

[54] FLOOR MAT WITH ELECTRICAL SWITCH

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[75] Inventor: Barry G. Newman, Monsey, N.Y.

[73] Assignee: Marc Manufacturing Inc., Stratford, Conn.

Primary Examiner—David Smith, Jr.
Attorney, Agent, or Firm—Ernest M. Junkins

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[56] References Cited

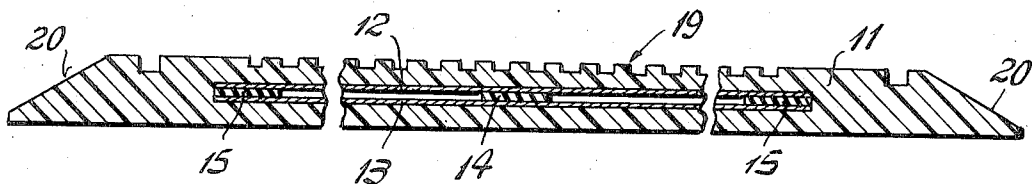
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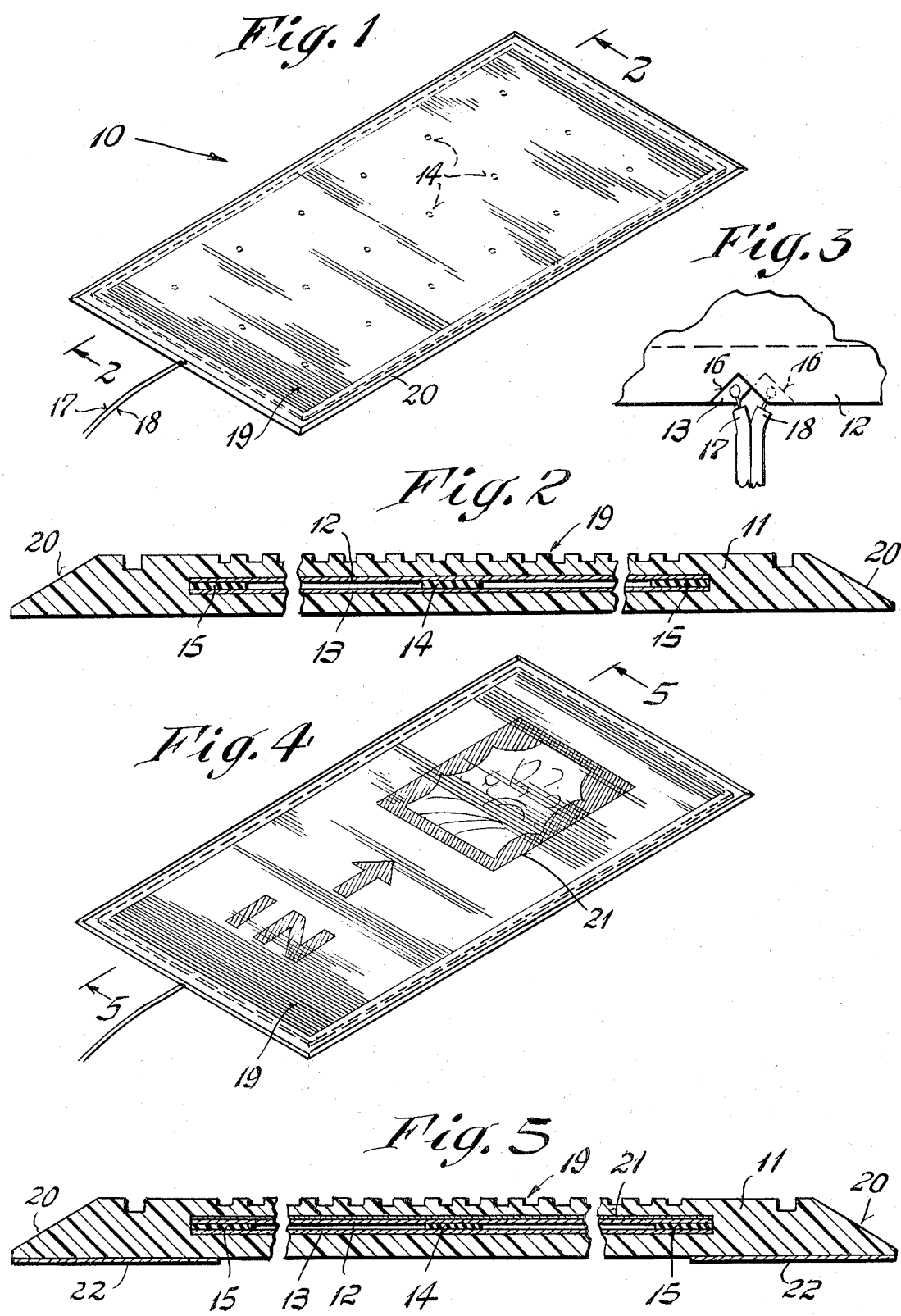
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[57] ABSTRACT

A floor mat which produces an electrical signal upon a force being applied, as by being stepped upon, by the force flexing a portion of a pair of spaced apart metal plates into engagement to complete a circuit and in which the plates are embedded within and adhered to a thick cured polyurethane covering material.

3 Claims, 5 Drawing Figures





FLOOR MAT WITH ELECTRICAL SWITCH

The electrical switch floor mat to which the present invention is directed has special utility when used to control the automatic opening of a door for a pedestrian or a vehicle. Normally such a mat is positioned on the floor adjacent the door and the force applied by a weight thereon causes closing of the switch within the mat which completes a circuit that controls an automatic door opening mechanism. With the removal of the weight, the circuit becomes open and the door closes.

The electrical components include a pair of metal plates, substantially the same size as the mat, that are normally placed slightly apart by resilient inserts therebetween. When a weight is applied, the inserts are compressed and the upper plates flexes somewhat so that it touches the lower plate in the area where the weight is applied to complete the circuit between the two plates. Upon removal of the weight, the plates again revert to being spaced apart and non-touching.

To provide protection for the plates, a skid resistant surface, acceptable appearance, etc., the plates have heretofore been enclosed in a covering material, either by laminating them between two layers of resilient material or by molding the material about the plates with the material heretofore suggested being rubber and/or polyvinyl chlorides. Such mats however have not been found sufficiently satisfactory because they malfunctioned easily and were not durable. One reason for this appears to be that the covering material merely acted as an envelope for the plates without any significant cooperation between the covering material and the plates.

It is accordingly an object of the present invention to provide a floor mat which has a weight responsive electrical switch which is extremely durable, but still remains relatively sensitive to a light actuating weight.

Another object of the present invention is to provide a floor mat of the above type in which the covering material is made to adhere to and remain bonded to the plates over the useful life of the mat.

A further object of the present invention is to provide a weight responsive floor mat which, while achieving the above objects, is capable of being reliably manufactured by having the covering material molded about the plates.

Another object of the present invention is to provide a floor mat of the above type in which a visible design may be easily incorporated into the mat.

In carrying out the present invention, the floor mat includes a pair of sheet metal plates that are relatively thin so as to be somewhat flexible and which are just slightly smaller in shape than the mat. Thin inserts of resilient insulating material such as sponge rubber are glued at spaced locations between the plates intermediate the edges while similar material is located about the edges. The plates are then positioned in a mold and a curable polyurethane resin composition is flowed about the plates to completely cover them and to have the desired shape of the final mat. The polyurethane composition is then cured to produce the finished mat.

Of particular importance in the present invention is the preparation of the surface of the plates and the selection of polyurethane covering material to secure a bond therebetween. The bond aids the mat in being

substantially more resistant to abuse that had heretofore caused malfunctioning and hence more durable.

While the polyurethane covering may have the color which the mat is desired to have, it has also been found that an essentially clear polyurethane material may also be used. With clear material, a design may be painted onto the top surface of the plate with an enamel or the like and be visible through the covering. Such an enamel moreover is selected to maintain the adhesion between the covering material and the plates.

Other features and advantages will hereinafter appear.

In the drawing:

FIG. 1 is a perspective view of a floor mat, made in accordance with the present invention, somewhat reduced in size.

FIG. 2 is a cross-section taken on line 2—2 of FIG. 1, enlarged to full size.

FIG. 3 is a diagrammatic representation showing electrical connections to the metal plates.

FIG. 4 is a view similar to FIG. 1 but having a visible design.

FIG. 5 is a cross-section, taken on line 5—5 of FIG. 4, enlarged to full size.

Referring to the drawing, the mat of the present invention is generally indicated by the reference numeral 10 and consists of a polyurethane covering material 11 into which is embedded a pair of identical steel plates 12 and 13. The plates are preferably formed of sheet steel, of 22 or 26 gauge thickness, and are separated by a plurality of small rubber compressible inserts 14 glued to the plates at selected intervals throughout the plates. In addition, a similar strip of rubber, such as sponge rubber, having a rectangular cross-section and indicated by the reference numeral 15 is glued about the edges of the plates to enclose the periphery thereof.

As shown in FIG. 3, each of the plates may have a similar off centered cut-out 16, so that a wire 17 may be soldered or otherwise secured to the lower plate 13 and a similar wire 18 secured to the upper plate. If a voltage is applied across the two wires 17 and 18 and a weight is applied to the plate, the rubber inserts 14 will be compressed and the plate will flex slightly so that the upper plate touches the lower plate to complete the circuit between the two wires 17 and 18. When the weight is removed, the plates separate to open the circuit. If they do not, and they continue to touch without a weight on the mat, then the switch is malfunctioning.

The particular spacing of the inserts 14, their resilience and thickness, basically set the weight which operates the switch. In one example, where the mat is about 3 × 6 feet, the insert 14 (and strip 15) are 1/16 of an inch thick and positioned on about 10 inch squares so that the normal space between the plates is about 1/16 of an inch which enables a person having a weight of more than 30 lbs. or so to operate the switch.

The plates 12 and 13 are encased by the covering material 11 with the latter having a thickness of perhaps 1/2 inches. The upper surface 19 of the covering may be grooved in order to provide a slip resistant surface while the edges may be beveled as at 20 to facilitate securing of the mat to the floor by the use of elongate metal clips. It will be understood that in addition to the size of the mat being variable, the surface 19 may also

be of a different grooved construction as may the edges 20.

The covering 11 is colored to make it opaque and render the plates indiscernable with one common color being black. With an opaque covering, it was quite difficult to form in the covering a design or other visible signs of a different color or colors on the surface. However the mat shown in FIGS. 4 and 5 enables a visible design to be easily incorporated into the mat. The design is formed as a painted film 21 on the upper surface of the upper plate 12 with the film's thickness being exaggerated for clarity in the drawing. The covering material 11 is clear or slightly colored, as for example, only a light amber and thus when the plates are embedded in the covering material the film 21 clearly shows to be visible. Thus, by simply painting the film 21 to have the desired design and using an essentially colorless covering material 11, a visible design may be easily incorporated into the mat. Moreover, in order to disguise the colorless edges of the mat, where the plates are not present, a film of paint, as for example 22, may be applied to the bottom surface of the mat and have a color which corresponds to the background color of the film 21 to thus provide the same color along the edges of the mat as in the design to thereby disguise the edges of the plates.

In both embodiments of the invention, the covering material 11 is a polyurethane material that is preferably formed into the desired shaped mat by being poured into a mold having a cavity that corresponds to the desired shape of the mat with the plates 12 and 13 being positioned within the mold. The liquid curable polyurethane resin composition flows throughout the cavity to assume its shape, is then substantially cured or hardened and the finished cured mat is then removed from the mold.

One form of polyurethane material that has been found especially advantageous in the present invention is a type of polyurethane material that is used as mold-forming material for casting plastic parts in the furniture industry. Such polyurethane material is used to form flexible molds, for molding rigid foam furniture parts. One type of material that has been found to be advantageously employed has the properties, after being cured at 80° C. for 16 hours, of being normally light amber in color, having a tensile strength of 2200 psi., an elongation percentage of 900 percent, a tear strength of 250 Graves, pli; a hardness of 75 plus or minus 5 Shore A, and a shrinkage of .5 to .75 percent. One type of such material is sold under the tradename "CONATHANE" TU-80 by Conap, Inc., Allegany, N.Y. 14706.

In both embodiments, the adherence of the polyurethane covering to the surfaces of the plates basically approximates the cohesion of the cured polyurethane elastomer so that an attempt to strip the covering from the plates is as apt to result in a tearing of the polyurethane covering as it is to become free from the plates. Moreover, as the polyurethane is applied throughout the surfaces of the plate and as the plate surfaces have throughout been treated so as to be free of material which would prevent adhesion, the same adhesion exists throughout the entire surfaces of the plates.

The use of a polyurethane that assures adhesion to the plates 12 and 13 provides a mat that is substantially more capable of resisting abuse, before malfunctioning, than in other kinds of floor mats. One type of normal

abuse is the cutting of a slit in the top surface of the covering to the top surface of the plate 12. However, with the adhesion present as herein disclosed, the only portion of the plate 12 that is susceptible to moisture occurring in the slit is only at the slit as the adhesion prevents the spreading of the moisture between the covering and the plates to enter between the two plates and short circuit them. Another type of normal abuse is caused by extremes in temperatures which tends, without adhesion, to form a slight bubble between the plate and the covering material and as the mat is continually stepped on the bubble in effect spreads and not only becomes a possible hazard but also could be forced towards the edges of the mat and serve to form an opening in the mat again through which moisture could enter to effect either a short circuiting or a rusting of the plate.

Still another type of abuse which could cause malfunctioning of the mat is that which may result from dents when for example a small stone has a heavy weight placed thereon so that the stone forms a small inwardly extending dent that remains even after the plates resume their normal spaced apart position. It has been found that the adhesion of the polyurethane covering to the plates makes the mat less subject to this type of malfunctioning by reason not only of the characteristics of the polyurethane covering but also by the adhesion thereof to the plates increasing the resistance of the material 11 to spreading when a heavy weight is applied to a small area.

While one specific composition of polyurethane material has been set forth, it will be understood that other and different compositions may be used provided each has the necessary exterior physical properties such as tear resistance, toughness, etc.; is capable of being molded about the plates so as to form the mat without any seams and is capable of adhering to the plates. Similarly, the type of paint for forming the design film 21 also has to be selected so as to provide the above described adhesion with the polyurethane covering material. Commercially available spray-can enamels have been found to be successful. When the plates are used directly as in FIGS. 1 and 2, they are preferably chemically cleaned to assure adhesion.

It will accordingly be appreciated that there has been disclosed a floor mat having an electrical switch which is actuated by a weight on the mat. This weight which may be on the order of 30 lbs. or so in the area of the size of a human foot, causes a flexing, at least in the area where the pressure is applied, to occur of a steel plate which is formed to be one part of a circuit and there is sufficient flexing to cause the plate to engage a bottom plate which is connected to the other side of an electrical circuit to thereby close the circuit. Such a signal may be used to operate an automatic door opener. It has been found that a floor mat may be rendered substantially more durable and resist abuses which could cause malfunctioning if the steel plates are embedded in a cured polyurethane elastomer which, while also having its own characteristics, is caused to adhere throughout to the surfaces of the plates. This adherence has been found to increase the abuse which the mat may resist before it malfunctions.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

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1. A floor mat for providing an electrical signal upon a weight being applied thereto comprising a pair of somewhat resilient metal plates, means resiliently maintaining the plates contiguous and slightly spaced apart, an electrical connector to each plate and a cured polyurethane one piece covering material completely enclosing said plates to form a mat slightly larger than the plates by said covering material being molded to the desired shape with the plates being positioned therein, said covering material being cohesive and adhering to the plates throughout their contacting surfaces and in which the adhesion of the covering material through the surfaces of the plates essentially approximates the cohesion of the covering material.

2. A floor mat for providing an electrical signal upon 15

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a weight being applied thereto comprising a pair of somewhat resilient metal plates, means resiliently maintaining the plates contiguous and slightly apart, an electrical connector to each plate and a cured polyurethane covering material completely enclosing said plates to form a mat slightly larger than the plates, a film adhered to the top surface of the top plate forming a design and in which a polyurethane covering is essentially colorless and adheres to the film whereby said design is visible through the film.

3. The invention as defined in claim 2 in which at least the bottom surface of the periphery of the covering material extending beyond the plates is covered by an opaque film.

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