

Dec. 4, 1956

S. S. ROBY ET AL  
FOUR PLATE MAT SWITCH

2,773,148

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2 Sheets-Sheet 1

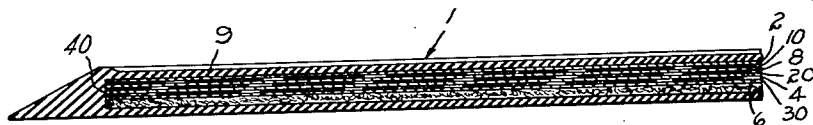


FIG. 1

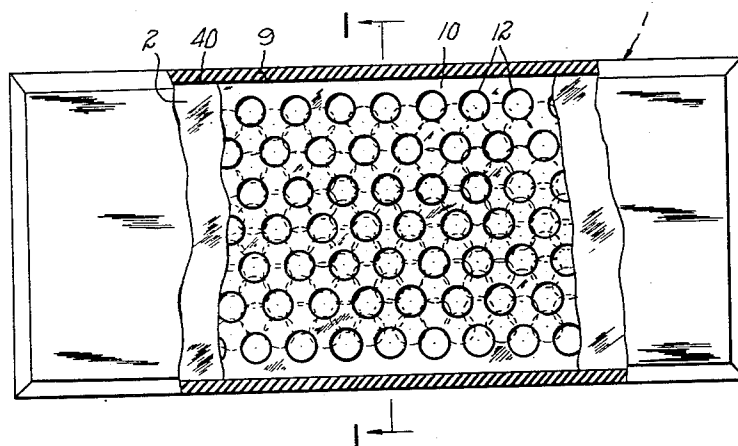


FIG. 2

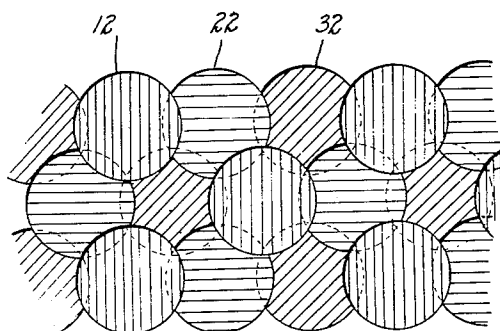


FIG. 3

INVENTORS  
SHELDON S. ROBY  
BY CHAMBERLAIN FERRY

*Lindsey and Prutzman*  
ATTORNEYS

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**FIG. 4**

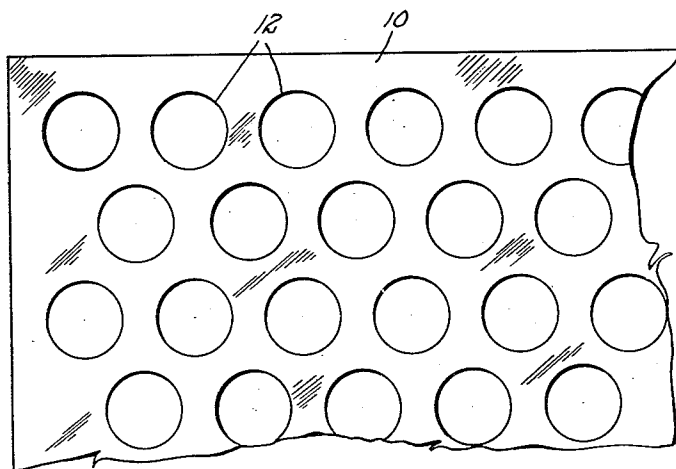
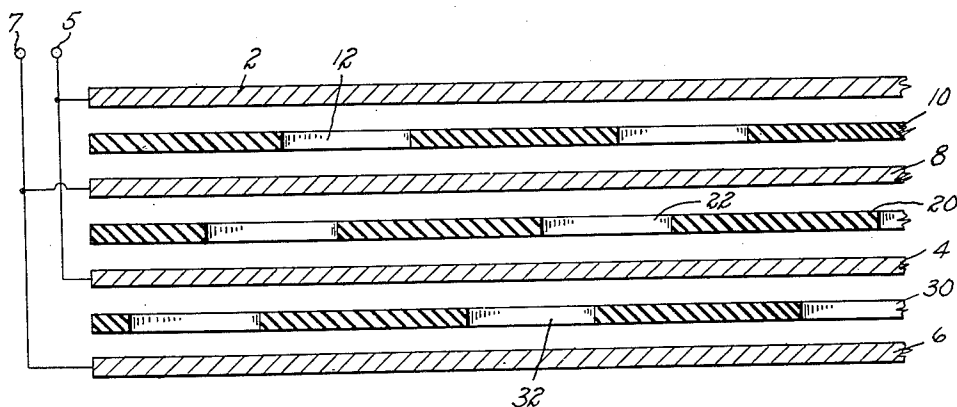


**FIG. 5**



INVENTORS  
SHELDON S. ROBY  
BY CHAMBERLAIN FERRY

*Lindsey and Prutzman*  
ATTORNEYS

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2,773,148

## FOUR PLATE MAT SWITCH

Sheldon S. Roby, Meriden, and Chamberlain Ferry, Kensington, Conn., assignors to The Stanley Works, New Britain, Conn., a corporation of Connecticut

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6 Claims. (Cl. 200—36)

The present invention relates to electric mat switches for controlling the operation of doors or the like in response to pressures applied thereon.

Particularly the invention relates to mat switches of the type comprising a multi-layer sandwich of several flexible metal plates maintained in normally closely separated relation by pieces of insulating material, the insulating material being suitably arranged to provide gaps allowing deflection of the metal plates into electrical contact when the sandwich is squeezed or pressed together, for example, by the weight of a pedestrian walking on the mat or a vehicle rolling on the mat.

For effective and reliable operation of mat switches of this type, it is important that contact be made when the plates are subjected to pressures greater than a predetermined minimum, regardless of where on the mat the pressure is applied. It is also important that contact be maintained as the point of pressure is moved across the mat as, for example, when a pedestrian walks across the mat. Thus sensitivity of the mat switch to pressure applied at any point thereon is highly desirable for dependable operation.

It is an object of the present invention to provide a mat switch of the aforesaid type having improved sensitivity to pressures applied at any point on its entire surface.

Another object is to provide a mat switch of the character described which is particularly suitable for construction and assembly at low cost, and for manufacture in a wide range of operating pressures.

Another object is to provide a mat switch of the aforesaid type in which the plate separating elements can be formed as integral apertured sheets, and can be assembled between the metal plates and properly located for correct operation of the switch without the use of adhesives.

Other objects will be in part obvious, and in part pointed out more in detail hereinafter.

The invention accordingly consists in the features of construction, combination of elements and arrangement of parts which will be exemplified in the construction hereafter set forth and the scope of the application of which will be indicated in the appended claims.

In the drawings:

Figure 1 is a vertical sectional view of a portion of the mat switch constructed in accordance with the present invention, taken on the line 1—1 of Figure 2;

Figure 2 is a plan view of the mat switch with portions cut away to show the arrangement of certain parts;

Figure 3 is a diagrammatic view, to an enlarged scale, illustrating the relative arrangement of certain portions of the mat switch structure.

Figure 4 is a plan view of a portion of the structure shown in Figure 2; and

Figure 5 is an enlarged view of a portion of the structure shown in Figure 1, particularly illustrating the arrangement of the parts, and showing schematically the electrical terminals associated therewith.

Referring to the drawing, a mat switch constructed in accordance with the present invention includes a sandwich 1 of four superposed metal plates separated by suitable pieces of non-conducting material, such as stiff paper, which serve to support the plates in normally closely spaced parallel relation. The upper metal plate 2 and the

2

lower middle metal plate 4 are normally connected electrically to a first common electrical terminal 5. The lower metal plate 6 and upper middle metal plate 8 are connected electrically to a second terminal 7. With this arrangement it will be recognized that physical contact between any two adjacent plates will close the circuit between the two electrical terminals 5 and 7, and thus perform a switching operation which can be employed for any desired control purpose, such as the opening of a door or the like. The entire sandwich may be enclosed, if desired, in a suitable weatherproof envelope 9 of rubber or the like, which may be corrugated on its upper surface to provide a suitable tread. The metal plates in the sandwich are preferably thin enough to be flexible and resilient and may be constructed, for example, of sheet aluminum having a thickness of about  $\frac{1}{32}$ ".

In accordance with the present invention, the pieces of insulating material separating each pair of adjacent metal plates are preferably formed as an integral thin sheet of non-conducting material which is provided with a plurality of perforations. The perforations are spaced at regular intervals and of sufficient size to permit deflection of one plate into contact with the other plate in response to pressure of the desired amount being applied to the plates in line with one of the perforations.

One such sheet 10, which serves to separate upper plate 2 from upper middle plate 8, is shown in detail in Figure 4. The perforations 12 in sheet 10 are preferably circular in shape and are spaced with their centers disposed on contiguous equilateral triangles, i. e. 120 degrees apart on interlocking circular loci.

Between the upper middle plate 8 and the lower middle metal plate 4 is a second integral sheet 20 of non-conducting material similar to sheet 10. This middle sheet is also provided with perforations or holes 22 of equal size and having the same spacing as perforations 12 in sheet 10, and also disposed with their centers at the corners of contiguous equilateral triangles. However, the perforations 22 in sheet 20 are staggered or laterally shifted relative to the perforations in sheet 10 so that, when the sheets are assembled in the mat switch, the centers of perforations 22, though spaced on triangles of the same size as the centers of perforations 12 in sheet 10, are disposed 60 degrees away from the centers of perforations 12 on common circular loci. The relative arrangement of the perforations or holes in sheets 10 and 20 is shown diagrammatically in Figure 3 where the perforations 12 in sheet 10 are represented by the circles hatched with vertical lines, and those in sheet 20 represented by circles hatched with horizontal lines.

Separating the lower middle metal plate 4 from the lower metal plate 6 is a third sheet of non-conducting material 30 similar to sheets 10 and 20. The third sheet has equal-sized circular perforations 32 like those of the first and second sheets. Perforations 32 are also disposed with the same spacing as perforations 12 and 22, and centered at the corners of contiguous equilateral triangles. However, perforations 32 are staggered relative to those in the first and second sheets so that each perforation in the third sheet is disposed in equilateral triangular relation with the adjacent corresponding perforations in the second and first sheets. Thus perforations 32 are properly laterally arranged to coincide with the areas laterally intermediate perforations 12 and 22 when the complete mat switch is assembled. This triangular relative arrangement of perforations 12, 22 and 32 is shown diagrammatically in Figure 3 where perforations 32 are represented by circles with diagonal hatching.

When the several insulating sheets 10, 20, 30 are assembled with the metal plates in the rubber envelope 9, the sheets will be accurately positioned by abutting against

3

the marginal shoulders 40 at the edge of the envelope. Since the sheets are integral, this will automatically insure accurate positioning of perforations 12, 22 and 32 in the relative triangular arrangement diagrammatically shown in Figure 3, thus greatly reducing the time and expense of assembly and eliminating the need for adhesives or other means to obtain this relative positioning.

In accordance with the invention, the perforations in the several sheets are preferably made of sufficient size in relation to the spacing of their centers so as to overlap in the manner shown in Figure 3. Though the actual contact area in which one metal plate can touch its neighbor through one of the perforations will be a circle somewhat smaller than the perforation, depending on the thickness of the sheets, the perforations need not overlap enough to allow exactly for this reduced actual contact area, because in practice the pressures applied to the mat switch will be over an area larger than a point contact. For example, the pressure applied by the heel of a woman's shoe, which is about the smallest contact area encountered in mats for pedestrian use, extends over an area about  $\frac{3}{4}$ " in diameter. Accordingly, mats for pedestrian use with perforations in the sheets of about 3" diameter have been found to give satisfactory performance, while for passenger vehicles, perforations of about  $1\frac{1}{2}$ " diameter have been found to give good performance. Thus with the arrangement shown, there will be no point on the mat switch where at least two metal plates are not exposed for contact in response to deflection of the plates by the application of suitable operating pressure on the mat switch. The switch will therefore be sensitive to pressures applied at any and all points over its entire area, and will be entirely devoid of dead spots. No less than the three insulating sheets perforated as shown can provide this complete coverage of the entire area of the mat switch, and of course no more than three sheets are required.

With a mat switch constructed as above described, it has been found that a tremendous variation can be obtained in the operating pressure required to deflect adjacent plates into contact merely by changing the size of the perforations in the insulating sheets. Thus such a mat switch is particularly suited for efficient and economical production for a wide variety of different applications, since only the insulating sheets need be changed to provide a wide variety of operating pressure ranges. Of course when the size of the perforations is changed, a corresponding change should be made in the spacing of their centers so as to preserve the overlapping arrangement shown diagrammatically in Figure 3, so that sensitivity of the switch over 100 percent of its surface area will be insured.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language used in the following claims is intended to cover all of the generic and specific features of the invention which, as a matter of language, might be said to fall therebetween. We claim:

1. A switch of the floor mat type comprising a stack of four metal plates including a base plate and three superposed flexible plates adapted to be flexed together responsive to pressure thereon to effect electrical contact between at least two adjacent plates, and first, second and third sheets of non-conducting material respectively separating adjacent plates of said stack, each of said sheets having perforations defining a plurality of holes therein, said perforations in each sheet being laterally staggered relative to the perforations in the other sheets with each perforation in each sheet disposed in equilateral triangular

4

and mutually overlapping relation with corresponding perforations in the other sheets.

2. A switch of the floor mat type comprising four superposed metal plates separated by lower, middle and upper insulating sheets, at least the upper three plates of said four being flexible, each of said sheets having circular perforations defining a plurality of spaced equal-sized holes therein, said perforations in each sheet being centered at the corners of contiguous equilateral triangles, and being laterally disposed in equilateral triangular relation to the perforations in the other sheets, each of said perforations in each sheet being of such a size as to partially overlap corresponding perforations in the other sheets.

3. A switch of the floor mat type comprising four metal plates including a base plate and three superposed flexible plates separated by lower, middle and upper non-conducting sheets, each of said sheets having perforations defining a plurality of equal-sized spaced holes therein, the perforations in each of said sheets being disposed in equilateral triangular relation with the perforations in the other sheets and having a size sufficient so that the perforations in the several sheets are mutually partially overlapped, a first electrical terminal connected to the top metal plate and lower middle metal plate, and a second electrical terminal connected to the bottom metal plate and upper middle metal plate.

4. A switch of the floor mat type comprising four metal plates including a base plate and three superposed flexible plates separated by lower, middle and upper insulating sheets, perforations in each of said sheets defining a plurality of equal-sized equally spaced circular holes therein, said perforations in the several sheets being relatively staggered so that the centers of the perforations in each sheet are disposed in equilateral triangular relation with the centers of the perforations in the other sheets, said centers having a spacing in relation to the size of said perforations such that the perforations in each sheet overlap the perforations in the other sheets sufficiently to cover the entire area of the metal plates.

5. A switch of the floor mat type comprising a stack of four superposed metal plates, the upper three plates being sufficiently flexible and resilient to permit flexing responsive to predetermined operating pressures to effect contact between at least two of said four plates, insulating sheets separating adjacent plates of said stack, each of said sheets being perforated to define a plurality of equal-sized equally spaced holes therein, the centers of the perforations in each of said sheets being disposed laterally in equilateral triangular relation with the centers of the perforations in the other sheets.

6. A switch of the floor mat type comprising four metal plates including a base plate and three superposed flexible plates separated by lower, middle and upper insulating sheets, each of said sheets having perforations defining a plurality of spaced equal-sized circular holes therein centered at the apices of contiguous equilateral triangles, the centers of the perforations in each of said sheets being disposed in equilateral triangular relation with the centers of the perforations in the other sheets, the centers of the perforations in each of said sheets being spaced relative to the centers of the perforations in the other sheets according to the size of said perforations so that the perforations in the several sheets mutually partially overlap sufficiently to completely cover the entire area of said plates.

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