and off of the lamps 45 forming the advertisement word or device proceeds automatically.

The details of the invention may be modified in various ways, especially the outer contours of the tilting box or of the tilting plates as well as the number of contact steps. In any of the embodiments illustrated two or more contact steps may also be arranged in transverse series side by side.

What I claim is:

1. An electric multiple contact switch, comprising a supporting base, a series of contacts carried by said base, means for feeding conducting liquid to said contacts, including a reservoir, a conduit leading away from and returning to said reservoir, individual passages branching from spaced points along said conduit and terminating at the respective contacts, and means permitting an angular movement of said supporting base about an axis lying generally in the direction of said conduit from which said passages branch.

2. The structure as in claim 1, wherein the portion of said conduit from which said individual passages branch forms a sharp angle with the axis about which angular movement takes place.

3. Electric multiple contact conducting-liquid switch, comprising a container, a row of contact members extending into the container, means defining wells about the contact members, a reservoir, a conduit leading from and back to the reservoir, including a portion passing along the row of contact members, passages affording communication between the said conduit portion and the respective wells, and means for tiltably supporting the container, the said means being so disposed that the tilting axis lies generally in the direction of the said conduit portion.

4. Apparatus according to claim 3, wherein the tilting axis forms an acute angle with the said conduit portion.

5. Apparatus according to claim 3, wherein the tilting axis forms an acute angle with the said conduit portion and the passages from the wells form acute angles with the conduit.

6. Apparatus according to claim 3, wherein the contact members are disposed eccentrically in the wells remote from the said passages.

7. Apparatus according to claim 3, wherein the said passages are directed into the wells substantially tangentially thereto.

8. Electric multiple contact conducting-liquid switch, comprising a container defining a row of wells, contact members extending into the wells, a conduit extending along the row of wells, communicating channels between the conduit and the wells, a step between each channel and the conduit whereby the flow of conducting liquid from the conduit into the respective channels is delayed, a reservoir connected with the conduit and means tiltably supporting the container so that the tilting axis extends generally in the direction of the said conduit.

9. Apparatus according to claim 8, wherein the said conduit forms a sharp angle with the tilting axis and the channels form an acute angle with the conduit.

10. Electric multiple contact conducting-liquid switch, comprising a container tiltable about a definite axis, two rows of contact members extending into the container on opposite sides of the tilting axis and a reservoir intermediate the two rows, having fluid connections to the contact members.

11. Apparatus according to claim 10, wherein the fluid connections include a conduit passing along each row of contact members, a well for each contact member and channels connecting the conduits with the wells.

12. Electric multiple contact conducting-liquid switch, comprising a container tiltable about a definite axis, two rows of contact members extending into the container, a well for each contact member, a reservoir intermediate the two rows of contact members and fluid connections from the well to the contact member, including a conduit passing along each row and connections between the conduits and the wells, the said conduits forming sharp angles with the tilting axis.

13. Apparatus according to claim 12, wherein the said conduits are substantially parallel to each other.

14. Apparatus according to claim 12, wherein the rows of contact members and the said conduits are disposed substantially in parallelism.

15. An electric multiple contact conducting-liquid switch, comprising two bodies of insulating material in superposition, one of the said bodies having recesses formed in one face thereof, and the other of said bodies being superposed upon said recessed face and cooperating with said recesses to define therewith a reservoir, a plurality of wells, and fluid connections from the reservoir to the wells.

In testimony whereof I affix my signature.

KARL BAYERLE.