Feb. 19, 1946. W. C. SLAUSON 2,395,300

ELECTRICAL DEVICE

Filed May 28, 1942

FIG. 1.

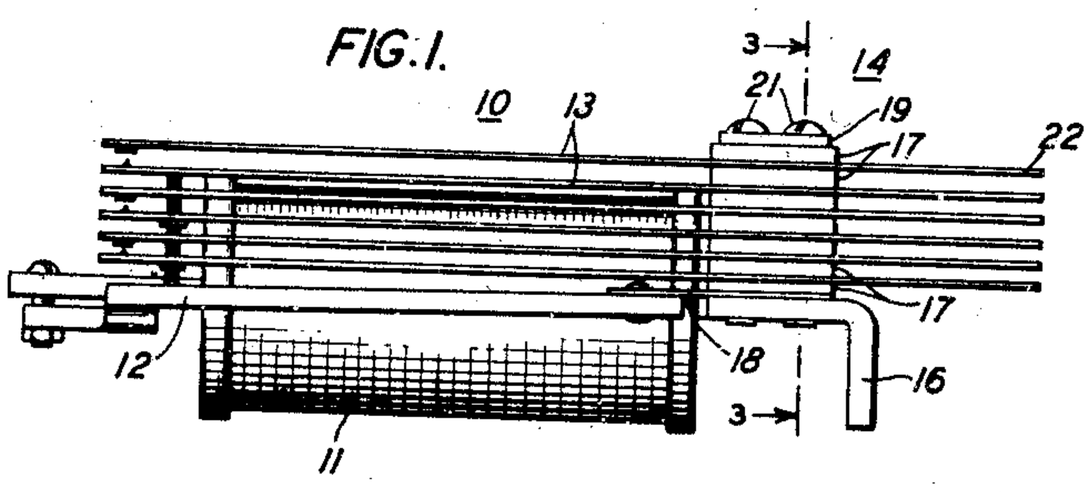
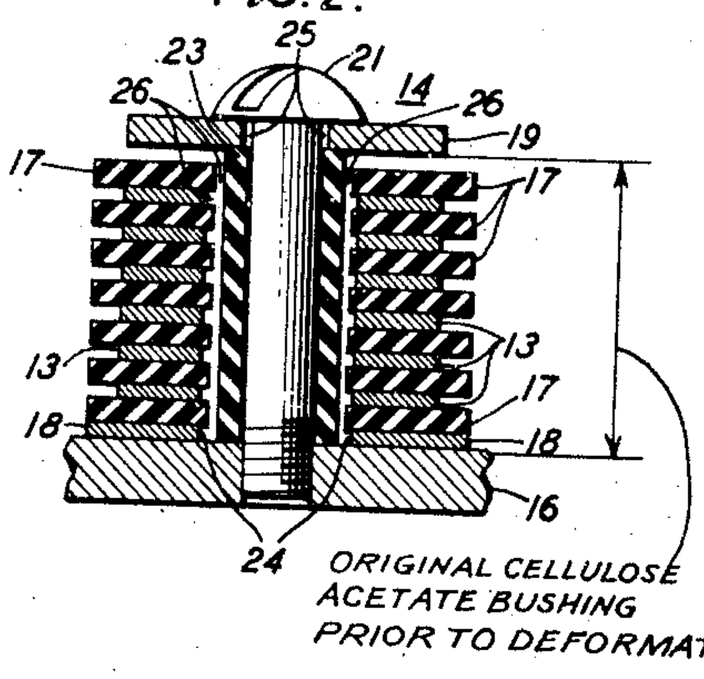
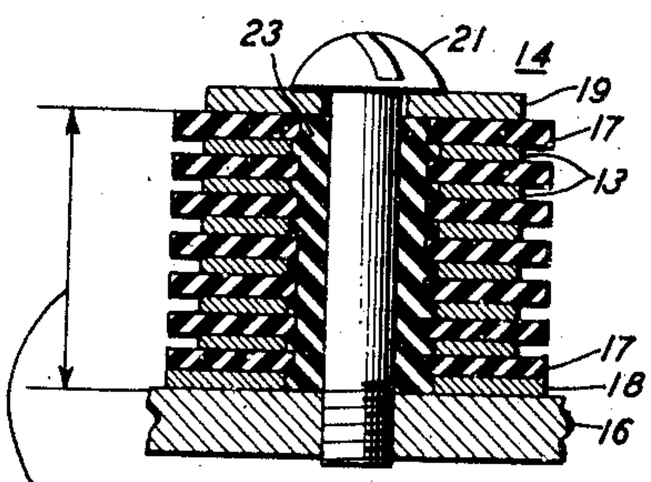


FIG. 2.



ORIGINAL CELLULOSE ACETATE BUSHING PRIOR TO DEFORMATION

FIG. 3.



CELLULOSE ACETATE BUSHING AFTER DEFORMATION

FIG. 4.

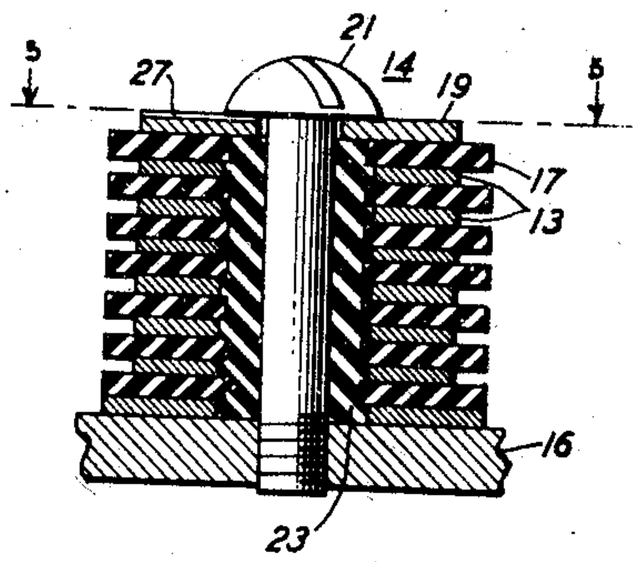
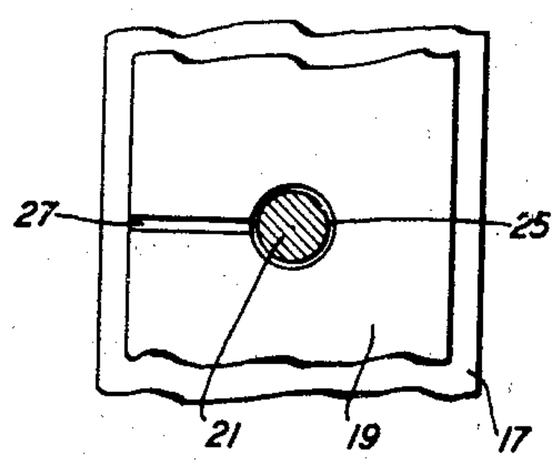


FIG. 5.



INVENTOR
W. C. SLAUSON

BY W. C. McKenney

ATTORNEY

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2,395,300

UNITED STATES PATENT OFFICE

2,395,300

ELECTRICAL DEVICE

William C. Slauson, Manhasset, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application May 28, 1942, Serial No. 444,917

7 Claims. (Cl. 200—166)

This invention relates to electrical devices and particularly to the construction of electrical contact assemblies wherein a plurality of contact members are arranged in a stack and are separated by insulating members.

In electrical devices of the above character, such as electromagnetic relays, jacks, keys, and the like, it is the usual practice to arrange the spring contact members in a stack or pile-up in which the contact members are interposed between insulated strips and in which outer compression plates having bolts extending through aligned apertures of the pile-up clamp the entire group into a compact assembly. It is also customary to insulate the bolts from the spring members by enclosing each bolt with an insulated bushing. In devices manufactured in accordance with the above practice the contact springs thereof often become short circuited with one another by the presence of loose metallic particles such as metal chips or slivers, which, during the manufacturing process, fall into the interstices between the outer surface of the insulated bushing and the circumferential edges of the spring members. Engagement of the chips with adjacent spring members produces a short circuit which can be corrected if detected during inspection, but due to the migration of the chips, in a relay, for example, during shipment and also after installation in a telephone exchange, shorts appear that were not apparent during the testing or inspection period with consequent loss in circuit and maintenance time. Several remedial expedients have been proposed heretofore such as the use of pliable rubber bushings, of length slightly longer than the over-all pile-up, which when compressed expand laterally to prevent longitudinal movement of the chips. Although the above pliable rubber bushing arrangement reduces the number of short circuits in spring pile-ups the reduction thereof is insufficient because of the lack of complete radial expansion along the entire length of the bushing so that more effective and yet at the same time economical means are highly desirable.

It is therefore an object of this invention to overcome the above disadvantages and to provide an improved and simplified construction for a contact spring pile-up.

Another object of the invention is to interlock the insulated bushing with the elements of a contact spring pile-up.

A further object of the invention is to construct a contact spring pile-up in which migration of slivers and chips is prevented in interstices between the contact spring elements and insulated bushings around the clamping screw.

According to a feature of the present invention advantages are secured over the prior arrangement by insulating the clamping screw of a spring pile-up with an overlong cellulose acetate bushing, which is comparatively rigid and at the same time infrangible when subjected to compression, assembling the various elements thereof into a loose pile-up, dipping the assembly into a solution of a cellulose acetate solvent, such as acetone, and then compressing the assembly whereby the softened acetate bushing flows radially into the space between the outer surface of the bushing and circumferential edges of the openings in the members through which the bushing extends, forming comparatively rigid extrusions thereon upon evaporation of the solvent.

Another feature of the invention resides in the use of an overlong cellulose acetate bushing in a contact spring pile-up in which the assembly is first compressed and the solvent later applied with the resultant softening and extrusion of the bushing, as described above.

These and other features of the invention will be more fully described in the following specification, taken in connection with the accompanying drawing in which:

Fig. 1 illustrates a telephone relay having a contact spring pile-up at the right end thereof;

Fig. 2 illustrates a cross-sectional view of the spring pile-up shown in Fig. 1 in which the overlong cellulose acetate bushing and other elements thereof are depicted in a loosely assembled condition;

Fig. 3 illustrates a cross-sectional view of the compressed spring pile-up taken along 3—3 of Fig. 1;

Fig. 4 illustrates another embodiment of the invention in which a slot is provided in the upper clamping plate for the application of the solvent; and

Fig. 5 illustrates a cross-sectional view taken along line 5—5 of Fig. 4 showing the slot in greater detail.

Referring now to the drawing and particularly to Fig. 1, there is shown a telephone relay 10 of a well known type, which comprises the usual winding 11, armature 12, contact springs 13 arranged in a pile-up or stack assembly 14, and a frame 16 for supporting said members. The spring pile-up comprises alternate contact springs 13 and insulation strips 17 superposed upon one another, a spring member 18 for flexibly supporting armature 12, clamping plate 19, and bolts or

screws 21 for securing pile-up 14 to frame 16 and also for compressing the members of pile-up 14 into a compact unit. Contact springs 13 are provided with terminal portions 22 for connection to external wiring. Inasmuch as the principles of construction and operation of relays are well understood, a more detailed description thereof is unnecessary, especially since they do not form a part of the present invention.

Referring particularly to Figs. 2 and 3, sectional views of spring pile-up 14 illustrate in greater detail the assembly of the various elements constituting the pile-up. In Fig. 2 is shown a loose assembly of the component parts, particularly bushing or sleeve 23 which is slightly longer than the over-all length of the pile-up, the excessive length being indicated approximately by the space between the inner edges of clamping plate 19 and uppermost insulation strip 17. A bushing having an overlength of approximately $\frac{1}{16}$ inch has been found to be suitable. Bushing 23 consists of an insulated comparatively rigid material, such as cellulose acetate, that is capable of being temporarily softened by a volatile solvent, such as acetone, and after being so treated assumes the modified form. Screw 21 is surrounded by bushing 23, the combination thereof extending through aligned openings 24 formed in springs 13, 18 and insulation strips 17, while screw 21 threadedly engages frame 16 and extends by itself through opening 25 in clamping plate 19. It is to be noted that spaces or interstices 26 appear between the outer surface of bushing 23 and the circumferential edges of the contact springs 13 and insulation strips 17 formed by the openings 24. It is also to be noted that the upper and lower edges of bushing 23 abut the inner surfaces of clamping plate 19 and frame 16 respectively.

In the manufacture of contact springs 13 burrs (not shown) often adhere to the circumferential edges of the openings 24 thereof and upon assembly of the springs into a stack these burrs chip off and reside in the interstices 26 so that when several chips (not shown) or a chip of sufficient length becomes lodged between adjacent contact springs 13 of a pile-up a short circuit results thereacross. Upon inspection of the assembly this short circuit is readily discovered but if the chips at the time of inspection do not contact adjacent contact springs 13 the relay is passed as being satisfactory. Later, because of movement of the relay, that is, as a result of shipment from the manufacturing plant and installation in the telephone exchange, the chips tend to migrate within the interstices so that contact may occur between adjacent springs 13, after the relays have been cut into service. From a manufacturing standpoint it is not economically practical to eliminate the burrs and chips entirely so that the next best expedient is to freeze whatever chips that are present in the assembly into place, thereby preventing subsequent migration of the chips. This is accomplished effectively by eliminating the interstices 26, in other words, by filling up these spaces 26 through the radial expansion of bushing 23.

In one embodiment of the invention, the loosely assembled contact spring pile-up, shown in Fig. 2, is first dipped into a volatile solvent (not shown) such as acetone, in order to temporarily soften the cellulose acetate bushing 23, then withdrawn from the solvent, after which the pile-up 14 is compressed to its ultimate size, as shown in Fig. 3, either by screws 21 or by a suitable compressing mechanism, as for example the fixture disclosed in Patent 2,129,869 issued September 13, 1938 to Harold S. Pike, screws 21 serving to retain the applied pressure to the pile-up upon removal of the compressing mechanism. By thus softening the overlong cellulose acetate bushing 23 and then shortening it to size by longitudinal compression bushing 23 is forced to expand or flow radially thereby filling up the interstices 26 formerly present between the outer surface of bushing 23 and circumferential edges of apertures 24 in springs 13 and insulation strips 17. Any chips present therein are therefore effectively sealed or frozen in place by the extrusions formed on bushing 23 in an economical and practical manner. Upon evaporation of the solvent, which is volatile, the bushing 23 with the extrusions formed thereon rehardens and assumes the set of the interstices.

In another embodiment of the invention, the spring pile-up 14 is first compressed and the solvent then applied to the overlong bushing 23. In order to satisfactorily apply the solvent to bushing 23 access must be provided therefor. A means for accomplishing this is illustrated in Fig. 4 where the clamping plate 19 is provided with a slot 27, shown more clearly in Fig. 5, extending from an edge of clamping plate 19 to aperture 25 thereof. As in the above first-mentioned embodiment the members of the spring pile-up are first assembled into a loose stack 14; however, in this embodiment, the next step consists in compressing the members thereof in a manner already described so that overlong bushing 23 is under pressure between clamping plate 19 and frame 16. The solvent (not shown) is then applied by a hypodermic syringe (not shown), or some other equivalent means, through slot 27 to bushing 23, which as it becomes softened expands radially because of the pressure to fill the interstices 26 formerly between the outer and inner circumferences of bushing 23 and apertures 24, respectively, of the contact springs 13 and insulation strips 17. Upon evaporation of the solvent, as mentioned hereinbefore, bushing 23 returns to its original state of rigidity with permanent extrusions formed thereon. Any chips or slivers that may have been lodged within the interstices 26 are therefore effectively sealed in place. To facilitate access of the solvent to bushing 23 more than one slot may be provided and these slots may be placed either in the top or bottom of pile-up 14 or may be placed in both clamping plate 19 and frame 16.

While this invention has been shown and described as embodying certain features merely for the purpose of illustration, it is, of course, understood that various modifications may be made in the details thereof and that the features may be applied to many other and widely varied fields without departing from the scope of the invention as defined in the appended claims. For example, the cellulose acetate bushing 23 may be softened by heat, as by a spot welding machine, in the above-mentioned second embodiment.

What is claimed is:

1. The process of making an electrical stack which consists in superposing alternate layers of apertured insulating strips and contact elements upon an apertured base, inserting an overlong insulating bushing into said strips and elements, placing an apertured clamping plate over said bushing, securing said base, strips, elements, and plate into a unit assembly by a bolt, subjecting the assembly to a volatile plasticizer for tem-

porarily softening the bushing and, applying pressure to the assembly whereby the bushing is expanded laterally to interlock with the strips and elements.

2. The process of making an electrical contact assembly consisting in superposing in alternate layers, insulator strips and contact elements having apertures therein, placing the strips and elements upon a frame provided with similar apertures, a'igning said strips, elements, and frame so that said apertures provide a continuous opening through the assembly, inserting an overlong cellulose acetate bushing into said opening, placing a clamping plate having an aperature over said bushing with the aperture in alignment with the opening, securing said strips, elements, frame and plates together by a bolt, subjecting the assembly to a volatile plasticizer for temporarily softening the bushing, and applying substantial pressure upon the plate and frame whereby said bushing because of its overlength is caused to expand laterally to interlock the bushing with said strips and elements.

3. The process of making an electrical spring pile-up which consists in superposing in alternate layers, insulated strips and contact springs having perforations therein, mounting said strips and springs upon a frame having similar perforations, aligning said perforations to produce continuous openings through the pile-up, inserting overlong cellulose acetate bushings into said openings, placing a plate having perforations over said bushings with the perforations in alignment with the openings, arranging said pile-up into a loose assembly by bolts threadedly engaging the frame, dipping the loose assembly into a volatile liquid solvent for temporarily softening the bushings, removing the assembly from the solvent, and applying substantial pressure upon the plate and frame whereby the bushing is contracted in length and expanded radially to fill the interstices between the bushing and circumferential edges of the perforations in the strips and contact springs, substantially as described.

4. The process of making a spring pile-up which consists in superposing in alternate layers insulated strips and contact springs having perforations therein, mounting said layers upon a frame having similar perforations, aligning the perforations to produce continuous openings through the pile-up, inserting tubular overlong cellulose acetate bushings into said openings, placing a clamping plate having perforations over said bushings with the perforations in line with the openings, inserting into said openings bolts, applying substantial pressure to the plate and frame whereby the bushing is contracted, and injecting a volatile liquid solvent into the area of the bushing whereby extrusions are formed on the bushings, said extrusions occupying the space between the bushing and edges of the strips and contact springs and sealing any chips in place.

5. The process of making an electrical stack which consists in constructing an assembly of alternate layers of insulated strips and contact springs secured by a bolt enclosed with a comparatively rigid overlong insulated bushing, temporarily softening said bushing, applying pressure to the assembly so that the softened bushing is expanded laterally to interlock with the strips and elements, and permitting the bushing to reharden.

6. An electrical spring pile-up comprising alternately disposed conducting springs and insulating strips, said springs and strips having axially aligned holes of different diameters forming a bore having a plurality of internally projecting ledges, a bushing disposed in said bore and having a plurality of integrally formed protrusions which fill the spaces between the ledges internally projecting from the bore, and means for clamping said springs, strips and bushing together to form a unitary structure.

7. In a stacked electrical spring assembly, a plurality of superimposed conducting springs having holes of substantially equal diameters, insulating strips therebetween having holes of diameters different from the diameters of the holes of said conducting springs whereby, when said springs and insulating strips are arranged in stacked formation with the axes of the holes thereof in alignment the stack is characterized by a bore having a plurality of irregularities, an insulating bushing disposed in said bore and having integral protrusions which fill the irregularities therein, and means for clamping the elements of said assembly into a unitary structure comprising a plate located on the upper and lower faces of the stack and having a hole therein, one of the holes being threaded, and a bolt passing through the hole in one of said plates through said bushing and screwed into the threaded hole in the other of said plates.

WILLIAM C. SLAUSON.