Sept. 6, 1960 L. A. WIKKERINK 2,951,921

MAT TYPE FLOOR SWITCH

Filed July 28, 1958

Fig. 1.

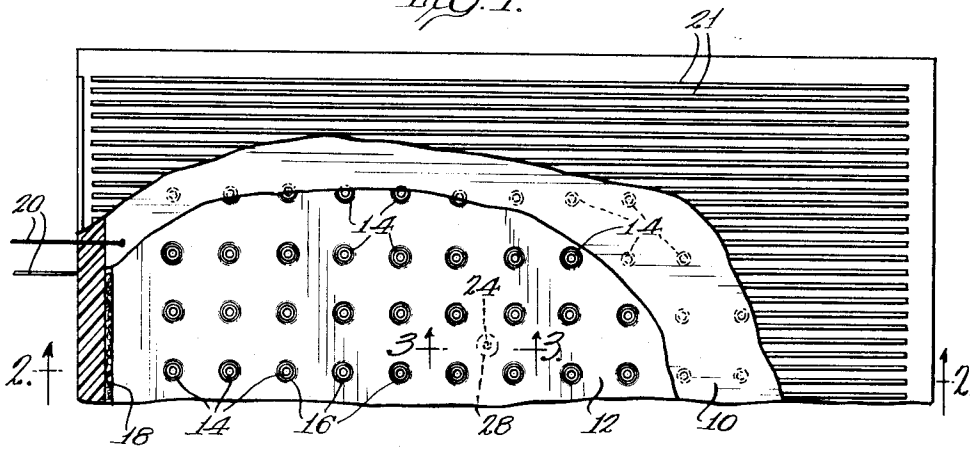
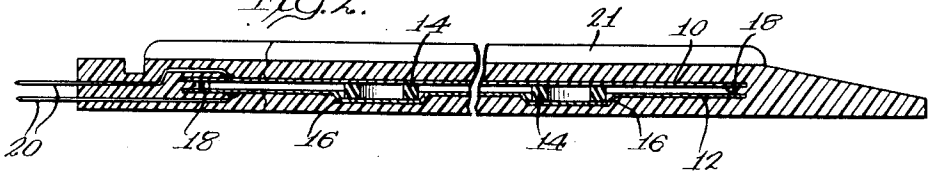


Fig. 2.



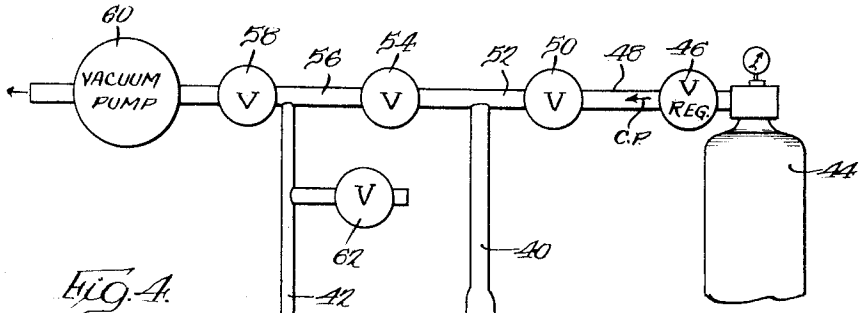


Fig. 4.

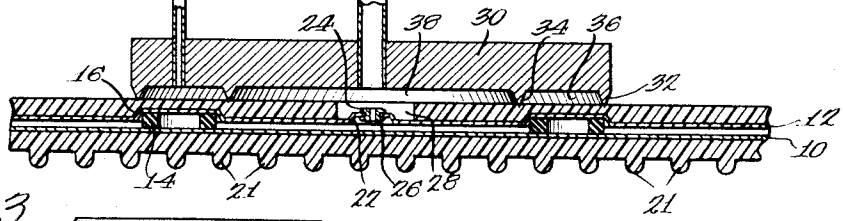
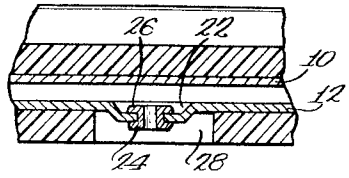


Fig. 3.



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MAT TYPE FLOOR SWITCH

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4 Claims. (Cl. 200—86)

The present invention relates to molded mat type floor switches.

Mat switches, as contemplated by this invention, are used for controlling the operation of such devices as public building automatic door openers, for instance. They have much the appearance of a flexible floor mat, and the molded resilient portion is usually formed of some pliable resin, such as a polyvinyl resin for instance.

In general, such mats consist of a bottom molded layer which is supported by the floor, and a top molded layer separated therefrom excepting that the layers are joined at their edges. These two resilient layers enclose a pair of metal sheets (aluminum is usually used for the purpose) spaced slightly apart by a plurality of soft rubber buttons or the like. The two metal plates act as the contacts of an electric switch, and are held away from each other until someone steps upon the mat, whereupon the two metal plates are pressed together locally so as to complete an electric circuit. This, in turn, in any suitable fashion controls the actuation of an automatic door operator or any other device which is under the control of the mat switch.

One of the problems associated with such mats is that even though they are well constructed with the switch elements well sealed within a one piece molded housing so as to prevent the possibility of moisture or dirt getting to the interior of the mat so as to contaminate the contact plates, they nevertheless in time are likely to become somewhat unreliable in their operation in that they may fail to make contact occasionally even though the weight thereon should be sufficient to insure good functioning.

A principal object of the present invention is to provide an improved mat switch of the general character outlined above, which has a higher order of reliability than mat switches heretofore in use.

An additional object is to provide novel mechanism for conditioning the interior of the mat switch after its manufacture is essentially complete so as to improve the operational characteristics and the useful life of the mat switch. Yet another object is to provide a novel mat switch in which the contacting plates remain in better condition over an extended period than mats heretofore in use, and to provide a method and apparatus useful for the construction of such mats.

Other objects and advantages will become apparent from the following description of a preferred embodiment of my invention which is illustrated in the accompanying drawings.

In the drawings, in which similar characters of reference refer to similar parts throughout the several views:

Fig. 1 is a plan view of the major portion of a mat switch of the type forming the subject matter of the present invention, with portions of the structure broken away so as to reveal the interior construction;

Fig. 2 is a vertical sectional view drawn to larger scale than Fig. 1. This view may be considered as taken in the direction of the arrows substantially along the line 2—2 of Fig. 1;

Fig. 3 is a fractional sectional view drawn to larger scale than Fig. 2 so as to reveal a detail of the construction. It may be considered as taken in the direction of the arrow along the line 3—3 of Fig. 1; and

Fig. 4 is a somewhat diagrammatic representation of apparatus used during the construction of the mat which forms the subject matter of this invention.

The mat switch of the present invention is constructed largely according to the teachings of my copending application Serial No. 699,076, filed November 26, 1957, and entitled Mat Type Floor Switch, and the mat of the present invention may be considered as an improvement over the one shown in that copending application.

Briefly, the present mat consists of a pair of large parallel metal plates, indicated at **10** and **12**, which are separated slightly by a plurality of spaced resilient rings or buttons **14**. As shown, these rings, which may be of soft rubber, repose in shallow depressions **16** in the lower sheet **12**. At their outer edges the plates are separated by a circumscribing strip of absorbent material indicated at **18**. This material may take the form of cotton wicking, for instance. The two plates, separated as described above, are provided with electrical leads **20**, and, while temporarily held together, are placed in the mold cavity into which is injected sufficient pliable plastic material in the liquid state, such as a polyvinyl resin for instance, to form a complete enclosure for the mechanism described above.

The mold is so formed as to give the mat the exterior contour desired, as well as a general design over the upper surface, such as the longitudinally extending ribs indicated at **22**. As the liquid plastic material is cast into the mold, some of the material is absorbed by the porous strip at **18**, and acts to anchor the plates comparatively rigidly at their edges relative to each other so as to eliminate the tendency of the plates to work at their edges and cut the enclosing layers of plastic material.

One of the problems associated with mats constructed as described above arises from the fact that probably the most acceptable material for forming the plates **10** and **12** is aluminum. Aluminum, however, has a tendency to form an oxide layer which is of an insulating nature. When the mat is manufactured, this layer is not thick enough to have any deleterious effect upon the operational characteristics of the mat switch, but I have found that with time this layer increases in thickness to such an extent that the mat switch may on occasion fail to operate satisfactorily since the aluminum oxide prevents the plates **10** and **12** from being brought into good electrical conducting relationship with each other when a person steps upon the mat.

This disadvantage of aluminum or of other metals which tend to oxidize is eliminated in the mat switch made according to the present invention in the following fashion. By referring to Fig. 3 of the drawings, which shows a vertical section drawn to large scale, it will be seen that the lower plate **12** is provided in some convenient location—near its center for instance—with a slight depression as is indicated at **22**. At the center of this depression the plate is punched to provide a small hole, and a hollow copper rivet **24** extends through this hole and is headed so that it is relatively tight in the aluminum sheet. It, in effect, therefore, provides a small diameter copper tube extending through the center of the aluminum sheet. The depression at **22** is simply for the purpose of preventing the head **26** of the rivet, which

is innermost, from being closer to the plate 10 than the remaining portion of the sheet 12.

With the lower sheet 12 prepared with the hollow rivet 24 in place as described above, the elements are assembled into the mold in the manner described above, and the plastic material is cast so as to enclose the switch elements excepting that the outer head of the rivet 24 is exposed by way of a small diameter opening 28 which extends through the layer of plastic material to the bottom surface. The result is that the mat, after the molding operation, is largely complete, and all of the working mechanism of the switch is completely enclosed and sealed excepting for the head of the rivet 24 and a small portion of the external surface of the lower aluminum sheet 12 immediately adjacent thereto.

After the molding operation the mat is transferred to the fixture which forms the subject matter of Fig. 4. This fiixture consists of a circular metal plate 30 which has an annular downwardly extending tapered ridge 32 at its periphery. The lower edge of this rib is only slightly rounded as shown. Toward the center of the plate 30 there is a second downwardly extending circular ridge 34 which may be considered as identical to the ridge 32 excepting that it forms a smaller circle concentric with the ridge 32. These two ridges provide an annular groove 36 therebetween, and a central reentrant area 38. The center space 38 communicates with a tube 40 which extends upwardly away from the back of the plate 30, and a separate tube 42 communicates through the back of the plate with the annular space 36.

Toward the right hand side of Fig. 4 I have indicated a source of argon gas. This may take the form of the conventional high pressure cylinder 44 equipped with an automatic pressure regulator 46 and the customary shutoff valve such that a pipe 48 connected to the regulator 46 receives argon gas under a constant pressure which is slightly above atmospheric. This pipe 48 is connected through a shutoff valve 50 with a pipe section 52 connected in turn through another shutoff valve 54 to a pipe section 56 which leads through a third shutoff valve 58 to the inlet of a vacuum pump 60. The previously mentioned conduit 40 connected to the space 38 at the bottom center of the plate 30 is connected to the pipe section 52 between the valves 50 and 54. The similar conduit 42, which leads to the annular space 36, is connected at its other end to the pipe section 56 between the valves 54 and 58, this conduit 42 also being vented to the atmosphere through an on-off valve at 62.

The mat, after the major molding operation, is laid face down upon a flat surface, with the opening 28 in the back thereof uppermost. The fixture 30 is then set upon the back surface of the mat so that the opening 28 in the back of the mat lies somewhere completely within the circle bounded by the ridge 34. Under these conditions, with the valves 50, 54 and 62 closed, valve 58 is opened so as to connect the inlet of the vacuum pump to the annular space 36. This evacuates the space 36 since the weight of the plate 30 is sufficient to cause the narrow circular ridges 32 and 34 to form a relatively good seal with the resilient back surface of the mat. As soon as the pressure in the space 36 has been reduced somewhat, the pressure of the surrounding atmosphere will press the mat and the circular plate more tightly together so as to form a completely airtight seal between the ridges 32 and 34 and the resilient back surface of the mat.

After this seal has been established, valve 54 is opened so as to connect the vacuum pump both to the annular space 36 and also to the central region 38 of the fixture. Substantially all of the air and other gases which may be present between the plates 10 and 12 are exhausted through the vacuum pump so as to establish a relatively high order of vacuum within the interior of the mat. No attempt need be made to pump the interior to an extremely low pressure level, as with electron tubes for instance, since the purpose of the exhausting step is simply to reduce the oxygen content in the interior of the mat to a relatively negligible level.

After the interior of the mat has been exhausted as explained above, valve 54 is closed and valve 50 opened. This causes argon gas to flow from the cylinder 44 through the pressure regulator 46 and valve 50 to the interior of the mat so as to fill the mat with inert argon to a pressure which is slightly above atmospheric. During this filling step the connection from the vacuum pump to the annular space 36 is continued so that although the pressure of the argon gas tends to lift the plate 30 away from the surface of the mat, this tendency is more than compensated for by the vacuum in the space 36.

After the interior of the mat has been filled with argon, valves 50 and 58 are closed and valve 62 is opened. This isolates the vacuum pump and the argon gas source from the fixture and reestablishes atmospheric pressure in the space 36. The plate 30 is then lifted from the mat so as to expose the opening 28 and the exterior end of the rivet 24. Since the argon gas pressure in the interior of the mat is slightly above atmospheric pressure, some argon gas will flow through the hole in the rivet to the atmosphere until atmospheric pressure is reestablished in the interior of the mat. As soon as this occurs the hole in the rivet 24 is plugged with melted solder so as to seal off communication between the atmosphere and the space between the plates 10 and 12. At the conclusion of the soldering operation a small quantity of the liquid polyvinyl plastic material is poured into the opening 28 so as to substantially fill the opening. As soon as this liquid material has cured to the plastic state, the mat is ready for use.

It will be seen that a mat constructed as explained above will provide a pair of aluminum plates for making electrical contact with each other when a person steps upon the mat, and that these plates are completely enclosed and sealed within a resilient plastic sheath, and that the entire interior space within the mat is filled with argon gas at substantially atmospheric pressure and therefore contains substantially no oxygen. Under these conditions the plates will maintain their bright, clean appearance, and good electrical contact making quality for an extremely long period of time, since deterioration of the surface cannot proceed in the absence of oxygen.

It should be appreciated that even though the connection between the rivet 26 and the aluminum plate 22 is not completely airtight, this is of no consequence because as soon as the plastic material has been poured into the hole 28 and has softened the surrounding plastic material to some extent so as to cure therewith, this plastic material will act to seal any slight leakage which may exist around the rivet. The rivet should not be so loose, however, as to permit any appreciable quantity of the liquid plastic to run through into the space between the plates 10 and 12.

From the above description of a preferred embodiment of my invention, it will be appreciated that changes in the structure and fixture and variations in the method may be made without departing from the scope or spirit of the invention, and that, therefore, the scope of the invention is to be measured by the scope of the following claims.

Having described my invention, what I claim as new and useful and desire to secure by Letters Patent of the United States is:

1. In the manufacture of mat switches the temporary combination of a partially completed mat comprised of a pair of spaced apart metal plates enclosed within an envelope of substantial thickness of molded resilient nonporous plastic material, said enclosure having a small reentrant opening therethrough so as to expose a small area of one of said plates, and the last said plate having a hole therethrough within said opening, and an apparatus

providing a surface having a pair of substantially concentric substantially circular ridges having their free edges in a substantially common plane pressed into engagement with said resilient plastic envelope with said reentrant opening lying within the area circumscribed by the smaller of said circular ridges, means for evacuating the space between said ridges, separate means for evacuating the space enclosed by the smaller of said circular ridges, and separate means for supplying an inert gas to the last said space.

2. In the manufacture of mat switches the temporary combination of a partially completed mat comprised of a pair of spaced apart metal plates enclosed within an envelope of substantial thickness of molded resilient nonporous plastic material, said enclosure having a small reentrant opening therethrough so as to expose a small area of one of said plates, and the last said plate having a hole therethrough within said opening, and an apparatus providing a surface having a pair of substantially concentric substantially circular ridges having their free edges in a substantially common plane pressed into engagement with said resilient plastic envelope with said reentrant opening lying within the area circumscribed by the smaller of said circular ridges, means for evacuating the space between said ridges, separate means for evacuating the space enclosed by the smaller of said circular ridges, and separate means for supplying argon gas at a pressure slightly above atmospheric to the last said space.

3. In the manufacture of mat switches the temporary combination of a partially completed mat comprised of a pair of spaced apart metal plates enclosed within an envelope of substantial thickness of molded resilient nonporous plastic material, said enclosure having a small reentrant opening therethrough so as to expose a small area of one of said plates, and the last said plate having a hole therethrough within said opening, and an apparatus providing a substantially circular ridge having its free edge in engagement with said resilient plastic envelope with said reentrant opening lying within the area circumscribed by said circular ridge, means for clamping said ridge into airtight engagement with said plastic envelope to form a seal therewith, means for evacuating the space enclosed by said circular ridge, and separate means for supplying a substantially inert gas at a pressure slightly above atmospheric to the last said space.

4. In the manufacture of mat switches the temporary combination of a partially completed mat comprised of a pair of spaced apart metal plates enclosed within an envelope of substantial thickness of molded resilient nonporous plastic material, said enclosure having a small opening therethrough so as to expose a small area of one of said plates, the last said plate having a hole therethrough within said opening, and an apparatus providing a member in engagement with said mat around said hole, means for clamping said member against said mat to form a seal therewith, means for evacuating the space between said plates by way of said hole and member, and means for refilling the space between said plates by way of said member and hole with a substantially inert gas.

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