

Jan. 18, 1955

S. S. ROBY ET AL
ELECTRIC MAT SWITCH

2,700,080

Filed Jan. 18, 1954

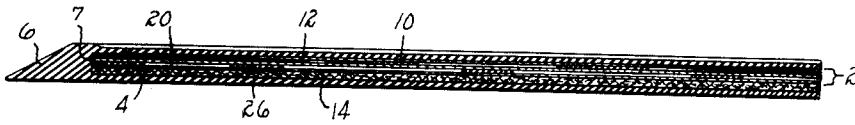


FIG. 1

FIG. 2

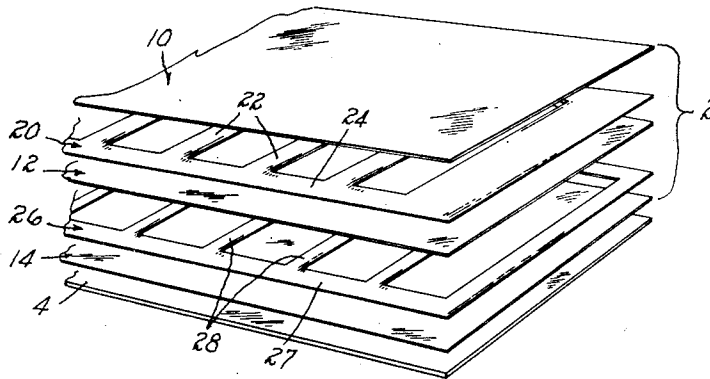
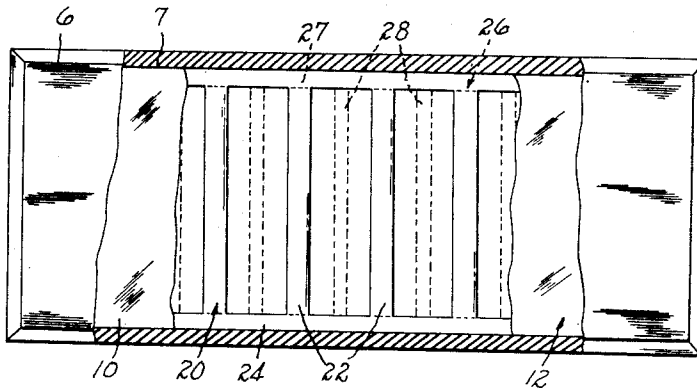


FIG. 3

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ELECTRIC MAT SWITCH

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Application January 18, 1954, Serial No. 404,738

5 Claims. (Cl. 200—86)

The present invention relates to electric mat switches for controlling the operation of doors or the like in response to pressures such as those applied to the mat by a person stepping thereon.

The present invention relates to mat switches of the type comprising a sandwich of at least three superposed flexible metal plates spaced apart by separators of thin non-conducting material which are regularly spaced as desired to maintain the metal plates normally in closely spaced-apart relation yet permit them to be squeezed or pressed together by, for example, the weight of a pedestrian walking on the mat. When the metal plates are thus pressed together sufficiently to make electrical contact, an external circuit to which the plates are electrically connected is thereby closed and this initiates any desired operation such as the opening of a door or the like.

For effective and reliable operation of mat switches of this type, it is important that no contact be made when the plates are subjected to pressures less than a predetermined minimum, regardless of where on the mat the pressure is applied, and that contact be made when the plates are subjected to pressure above the minimum value, regardless of where 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 uniformity of 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 an improved electric mat switch having a uniform sensitivity to pressures applied at any point on its surface.

Another object is to provide a mat switch of the character described which is particularly suitable to construction and assembly at reduced cost.

Another object is to provide a mat switch of the three-plate type so constructed and arranged that the pressure required to make contact between the middle and upper plates is substantially equal to the pressure required to make contact between the middle and lower plates.

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 drawing, Fig. 1 is an enlarged vertical sectional view of a mat switch constructed in accordance with the present invention;

Fig. 2 is a plan view of the mat switch shown in Fig. 1, with portions cut away to show the arrangement of certain parts; and

Fig. 3 is an exploded perspective view of a portion of the mat switch structure.

Referring to Fig. 1 of the drawing, a mat switch constructed in accordance with the present invention includes a sandwich 2 of three metal plates suitably separated by thin non-conducting spacer elements as hereinafter described. The sandwich is enclosed in a suitable weather-proof envelope 6 of rubber or the like. Envelope 6 has a marginal shoulder which accurately aligns the elements of sandwich 2, and a top surface 8 which is corrugated in the usual manner to provide a tread.

The sandwich portion of the switch includes an upper plate 10, a middle plate 12, and a lower plate 14. The upper and middle plates are preferably sufficiently thin

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as to be flexible and resilient, and may be constructed, for example, of sheet aluminum having a thickness of about $\frac{1}{32}$ ". If desired, the lower plate 14 may be the same material as the upper and middle plates, or lower plate 14 may be rigid. Rigidity of lower plate 14 may be achieved by using a thicker sheet, or a stiffer material such as galvanized steel, or reinforcing its under side with a sheet 4 of stiff material such as Masonite or the like.

The plates 10, 12, 14 may be of any desired size, preferably rectangular in cross section, and are of sufficient width to extend substantially entirely across the doorway or operating location of the switch and of sufficient length to extend outwardly from the doorway a suitable distance on either side.

Suitable electrical connections between the switch and an external circuit are provided by means of a pair of terminals, not shown, one of which is secured in any conventional manner to the middle plate 12, and the other of which is connected to both the upper plate 10 and lower plate 14. Thus the circuit between such terminals will be closed by the switch whenever contact is established between the middle plate and either the upper or lower plates.

The upper plate 10 and middle plate 12 are spaced in normally closed parallel relationship by a stencil 20 of thin non-conducting material, such as heavy paper, preferably cut from an integral sheet. In accordance with the present invention, the stencil 20 is preferably cut out to form a plurality of spaced separators in the form of parallel rectangular strips 22, equally spaced apart laterally, which extend completely across the plates 10, 12. The periphery 24 of stencil 20 is continuous, and serves to separate the upper and middle plates along their entire periphery.

The middle and lower plates 12, 14 are spaced by another stencil 26 of thin non-conducting material, such as paper or the like. This stencil 26 likewise has a continuous periphery 27 and a number of separators in the form of parallel rectangular strips 28, which are preferably disposed in laterally spaced relation so that their center-to-center distance is the same as that of the strips 22 between the middle and upper plates. However, the strips 28 are staggered or laterally displaced so as to be positioned laterally midway between the strips 22.

With this arrangement, pressure on the mat from the weight of a pedestrian or the like at points between strips 22 will simply deflect upper plate 10 downwardly sufficiently to make electrical contact between it and middle plate 12, and thus perform the desired switching operation. Pressure on the mat at points between strips 28 will cause a downward deflection of both the upper and middle plates 10, 12, which will remain separated by a strip 22 and hence will not make contact. Not until middle plate 12 is deflected far enough to make contact with lower plate 14 at a point between strips 28 does the switch close. During this deflection of plates 10 and 12, lower plate 14 remains substantially undeflected.

Thus it may be seen that for contact to be made between the middle and lower plates, sufficient pressure must be applied to the mat switch to deflect both the upper and middle plates downwardly. In the design of the mat switch, it is customary first to space the strips 28 the proper distance so that pressure on the switch midway between two strips 28, and of the desired amount as determined by the contemplated use of the switch, will be able to deflect plates 10 and 12 downward enough so that plate 12 will contact plate 14.

In accordance with the present invention the strips 22 are arranged with substantially reduced spacing relative to the spacing determined for strips 28, so that the sensitivity of the switch to pressure applied at a point between strips 22, which need deflect only one plate, is equalized with sensitivity to pressure applied at any point between strips 28, which must deflect two plates. This is accomplished by making the width of the spaces between the upper strips 22 substantially less than the size of the spaces between the lower strips 28. The relation between the size of the spaces between strips 22 and the size of the spaces between strips 28 which is required to obtain uniform operating pressures throughout the mat will of

course vary according to the specific materials used and the dimensions of the mat and component parts. In general, however, it has been found that the width of the spaces between strips 28 should preferably exceed the width of the spaces between strips 22 in the ratio of approximately three to two, as shown in the drawing. With the center-to-center distance of the upper and lower strips being the same, the decreased width of the spaces between the upper strips 22 may be conveniently obtained by increasing the width of the strips 22 themselves.

With this relation between the size and spacing of the separators between the upper and middle plates and between the middle and lower plates, it has been found that the pressure required to actuate the switch is substantially equalized whether applied at a point coincident with one of the upper strips 22 or at a point coincident with one of the lower strips 28. Although actuation of the switch when pressure is applied coincident with one of the upper strips 22 requires deflection of both the upper and middle plates 10, 12, the increased spacing between the lower strips 28 provides a larger unsupported span for middle plate 12, and thereby makes it easier to deflect downwardly into contact with lower plate 14.

As a result of this arrangement with a substantially larger spacing between the strips 28 than between strips 22, it has been found that a substantial improvement in the uniformity of sensitivity of the mat switch is obtained, and hence dependable operation of the switch is insured responsive to the application of minimum operating pressures anywhere on the mat. Arrangement of the strips between each pair of plates in a single integral stencil, which can be stamped from a sheet of stock in one cutting operation, and has a continuous peripheral edge which can be accurately aligned by shoulder 7 of envelope 6 without requiring prealignment with the metal plates before assembly, substantially reduces the cost of manufacture of a mat switch constructed as described. While the separators have been depicted as strips of different widths, it will be recognized, of course, that the present invention is not limited to separators of that particular configuration, but embraces other common geometrical shapes such as circles, polygons, and the like, which need not necessarily be joined together in integral stencils.

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 drawing shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the language in the following claims is intended to cover all of the generic and specific features of the invention herein described and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

I claim:

1. In a switch of the floor mat type including three spaced superposed parallel metal plates adapted to be flexed together responsive to pressure thereon to effect contact between the upper and middle plates or between the middle and lower plates to perform an electrical switching operation, first spaced apart separators of thin non-conducting material between the upper and middle plates creating first open areas permitting said upper plate to be flexed into contact with said middle plate, and second spaced apart separators of thin non-conducting material between the middle and lower plates disposed in staggered relationship with respect to the first separators and creating second open areas displaced from said first open areas to permit said middle plate to be flexed into contact with said lower plate, said second separators being smaller in area than said first separators so that the size of said second open areas is larger than the size of said first open areas, whereby the pressure required to establish contact between said upper and middle plates is substantially equal to the pressure required to establish contact between said middle and lower plates.

2. In a switch of the floor mat type including three spaced superposed parallel metal plates adapted to be flexed together responsive to pressure thereon to effect contact between the upper and middle plates or between the middle and lower plates to perform an electrical

switching operation, means for equalizing the contact pressure between upper and middle plates with contact pressure between middle and lower plates comprising a first sheet of thin non-conducting material having equally spaced first separators extending between the upper and middle plates, a second sheet of thin non-conducting material having equally spaced second separators extending between the middle and lower plates intermediate said first separators, said second separators having an area in relation to said first separators such that the spaces between said first separators are approximately two-thirds the size of the spaces between said second separators.

3. In a switch of the floor mat type including three spaced superposed parallel metal plates adapted to be flexed together responsive to pressure thereon to effect contact between the upper and middle plates or between the middle and lower plates, one electrical connector attached to the middle plate, and another electrical connector attached to the upper and lower plates, spacers for said plates comprising a first stencil of thin non-conducting material between the upper and middle plates, said first stencil having parallel equally spaced first strips extending across said plates, a second stencil of thin non-conducting material between the middle and lower plates, said second stencil having second strips disposed laterally midway between said first strips, said second strips being narrower than said first strips so that the spaces between said first strips are wider than the spaces between said second strips, whereby the pressure required to establish contact between said plates is substantially equal at all points on said switch.

4. In a switch of the floor mat type including three spaced superposed parallel metal plates, the upper two plates being sufficiently flexible and resilient to permit flexing responsive to pressures thereon to effect contact between the upper and middle plates or between the middle and lower plates, one electrical connector attached to the middle plate, and another electrical connector attached to the upper and lower plates, plate spacing means comprising first parallel equally spaced non-conducting separator strips between the upper and middle plates, second parallel non-conducting separator strips between the middle and lower plates in vertical disalignment with said first strips, said second strips having the same center-to-center spacing as said first strips and being narrower than said first strips by an amount such that the spaces between said first strips are approximately two-thirds the width of the spaces between said second strips, whereby the pressure required to establish contact between the upper and middle plates is substantially equal to the pressure required to establish contact between the middle and lower plates.

5. In a switch of the floor mat type including three spaced superposed parallel conducting plates adapted to be flexed together responsive to pressures thereon to effect electrical contact between the upper and middle plates or between the middle and lower plates, one electrical connector attached to the middle plate, and another electrical connector attached to the upper and lower plates, means for equalizing the pressure required to establish contact between said plates at all points on said switch comprising a first stencil of thin non-conducting material between the upper and middle plates, said first stencil having parallel equally laterally spaced first strips extending across said plates, a second stencil of thin non-conducting material between the middle and lower plates, said second stencil having parallel second strips laterally staggered relative to said first strips and laterally spaced with the same center-to-center distance as said first strips, said second strips having an individual width in relation to said first strips such that the spaces between said first strips are approximately two-thirds the width of the spaces between said second strips, and a stiff non-conducting support plate beneath said lower plate.

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