United States Patent [19]

Wikkerink et al.

[11] **3,722,086**

[45] **Mar. 27, 1973**

[54] **PROCESS FOR MAKING FLOOR MAT SWITCHES**

[75] Inventors: **Lance A. Wikkerink,** Greendale; **Lee R. Wikkerink,** West Allis, both of Wis.

[73] Assignee: **Lanson Industries, Inc.,** Milwaukee, Wis.

[22] Filed: **Aug. 21, 1970**

[21] Appl. No.: **65,873**

[52] **U.S. Cl.** **29/622,** 29/627, 200/86, 264/89, 264/90, 264/272

[51] **Int. Cl.**...**H01h 11/00,** H01h 11/02, H01h 11/04

[58] **Field of Search** .....200/86; 264/89, 90, 272; 29/622, 627, DIG. 44

[56] **References Cited**

UNITED STATES PATENTS

3,166,396	1/1965	Miller et al.	29/627 UX
3,388,363	6/1968	Novick	264/272 X
3,395,209	7/1968	Millard	264/272 X

OTHER PUBLICATIONS

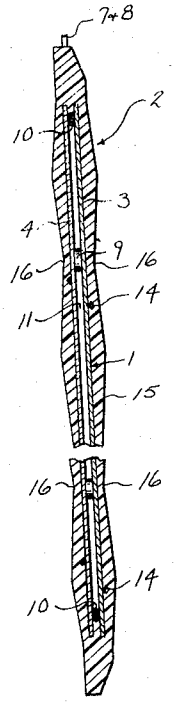
IBM, T.D.B., Vol. 8 No. 12, 5–66, page 1705 by Farrell, Herrmann and Stuby.

Primary Examiner—John F. Campbell
Assistant Examiner—Robert W. Church
Attorney—Thomas O. Kloehn

[57] **ABSTRACT**

To make a floor mat switch, a large O-ring seal is held out adjacent the periphery of one contact plate and rubber separator discs are cemented to the surface of the plate at evenly spaced intervals. A second contact plate is laid on the O-ring seal and spacer discs and the space between the two plates is evacuated. A vinyl spacer ribbon is wound about the plates. The two plates are then suspended in a composite mold in an oven, centered by the spacer ribbon. Liquid vinyl is pumped into the mold and heat cured about the plates.

9 Claims, 7 Drawing Figures



PATENTED MAR 27 1973

3,722,086

SHEET 1 OF 3

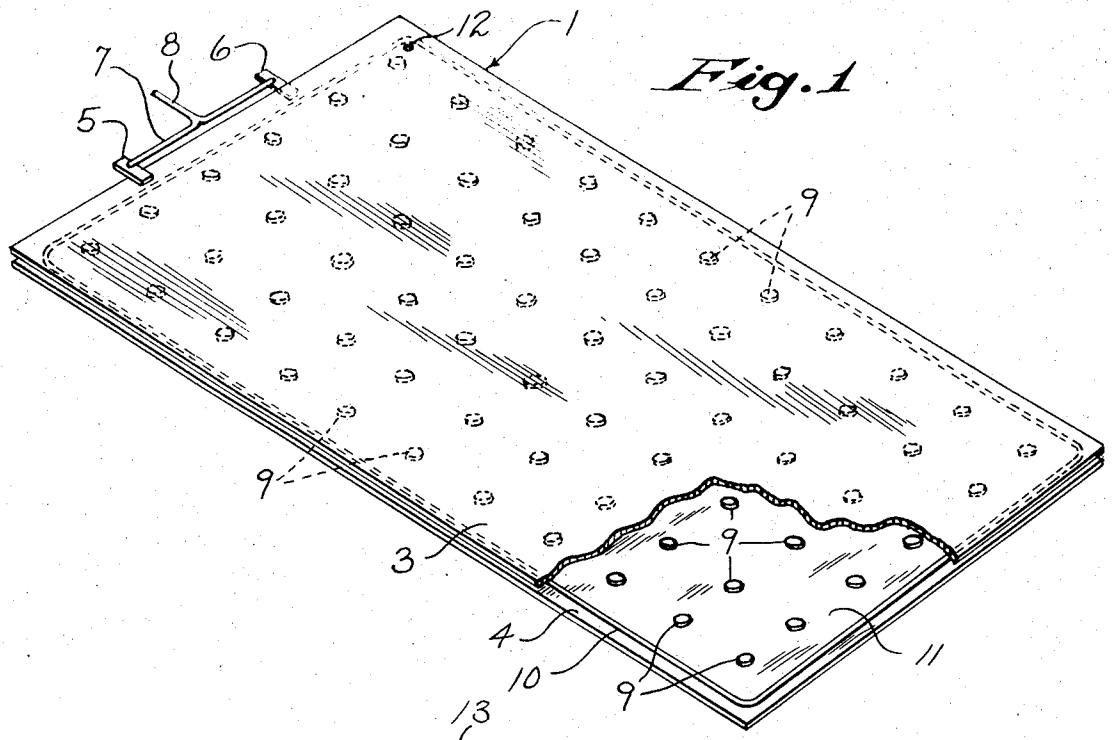


Fig. 1

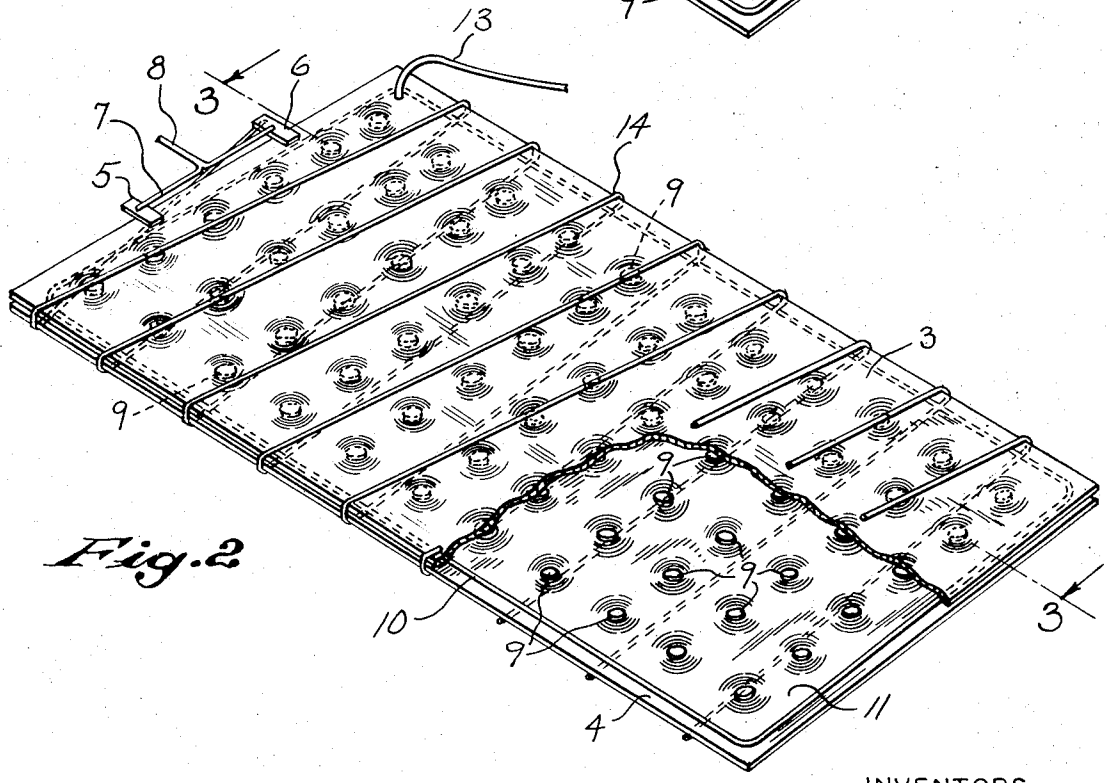


Fig. 2

INVENTORS
LANCE A. WIKKERINK
LEE WIKKERINK

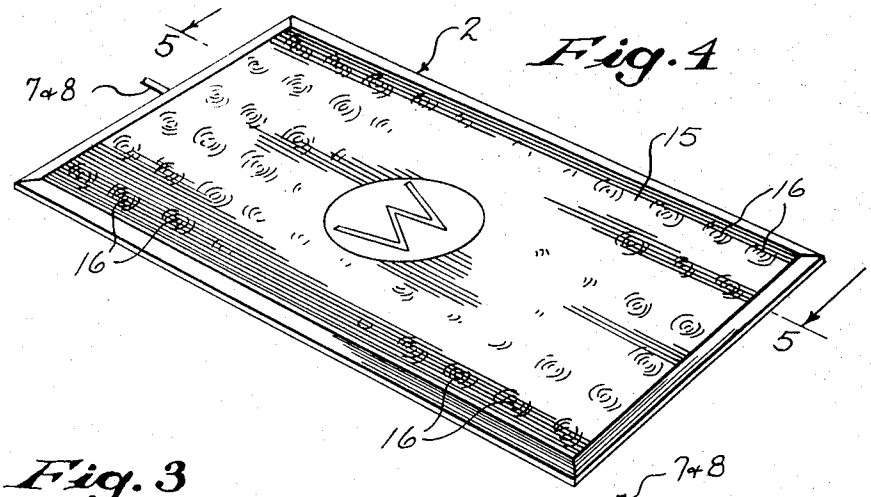


Fig. 4

Fig. 3

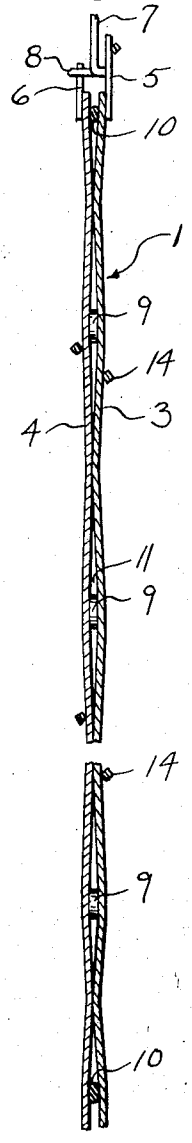
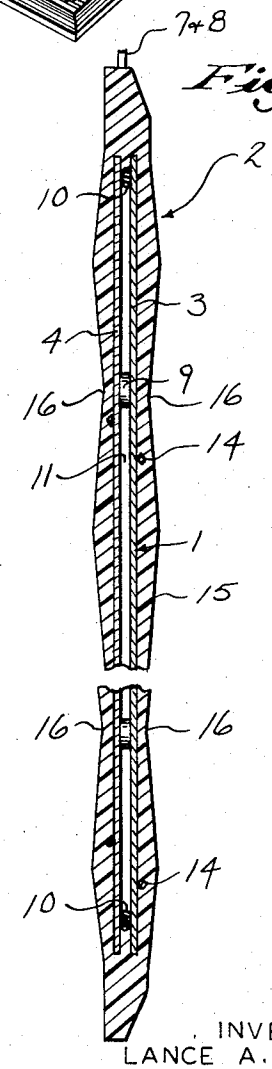
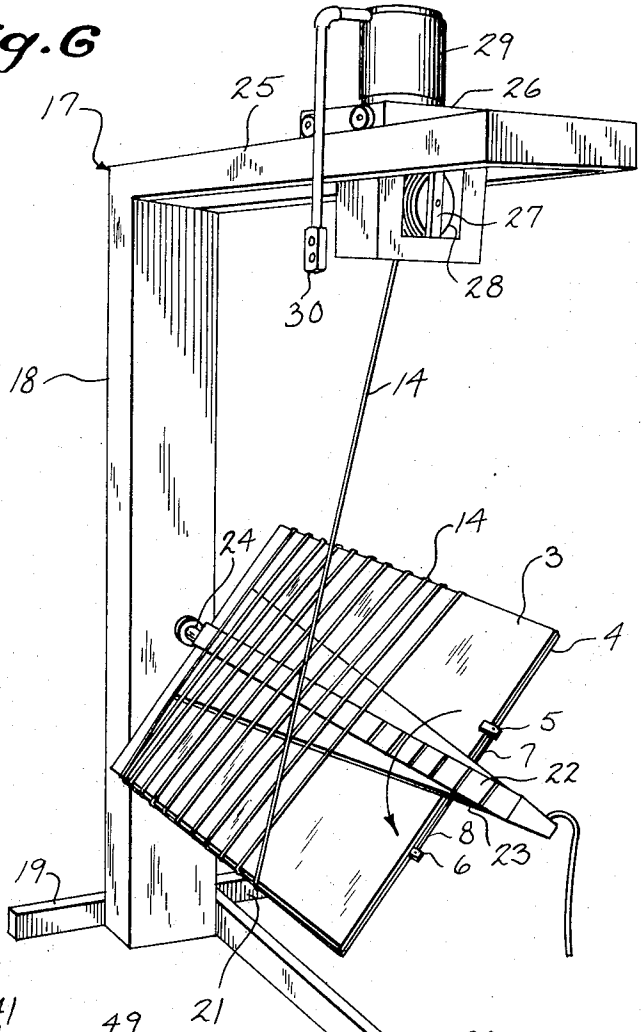


Fig. 5



INVENTORS
LANCE A. WIKKERINK
LEE WIKKERINK

Fig. 6



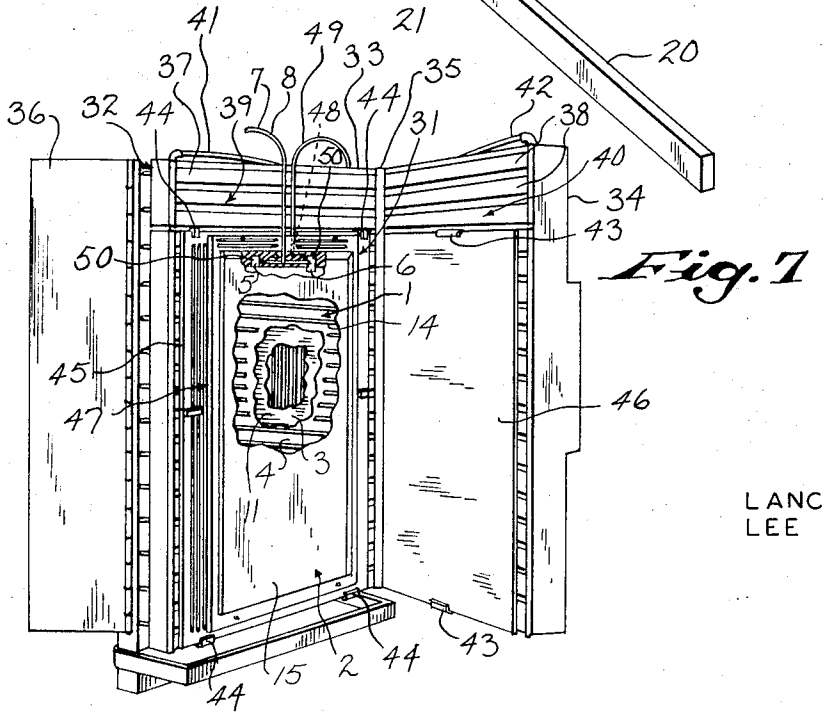


Fig. 7

INVENTORS
LANCE A. WIKKERINK
LEE WIKKERINK

PROCESS FOR MAKING FLOOR MAT SWITCHES

BACKGROUND OF THE INVENTION

Floor mat switches are commonly used to control power operated doors in public buildings, most notably in grocery stores and supermarkets. These switches appear as floor mats on either or both sides of the threshold of a power operated door and the weight of a person or a cart or other vehicle on the mat closes the switch, completing an electrical circuit which controls the power actuator to open the door. U.S. Pat. Nos. 2,972,778 and 3,136,833, which issued on the applications of one of the joint inventors of the present invention, illustrate a prior art floor mat switch and a method and apparatus for making it.

According to the prior art, a pair of aluminum contact plates would be assembled together, separated from one another by a strip of cotton webbing around the edges and a plurality of rubber rings located in depressions of one of the two plates. Then a channel shaped extrusion of vinyl plastic would be fitted over the aluminum plates about their edges to hold the structure together. The assembly would be placed in a horizontal, hollow mold resting on a number of blocks of vinyl plastic to space it from the bottom of the mold. The mold would then be closed and placed in an oven where it would be filled with liquid vinyl which would be heat cured. Utilizing this procedure and apparatus, each floor mat switch would require a substantial amount of labor and consume much time in its assembly, limiting the manufacturer's productive capacity and incurring substantial cost in production.

SUMMARY OF THE INVENTION

The present invention relates to a process for making floor mat switches, and more particularly the invention resides in the steps of assembling a pair of conductive contact plates side by side with a plurality of pads of resilient dielectric material positioned between the plates to hold them normally apart and a band of resilient dielectric material adjacent the periphery of the plates between the plates to define and seal a space between the plates, at least partially evacuating said space between the plates, forming an envelope of polymeric material about the evacuated assembly of plates to entirely enclose and seal the assembly of plates, and injecting a desired atmosphere into said space between said plates. The invention also resides in wrapping a ribbon of polymeric material about the evacuated assembly of contact plates to accurately locate said assembly of contact plates in a mold prior to casting an envelope of polymeric material about said plates. The invention also resides in a machine for wrapping a ribbon of polymeric material about the evacuated assembly of contact plates. The invention also resides in an apparatus for forming an envelope of polymeric material about an evacuated assembly of contact plates comprising a two part oven with heating elements in each part which parts are adapted to be closed together, and a composite mold to be mounted vertically in said oven and including a back plate to be mounted on one of the two members of said oven and a top plate to be mounted on the other member of said oven with a frame defining a desired perimeter for a floor mat switch mountable on one of said plates with means to suspend an evacuated assembly of contact plates within said frame and having a sprue for introducing a liquid polymeric material into said composite mold about said evacuated assembly of contact plates.

The foregoing process and apparatus provide means for manufacturing floor mat switches with greatly reduced labor requirements and in much less time than had previously been possible. The use of the composite mold as set forth in the foregoing combination minimizes the inventory of mold components required to provide the usual range of options in size and configuration of floor mat switches to meet the needs of various customers. This greatly reduces the cost of production. The use of spirally wound spacer ribbon instead of blocks to locate the assembly of contact plates in the mold increases the accuracy of the location of the assembly plates while greatly reducing the time and labor otherwise required to mount the assembly in the mold. Mounting the mold in the oven likewise reduces the labor and time required to manufacture the switch.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is an isometric view of an assembly of contact plates with portions broken away to illustrate interior structure,

FIG. **2** is an isometric view of an assembly of contact plates with spacer ribbons spirally wound about them and portions broken away to illustrate interior structure,

FIG. **3** is a view in section of the evacuated assembly of contact plates shown in FIG. **2** taken along the line **3—3** in FIG. **2**,

FIG. **4** is an isometric view of the floor mat switch made according to the present invention.

FIG. **5** is a view in section of the floor mat switch shown in FIG. **4** taken along the lines **5—5** in FIG. **4**,

FIG. **6** is an isometric view of apparatus for spirally winding spacer ribbon about evacuated assembly unit of contact plates, and

FIG. **7** is an isometric view of an oven and mold for casting an envelope about an evacuated assembly of contact plates with portions broken away to illustrate interior structure.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

A switch mechanism **1** for a floor mat switch **2** consists of two spaced apart contact plates **3** and **4**. The contact plates **3** and **4** are sheets of slight gauge spring steel which are flexible and highly resilient. Each of the contact plates **3** and **4** have a tab **5** and **6**, respectively, welded to it to project from one end and to which lead wires **7** and **8**, respectively, are soldered.

The contact plates **3** and **4** are normally spaced apart and electrically isolated from one another by a plurality of pads **9** of resilient dielectrical material, and in the preferred embodiment the pads **9** are 1/16 inch discs of rubber, which are positioned at evenly spaced locations between the contact plates **3** and **4**. A band **10** of resilient dielectric material positioned between the contact plates **3** and **4** adjacent their peripheral edges serves to space the edges of the contact plates **3** and **4** apart and to seal and define a space **11** between the contact plates **3** and **4**. In the preferred embodiment,

the band 10 is an O-ring seal having a circular cross section oneeeighth inch in diameter.

To assemble the switch mechanism 1, the pads 9 are cemented to the inside surface of the lower contact plate 4 in the desired locations and the sealing band 10 is positioned adjacent to the periphery of the contact plate 4 and then the contact plate 3 is placed upon the pads 9 and the band 10. A hole 12 through the corner of the contact plate 3 is connected to a vacuum line 13 and the air is evacuated from the space 11 enclosed between and defined by the contact plates 3 and 4 and the sealing band 10. When the space 11 is evacuated, ambient atmospheric pressure collapses the flexible plates 3 and 4 together in the spaces around the pads 9 as can be seen in FIG. 3 with the result that the switch mechanism 1 becomes a unified structure that it is easily and conveniently handled. Then a spacer ribbon 14 of polymeric material is spirally wrapped about the evacuated contact plate assembly. In the preferred embodiment, the spacer ribbon 14 is a ribbon of clear vinyl material having a square cross section and it is twisted as it is wound about the switch mechanism 1.

Next an envelope 15 of polymeric material is formed about the switch mechanism to completely enclose the switch mechanism and seal it from ambient atmosphere. In the preferred embodiment the envelope 15 is a vinyl plastic which is cast about the switch mechanism 1 in a liquid form and cured to its solid, resilient form. The rubber of the O-ring seal 10 and the vinyl of the envelope 15 are selected so that the vinyl envelope 15 will form a bond with the O-ring seal 10 along their areas of contact thus perfecting the seal of the space 11 between the contact plates 3 and 4. Then a hollow needle is inserted through the envelope 15 and into the space 11, and the space 11 is filled with a dry atmosphere of some desired or convenient composition which could be air or an inert gas. The restoration of air pressure in the space 11 allows the contact plates 3 and 4 to spring back to their normal, substantially parallel relationship so that they are out of electrical contact with one another. When this is done, the mat switch 2 will appear to have depressions 16 at each location of a pad 9. These depressions 16 occur as a result of the formation of the envelope 15 about the switch mechanism 1 while the space 11 between the contact plates 3 and 4 is evacuated so that the contact plates 3 and 4 are collapsed together and the envelope 15 of vinyl plastic is thicker between the pads 9 than over the pads 9.

The assembly of the switch mechanism 1 can be carried out on an ordinary work bench. Then the evacuated assembly of contact plates 3 and 4 is mounted in a machine 17 which wraps the spacer ribbon 14 spirally about the evacuated assembly of contact plates 3 and 4. The wrapping machine 17 has a main supporting post 18 which is a hollow rectangular steel structure that is stabilized in an upright position by three horizontal feet 19, 20 and 21 projecting from its bottom end to rest on the floor. Part way up the main supporting post 18 a pair of spaced apart, tapered blades 22 and 23 are horizontally mounted on a power rotated shaft 24 which is rotatably end mounted in the main supporting post 18, which contains the drive means for the shaft 24.

A horizontal track 25 projects from the top of the main supporting post 18 above and parallel to the blades 22 and 23, and a carriage 26 rides along the track 25. The carriage 26 contains a swivel mounted stirrup 27 which rotatably supports a spool 28 of spacer ribbon 14 so that the stirrup 27 can rotate about an axis perpendicular to the axis of the spool 28. An electric motor 29 on the carriage 26 is connected to spin the stirrup 27 about its vertical axis, and the electric motor 29 is controlled from a switch 30 on the end of a handle, which is used to move carriage 26 along track 25.

When the evacuated assembly of contact plates 3 and 4 is placed between the blades 22 and 23 on the wrapping machine 17, the blades 22 and 23 may be clamped or tied together at their external ends to grip the contact plate assembly tightly between them. After the end of the spacer ribbon 14 from the spool 28 is tied to the contact plate assembly, the shaft 24 mounting the blades 22 and 23 is started rotating so that the spacer ribbon 14 is wound about the plates 3 and 4, pulling the ribbon 14 from the spool 28. Meanwhile the electric motor 29 driving the stirrup 27 is started so that the spool is twisted about a vertical axis as the spacer ribbon 14 is pulled from it and simultaneously the carriage 26 is pulled along the track 25. Hence the spacer ribbon 14 is spirally wound along the length of the contact plate assembly until it reaches the other end, when the machine is stopped and the end is cut off and tied to the tab 5 on the contact plate 3 to secure it.

The spacer ribbon 14 is made of the same vinyl material as the envelope 15 so that it will become fused in the envelope in the completed floor mat switch 2. Since the vinyl of the envelope 15 will be pigmented or otherwise colored to meet the demands of the customer, the spacer ribbon 14 is made of a clear vinyl so that it will be invisible in the final product. It is important that the spacer ribbon 14 be twisted as it is wound about the contact plate assembly to facilitate the flow of liquid vinyl for the envelope 15 about the spacer ribbon and along the surface of the contact plates 3 and 4.

The evacuated assembly of contact plates 3 and 4 with the spacer ribbon 14 thus would about it is vertically mounted in a composite mold 31 in an oven 32. The oven 32 is made up of two main members 33 and 34 joined together along one vertical edge by a hinge 35, and it has a latch 36 hinged to the stationary member 33 along the other edge to latch the members 33 and 34 closed during the molding and curing operation. Each of the members 33 and 34 has a plurality of heating elements 37 and 38, respectively, extending horizontally across its respective inside surface 39 and 40. In the preferred embodiment, the heating elements 37 and 38 are flattened steam conduits fed by steam pipes 41 and 42. Inside surfaces 39 and 40, respectively, of the oven members 33 and 34 also have mounting means 43 and 44, respectively, for supporting the composite mold 31.

The composite mold 31 is made up, essentially, of three components, a back plate 45, a top plate 46 and a frame 47. In the preferred embodiment, the back plate 45 is a flat aluminum plate 45, which is clamped to the inside surface 40 of the swinging member 34 of the oven by the mounting means 44. The top plate 46 is clamped by the mounting means 43 to the inside surface 39 as a stationary oven member 33 to be in alignment with the back plate 45 when the oven 32 is closed.

The inside surface of the top plate **46** is a negative configuration of the desired tread **48** of the completed floor mat switch **2**. The frame **47**, which bears the peripheral configuration of the completed floor mat switch **2**, is screw fastened to the top plate **46**. The frame **47** also bears the desired configuration of the border about the edge of the completed floor mat switch **2**, which may be beveled, or it may be grooved to interlock with an adjacent floor mat switch, or it may be any other design requested by the customer. The top of the frame **47** has a vertical sprue **48** communicating through it to receive a conduit **49** from a reservoir (not shown) of liquid vinyl. Finally, hangers **50** project horizontally from the frame **47** to fit through holes in the tabs **5** and **6** projecting from the ends of the contact plates **3** and **4**.

The evacuated assembly of contact plates **3** and **4** is vertically suspended in the composite mold **31** by the tabs **5** and **6** which are hung on the hangers **50** projecting from the frame **47**. The lead wires **7** and **8** which are bound together in a single conduit are then drawn out of the oven **32** for convenience and the swinging member **34** of the oven is closed against the stationary member **33** and latched tightly shut. This closes the composite mold **31**. The spacer ribbon **14** is selected for its cross sectional dimensions so that it will accurately center the evacuated assembly of contact plates **3** and **4** inside of the composite mold **31**. After the oven **32** is thus latched shut, liquid vinyl is pumped through the conduit **49** to fill the composite mold **31** while the oven **32** is heating. After several minutes the liquid vinyl has been cured to its final, solid, resilient condition. After the heat is turned off, the oven **32** may be opened and the completed floor mat switch easily stripped from the composite mold **31**.

As is readily apparent from the foregoing description of the preferred embodiment of the invention, the switch mechanism **1** can be quickly assembled together with a minimum of labor, and once the contact plate assembly **3** and **4** which makes up the switch mechanism **1** has been evacuated, it becomes a a rigid unitary structure, which a single workman can easily handle and mount between the blades **22** and **23** of the wrapping machine. The spacer ribbon **14** is then rapidly spirally wound about the evacuated assembly of contact plates **3** and **4**, which then can be removed from the wrapping machine and quickly hung in the composite mold **31** so that the envelope **15** can be cast about it and cured. The size of the floor mat switch **2** is easily changed with a minimum of expense and effort by changing the frame **47** that is mounted on the top plate **46**, and a wide variety of border designs can be achieved in the same manner If a different back configuration or tread configuration is desired for the floor mat switch **2**, then a different back plate **45** or top plate **46** may be employed. Thus a wide variety of designs for floor mat switches **2** can be manufactured with a minimum tool inventory.

The invention in which the above described preferred embodiment participate is set forth in the claims that follow.

We claim:

1. A process for making a floor mat switch having a pair of normally spaced apart electrically conductive contact plates encased in an envelope of polymeric material, the process comprising the steps of,

selecting a pair of electrically conductive contact plates of length and width sufficient to span a predetermined pedestrian passageway, and of material and thickness such that at least one of said electrically conductive contact plates is resiliently flexible to bend under external pressure into contact with the other of said electrically conductive contact plates;

placing a plurality of resilient dielectric pads at spaced locations on a surface of a first of said pair of electrically conductive contact plates and placing a sealing band of resilient dielectric material on said surface adjacent to and about the periphery of said first electrically conductive contact plate;

assembling a second of said pair of electrically conductive contact plates substantially parallel with said first electrically conductive contact plates adjacent to said surface and against said sealing band and said resilient dielectric pads to define a sealed enclosed space between said electrically conductive contact plates;

evacuating air from said sealed enclosed space between said electrically conductive contact plates to allow ambient atmospheric pressure to at least partially collapse said electrically conductive contact plates together to form an evacuated assembly of said electrically conductive contact plates held together by ambient air pressure;

encasing said evacuated assembly of electrically conductive contact plates in an envelope of polymeric material to enclose and seal said evacuated assembly of electrically conductive contact plates from ambient atmosphere;

and injecting a predetermined atmosphere into said space between said assembly of electrically conductive contact plates to restore said electrically conductive contact plates to a substantially parallel spaced apart relationship.

2. A process for making a floor mat switch as set forth in claim **1** wherein,

said evacuated assembly of contact plates is placed in a mold having an internal configuration corresponding to a desired external shape of a completed floor mat switch;

and a polymeric material is injected into said mold about said evacuated assembly of contact plates and said polymeric material is cured to a solid resilient condition.

3. A process for making a floor mat switch as set forth in claim **2** wherein,

a ribbon of polymeric material is spirally wrapped about said assembled evacuated electrically conductive contact plates before said assembled evacuated electrically conductive contact plates are placed in said mold to properly locate said assembled evacuated electrically conductive contact plates in said mold.

4. A process for making a floor mat switch as set forth in claim **3** wherein,

said ribbon has a generally rectangular cross section and is twisted when it is wound about said evacuated assembly of contact plates.

5. A process for making a floor mat switch set forth in claim **2** wherein,

an electrically conductive tab is fastened to each of said contact plates to project laterally from said

contact plates when said contact plates are assembled together;

and said evacuated assembly of contact plates are supported in said mold on said tabs.

6. A process for making a floor mat switch as set forth in claim 5, wherein,

said mold is vertically mounted in an oven;

said evacuated assembly of contact plates is suspended in said mold from said tabs;

said polymeric material is injected into said mold in a liquid form and cured to a solid resilient envelope in said mold;

and said mold is opened and a completed floor mat switch is removed from said mold.

7. A process for making a floor mat switch having a pair of normally spaced apart contact plates encased in an envelope of polymeric material, the process comprising the steps of,

selecting a pair of electrically conductive contact plates of length and width sufficient to span a predetermined pedestrian passageway, and of material and thickness such that at least one of said contact plates is resiliently flexible to deform under external pressure into contact with the other of said contact plates when said pair are assembled together in normally spaced apart relationship;

placing a plurality of dielectric pads at spaced locations on a surface of a first of said pair of contact plates and placing a sealing band of dielectric material on said surface adjacent to and about said periphery of said first contact plate;

assembling a second of said pair of electrically conductive contact plates adjacent to said first electrically conductive contact plate against said sealing band and said dielectric pads in normally spaced apart relationship with said first electrically conductive contact plate to form an assembly of said contact plates;

wrapping ribbon of polymeric material about said assembly of contact plates;

placing said assembly of contact plates in a mold such that said ribbon locates said assembly of electrically conductive contact plates in predetermined spaced relationship within the inside of said mold;

and injecting a polymeric material compatible with said ribbon into said mold about said assembly of electrically conductive contact plates to fuse with said ribbon forming a substantially homogeneous envelope of polymeric material about said assembly of electrically conductive contact plates.

8. A process for making a floor mat switch as set forth in claim 7 wherein

said ribbon has a rectangular cross sectional shape and is twisted to facilitate flow of said polymeric material injected into said mold.

9. A process for making a floor mat switch as set forth in claim 7 wherein

said ribbon is spirally wrapped about said assembly of electrically conductive contact plates.

* * * * *