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C. LIVINGSTON
PERMUTATION DEVICE

2,208,426

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Fig. 1.

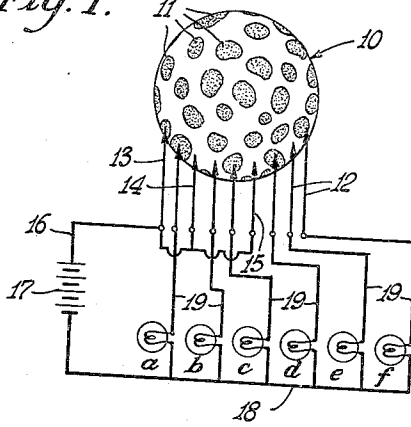


Fig. 2.

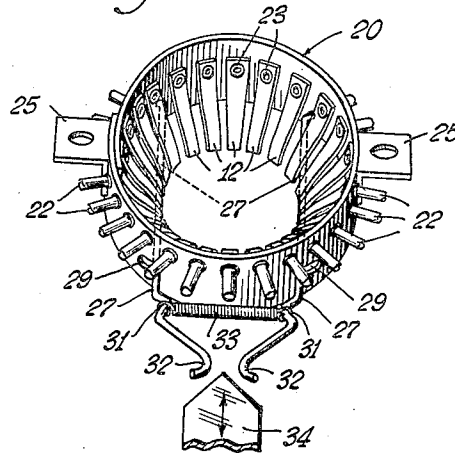


Fig. 3.

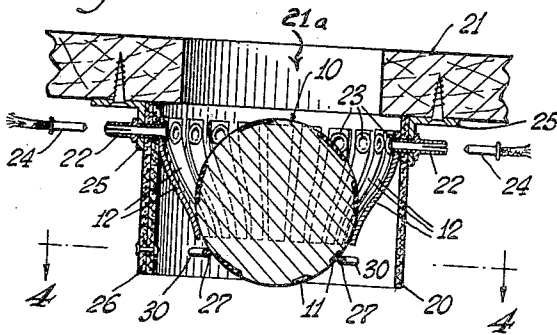


Fig. 5.

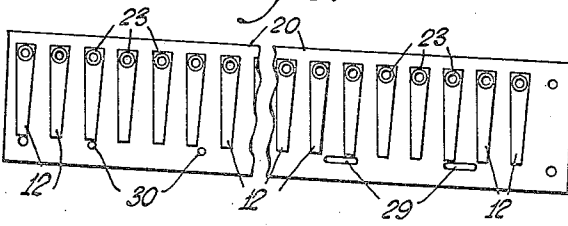
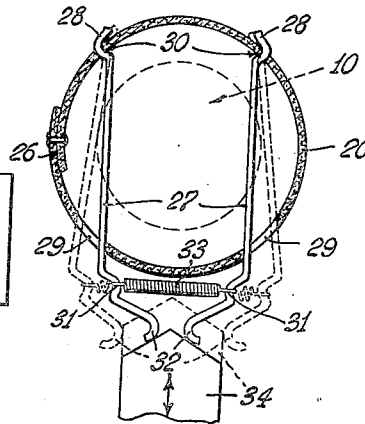


Fig. 4.



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UNITED STATES PATENT OFFICE

2,208,426

PERMUTATION DEVICE

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21 Claims. (Cl. 273—123)

This invention relates to a permutation device in the nature of a switch especially intended for use with amusement apparatus. The principal object of the invention is the provision of a ball having a plurality of conductive and non-conductive surface portions, and a nest of contacts through which circuits are closed by engagement with the conductive surfaces of the ball, the arrangement of said surfaces being such that they are irregularly dimensioned or positioned, so that the particular circuits which will be established at any given time will depend upon the manner in which the ball lies in the nest.

Another important object of the invention is the provision of a conductive ball having non-conductive surface portions arranged in a predetermined pattern for permutable contacting engagement with a plurality of contacts whereby different circuits may be set up depending upon how the various conductive and non-conductive surface portions on the ball are disposed with respect to the contacts.

Another object is the combination with an amusement device such as a ball-rolling game, of a conductive ball having relatively non-conductive surface portions, and a bank of contacts arranged in a circle into which the ball fits so that the various conductive surface portions thereof may engage the contacts in various arrangements, depending upon how the ball happens to rest in the bank, circuit connections to the contacts being combined and permuted through the ball for the purpose of controlling signals, score indicators, objective scoring circuits, or any other changeable circuit means.

Other objects and novel aspects of the invention reside in certain details of the construction and arrangement of parts, and the combination, hereinafter described in view of the annexed drawing in which:

Fig. 1 is a circuit diagram;

Fig. 2 is a top perspective of the contact nest;

Fig. 3 is a vertical section through a ball game board with the permutation device in operative position;

Fig. 4 is a horizontal section through the bottom of the contact nest looking in the direction of lines 4—4 of Fig. 3;

Fig. 5 is a plan view of the inside of the contact strip before it is rolled to form the nest.

The invention is briefly exemplified in its broader aspects in Fig. 1, wherein a metal ball 10 is provided with a plurality of non-conductive areas or spots 11, preferably distributed in an uneven pattern over the surface of the ball, and

preferably of uneven or unequal size or area. The object of this non-uniformity of distribution and size is to provide for the disposition of conductive surfaces in different relative positions for contacting engagement with different spring contacts 12 whenever the position of the ball is changed relative to these contacts.

Certain contacts 13, 14, 15, in the group are looped or connected together with a conductor 16 which is connected to one side of a power source or battery 17. The return side of the battery is connected by a common conductor 18 to one terminal of each of a plurality or bank of controlled instrumentalities such as the signal lamps *a*, *b*, *c*, etc., the remaining terminal of each of these lamps being respectively connected to one of the ordinary contacts 12 of the group or nest of contacts.

Examination of the disposition of the ball in Fig. 1 will show that the contact 13 is engaged with one of the insulated spots 11, so that no circuit is established with the ball by contact 13; but contacts 14 and 15 both are touching the bare conductive surface of the ball, and hence the battery, or one terminal thereof, is connected to the conductive ball. Further examination of Fig. 1 will disclose that the contacts 12 which are connected through conductors 19 with lamps *b* and *c* happen to be touching bare surfaces on the ball, and as a result current will flow from the battery through these particular lamps *b* and *c*, and the same will be illuminated. If the position of the ball be changed slightly, some of the other lamps might be illuminated instead. Thus, a great variety of combinations and permutations of circuits may be effected through the lamps *a*, *b*, *c* . . . *f* by changing the position of the ball as it rests against the contacts.

A preferred form of the contact bank or nest is shown in Fig. 2, and includes a cylindrical sleeve or collar 20 of insulating material, such as fibre, having a plurality of spring contact fingers 12 attached in spaced relation around the inner surface thereof by means such as the riveted or peened inner ends 23 of contact plugs 22, which extend outwardly of the outer surface of the collar for engagement with complementary connection plugs 24 (Fig. 3). The opposite unattached ends of the several contact fingers 12 are preferably tapered so that they may be bent inwardly to engage the ball 10 as shown in Fig. 3.

Means are provided in the nest for releasably holding the ball therein (Fig. 4), said means including a pair of wire rods 27 crimped at one end 28 to fit into holes 30, the opposite portions

of the rods extending through circumferentially elongated slots 29 in the wall of the collar opposite the holes 30 and terminating in outwardly flared crimps 32 for spreading engagement with the nose of a releasing wedge 34. Crimps 31 are formed in the outer parts of the rods behind the endmost crimps 32 to provide seating means for engagement with the ends of a spring 33 which normally draws the two rods together into substantially parallel relation as seen in full lines in Fig. 4. In this latter condition, the distance between the two rods is slightly less than the diameter of the ball 10 so that the latter will rest on the rods and be retained in the nest as shown in Fig. 3.

In order to release the ball, the wedge 34 is moved toward the nest against the crimps 32 until the rods are spread apart against the tension of the spring, whereupon the ball may drop between the rods out of the nest. The wedge may be operated in conjunction with a master control lever in a game or the like. When the wedge is withdrawn, spring 33 restores the rods to normal position.

In Fig. 3 the contact bank or nest is shown in combination with a ball game board 21, mounted on the underside of the board by screws in the mounting angle brackets 25. The passage or opening in the nest is aligned with a ball opening or exit 21a in the board and through which the ball 10 passes into the nest to rest on rods 27 in contact with the spring fingers 12.

The nest may be constructed in various forms, a preferred one of which is the simple cylindrical sleeve 20 depicted, and which is made conveniently from the flat strip of insulating fibre shown in Fig. 5. The several holes 29 and 30 for the rivet ends 23 to hold the contact fingers in place, and holes for the rivets or eyelets employed to secure the ends of the strip together, are all punched at a single operation. When the contacts are riveted in place, the ends of the strip are brought together about a cylindrical form and riveted together, one of the rivets or eyelets employed for this purpose also securing the left-hand bracket 25 (Figs. 2 and 3) in place, the right-hand bracket 25 being held by one of the ends 23.

The circuit changing device or ball 10 may be made by applying thin spots of a suitable enamel or glazing material to the surface of the usual nickel or chromium plated metal ball, different colors being employed to render the ball attractive. The surface of the ball may be streaked instead of spotted. The metal surface may be rendered negligibly conductive in spots by oxidation. Equivalent arrangements include the use of a molded ball with surface depressions filled with a non-conductive plastic; or the use of a non-conductive plastic or like material for the ball and precipitating a thin coating of metal such as silver from solution (e. g. silver nitrate) in spots on the surface of the ball. The metal ball painted is preferred for simplicity, and the surface of such a ball constitutes a continuum which is electro-conductive. However a non-conductive ball (plastic) could be employed with areas of metallic particles or filings pressed therein in various densities.

The electrical instrumentalities or lamps, a, b, c, etc. may be arranged to designate score values for various ball exits such as the hole 21a, there being one ball 10 projected onto the board 21 before or after other balls to predetermine such

score values or totalize the same, the ball 10 being of different diameter than the other balls, as would be the hole 21a, so that the other balls could not enter the nest. However, the application of the invention is not intended to be restricted to amusement apparatus such as described, but may be used for a variety of circuit changing purposes; for example, a plurality of contact banks or nests may be arranged in alignment with the rods 27 omitted, and the ball 10 passed successively therethrough for transient engagement with the various contact fingers to change lamp connections, for example, in an advertising device. Nor need the contacts 12 be arranged only as shown; any arrangement is contemplated in which the ball may variously engage a plurality of contacts either transiently or at rest. Other arrangements will occur to those skilled in the art, and the invention is therefore not confined to the details set forth in the exemplary description, but is to be broadly interpreted in accordance with the annexed claims.

Having thus described and explained my invention, what I claim and desire to protect by Letters Patent of the United States is

1. Circuit changing means comprising, in combination, a conductive ball having a multiplicity of non-conductive surface areas thereon, and a multiplicity of contacts arranged for contacting engagement with the surface of said ball to establish circuit connections therethrough for permutation and combination depending upon whether said contacts engage conductive or non-conductive surface portions thereon.

2. Circuit changing means comprising, in combination, a plurality of contacts numbering more than two disposed in circular array, and a ball having a plurality numbering more than two of conductive and non-conductive surface areas thereon and adapted to be moved into the center of the group of said contacts for engagement therewith, and circuit connections established in permutation and combination through said contacts and ball dependent upon whether said contacts engage conductive or non-conductive surface areas as aforesaid.

3. Circuit permutation and combination means comprising, in combination, a plurality of contacts numbering more than two, and a ball having insulation in spaced-apart areas on its surface, said areas numbering more than two and means for supporting said ball in engagement with said contacts, whereby to establish circuit connections between such of said contacts as engage conductive surface portions of the ball.

4. Circuit changing means comprising, in combination, a multiplicity of contacts arranged about a center, a ball having a multiplicity of conductive and non-conductive surface areas thereon and being of a diameter to fit into the central space between the contacts in engagement therewith, and means for releasably supporting said ball in position between the contacts as aforesaid whereby electrical contact may be effected variously between a conductive surface area and a contact in engagement therewith depending upon the relative positions of said ball on said supporting means.

5. In combination, a ball having conductive and non-conductive surface portions spaced apart in relative alternation over the entire surface thereof, and a plurality of contacts and means mounting the same for engagement as a group with the surface of said ball, whereby a

circuit connection may be effected between two or more contacts engaging a conductive surface portion on the ball.

6. In combination, a ball having an electrically conductive surface with relatively non-conductive areas spaced apart thereon, a plurality of contacts and means for supporting the same and said ball in mutual engagement whereby electrical connection may be established between any of said contacts engaged with conductive surface areas of said ball.

7. Circuit permutating and changing means comprising, in combination, a conductive ball having insulated spots on its surface, a group of contacts and means mounting the same for engagement as a group with said ball, means for releasably supporting said ball in engagement with the contacts as aforesaid, and means for actuating said releasable supporting means at least one of said contacts being connected to one terminal of a source of electric power, the remaining contacts being adapted for connection severally with electrically actuated means through which circuits are closed to the remaining terminal of said power source.

8. In combination, a plurality of contacts, and a ball having a conductive surface with irregularly spaced non-conductive areas thereon, and means for supporting said ball in engagement with all of said contacts, whereby to establish circuit connections between such of said contacts as engage conductive surface portions of the ball.

9. In combination, a plurality of contacts, and a ball having a conductive surface with areas of insulation of different size distributed over the surface of the ball, and means for supporting said ball in engagement with all of said contacts, whereby to establish circuit connections between such of said contacts as engage conductive surface portions of the ball.

10. In combination, a conductive ball having areas of insulation arranged in a predetermined pattern over its surface, means providing a receptacle for said ball, and a plurality of contacts mounted on said receptacle for engagement with said ball therein, whereby various electrical circuits may be established between contacts engaging conductive portions of the surface of said ball.

11. In combination, means providing a ball rolling surface having a ball exit therein through which a ball may gravitate, a ball receptacle arranged to receive a ball from said exit, a conductive ball having a plurality of non-conductive surface areas thereon and adapted to be rolled over said surface for movement through said exit into said receptacle, a plurality of contacts arranged to engage said ball in said receptacle to variously engage said conductive and non-conductive surfaces thereon, and electrically operated instrumentalities connected severally in circuit with said contacts and a power source for energization through circuits completed through such of said contacts as engage conductive surface portions of the ball in said receptacle, and releasable ball supporting means in said receptacle and arranged for operation from a normal ball-supporting condition to release said ball for movement out of said receptacle.

12. In combination, means providing a support on which a ball may be rolled and having an exit through which said ball may pass, a conductive ball to be rolled on said support and having non-conductive portions distributed irregularly on its surface, a bank of contacts ar-

ranged relative to said exit to engage said ball as a group when said ball moves through the exit, releasable means for supporting said ball in engagement with said contacts when the ball moves through said exit, and electrically operated means connected with said contacts and actuated by completion of electrical circuits through such of said contacts as engage conductive surface portions of said ball supported as aforesaid.

13. A permutation switch comprising, in combination, a nest including a multiplicity of contacts and means for supporting a ball in position for contacting engagement with said contacts, and a conductive ball adapted to fit into said nest and having multiple means on its surface variously preventing electrical contact of contacts therewith when the ball is in different positions in the nest.

14. A permutation switch comprising, in combination, a group of contacts and means for supporting a ball in position to be engaged simultaneously by said contacts, and a ball having surface areas which constitute an electro-conductive continuum with irregularly distributed areas of insulation thereon and so arranged that said ball may be disposed in various positions on said supporting means so that different contacts will be engaged with conductive or non-conductive areas on the ball at different times whereby to establish different circuit connections through said continuum and the contacts engaging the same responsive to changes in the disposition of the ball on the supporting means as aforesaid.

15. A circuit changing device comprising an insulating sleeve having a plurality of contacts arranged in special relation about its inner surface, a conductive ball having insulating areas disposed in a non-uniform arrangement on its surface and adapted to fit into said sleeve in engagement with said contacts, and means for releasably supporting said ball in said sleeve, electrical connection being established between different contacts at different times through said ball depending upon the position of the ball in the sleeve with respect to whether the contacts engage conductive or non-conductive areas thereon.

16. A circuit changing device comprising a support providing a receptacle for a ball, a ball adapted to fit into said receptacle and having conductive and non-conductive surface areas in irregularly spaced relation thereon, the conductive areas being electrically interconnected, and a plurality of contacts mounted on said support to surround the ball therein and engage the surface thereof, said contacts being variously connected in common by engagement with conductive surface portions of the ball when the latter assumes different positions in the receptacle to change the relative positions of the conductive and non-conductive areas with respect to the contacts.

17. A device of the class described comprising in combination, a support of insulating material having a cylindrical opening therethrough and a plurality of yieldable contact fingers arranged in a circle about the inner wall of said opening so as to engage the surface of a ball therein and yield to permit passage of said ball through said opening, and a conductive ball having non-conductive spots on its surface in irregularly spaced relation, said ball being of a diameter to pass through said opening in the support in contact with said fingers.

18. A device of the class described comprising in combination a cylindrical insulating sleeve having a plurality of springy contact fingers mounted in circular array around the inner periphery of the sleeve, a conductive ball of a size to fit into said sleeve in contact with said fingers, said ball having insulating spots formed on its surface in irregularly spaced relative relation for various engagement with said contacts dependent upon the position of the ball in the sleeve, means for releasably supporting said ball in said sleeve and including a pair of members mounted to extend across the sleeve at one side of the group of contacts, said members being further mounted for movement toward and away from each other in a direction laterally of the sleeve, spring means normally urging said members toward each other into ball-supporting position in which the distance between said members is insufficient to permit said ball to pass therebetween, said members being movable away from each other to widen the distance therebetween and permit said ball to pass out of the sleeve, said members being arranged and constructed to be wedgedly moved apart to permit the ball to pass therebetween as aforesaid, and means for wedging said members apart.

19. A circuit changing device comprising a ball having a multiplicity of conductive and non-conductive surface areas thereon and adapted to be positioned in engagement with a multiplicity of contacts to establish electrical connection be-

tween such of the contacts as engage conductive surface portions of the ball.

20. In a device of the class described, a contact nest comprising a cylindrical sleeve of insulating material having a plurality of springy contact fingers each attached at one of their ends in a circular array around the inner periphery of said sleeve, the opposite ends of said fingers being biased toward the center of the sleeve for contacting engagement with a circuit completing ball receivable therein, and means for releasably retaining said ball in the nest sleeve and including supporting members mounted to extend across the sleeve and upon which said ball rests in engagement with said contacts, said members being mounted for movement toward and away from each other into and out of ball-supporting position and having parts arranged for engagement with a wedging device adapted to be moved in a direction between said members to move the same apart and out of ball supporting position, and spring means normally urging said members toward each other into ball supporting position.

21. A circuit permutating and changing device for use with a nest of contacts spaced with respect to a center to engage a spherical surface, said device comprising a conductive sphere having a plurality, numbering more than three, of insulated areas irregularly spaced apart on the surface thereof.

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