Aug. 26, 1958 A. LOGAN 2,849,698

COMPOSITE PLATES AND METHODS OF MAKING THEM

Filed March 15, 1954 2 Sheets-Sheet 1

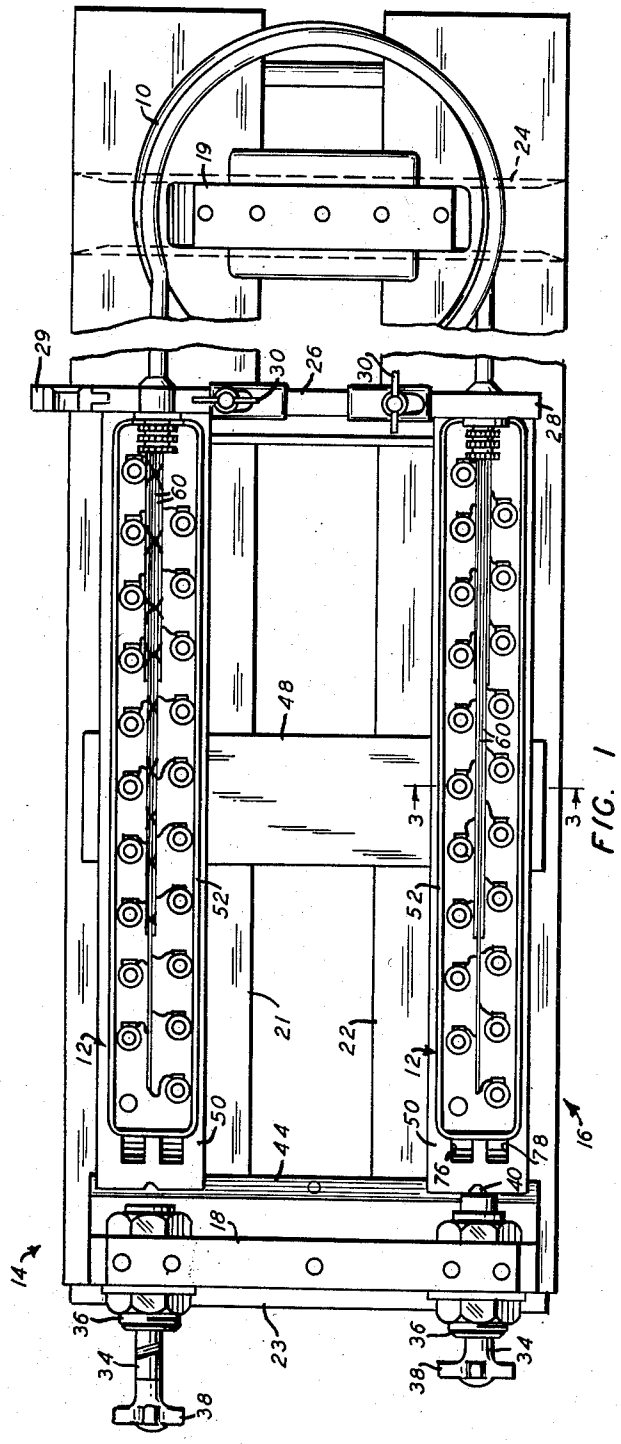

FIG. 1

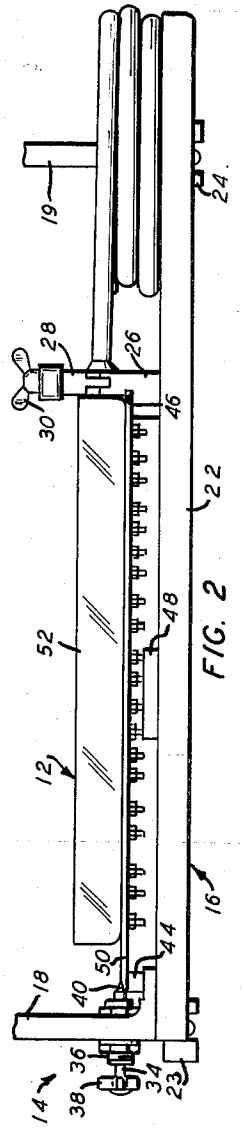

FIG. 2

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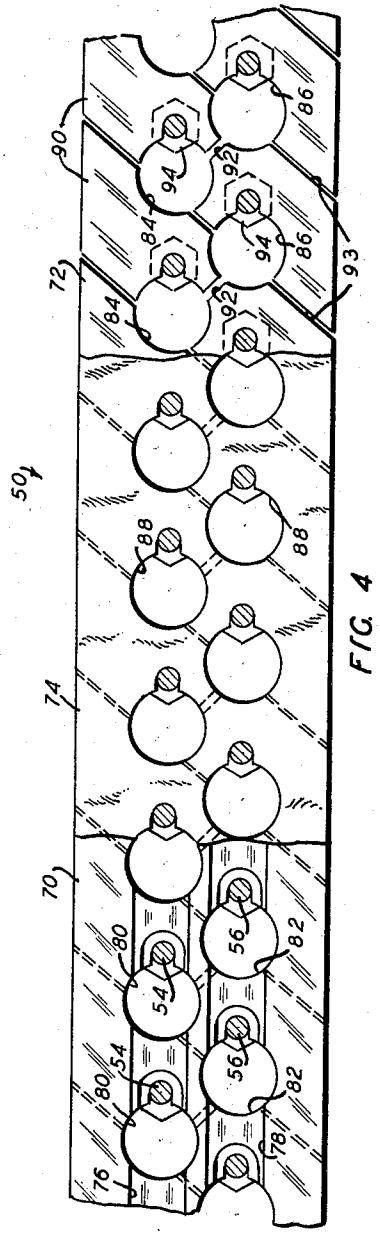

FIG. 4

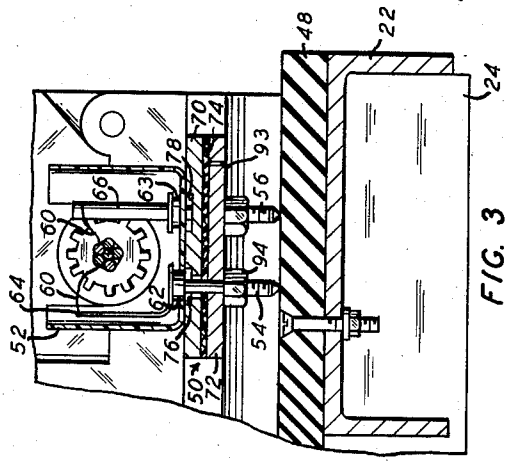

FIG. 3

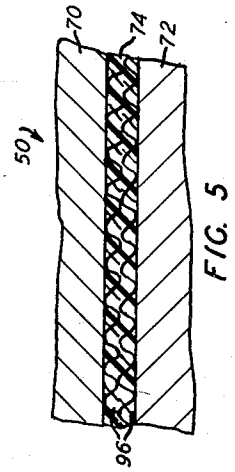

FIG. 5

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2,849,698

COMPOSITE PLATES AND METHODS OF MAKING THEM

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Application March 15, 1954, Serial No. 416,125

7 Claims. (Cl. 339—198)

This invention relates to composite plates and methods of making such plates, and more particularly to composite plates employed to support cable terminals during manufacturing and electrical testing thereof, and methods of making such composite plates.

In the manufacture of some types of cable terminals, electrical tests are performed on the individual terminal elements thereof at an intermediate stage of the assembling operations. It is convenient and practical to perform such tests while the partially assembled terminals are still mounted on special fixtures employed to support them during the assembling operations. Certain features of such fixtures are disclosed and claimed in patent 2,729,850 granted January 10, 1957, on a copending application Serial No. 244,810, filed September 1, 1951, by L. S. Dewees.

The apparatus disclosed in the Dewees patent includes a supporting plate composed of steel, one side of which is secured to a coextensive insulating plate composed of phenol fabric (a fabric impregnated with a phenol-formaldehyde type resin). The steel plate and the insulating plate are provided with a plurality of slots aligned in the proper pattern to allow the individual terminal posts of a cable terminal to pass through them. The slots in the insulating plate are made slightly smaller than the slots in the steel plate, in order to keep the terminal posts insulated from each other by preventing them from contacting the sides of the slots in the steel plate. It has been found that the phenol fabric plate shows excessive wear after it has been used repeatedly, and eventually its insulating properties may become impaired.

It is an object of this invention to provide new and improved composite plates and method of making such plates.

A further object of the invention is to provide new and improved composite plates for supporting cable terminals while manufacturing and testing such terminals, and methods of making such composite plates.

A composite plate illustrating certain features of the invention may include a pair of parallel metal plates having a plurality of slots aligned to permit the individual terminal posts of a cable terminal to extend through the composite plate, the slots in one of said plates being slightly larger than the corresponding slots in the other plate so that the terminal posts extending through the aligned slots are prevented from electrically contacting the plate having the larger slots therein, and a layer of insulating material sandwiched between and bonded to the pair of metal plates.

A method illustrating certain features of the invention comprises the steps of stamping a plurality of slots in a metal plate in a pattern designed to receive the individual terminal posts of a cable terminal, stamping in another metal plate a plurality of slightly larger slots arranged in a similar pattern, placing the plates side by side with the slots therein in alignment, bonding the plates together with an intermediate layer of insulating cement, and cutting a series of diagonal slots in one of the plates to divide this plate into a plurality of isolated segments each of which

receives one of the individual terminal posts and insulates them from each other.

A complete understanding of the invention may be obtained from the following detailed description of a composite plate and a method forming specific embodiments thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a top plan view of a pair of cable terminals mounted on a fixture having a pair of composite plates embodying the invention;

Fig. 2 is a reduced, side elevation of the apparatus illustrated in Fig. 1;

Fig. 3 is an enlarged, fragmentary, vertical section taken along line 3—3 of Fig. 1;

Fig. 4 is an enlarged, fragmentary, plan view of a composite plate embodying the invention, with portions broken away to show details of its construction, and

Fig. 5 is an enlarged, fragmentary, vertical section of a portion of the composite plate shown in Fig. 4.

Referring now to the drawings, the opposite ends of a coiled cable stub **10** are joined to a pair of identical, partially completed cable terminals **12—12**, in the manner shown in Figs. 1 and 2, while manufacturing operations are performed on the terminals. The coiled cable stub **10** together with the terminals **12—12** are supported on a fixture, designated generally by the numeral **14**, having a rectangular base **16** and a pair of upright members **18** and **19** secured thereto. The upright member **18** rises from one end of the base **16**, and the upright member **19** rises from a point spaced from but near to the opposite end thereof. These upright members function as handles which may be grasped by an operator in lifting and transporting the fixture **14** from one operation to another, and they also serve as supports which enable fixtures of this type to be stacked upon each other. The convolutions of the coiled cable stub **10** surround the upright member **19** and thereby hold the cable stub properly positioned.

The base **16** of the fixture **14** is constructed from a pair of parallel channels **21** and **22**, which are connected by a pair of cross bars **23** and **24** located near the upright members **18** and **19**, respectively. In order to reduce the weight of the fixture **14**, the base **16** is preferably made of aluminum. A steel abutment **26** rises vertically from the base **16** at a point intermediate the upright members **18** and **19** but closer to the upright member **19**. As shown in Fig. 1, the abutment **26** is provided with pivoted clamps **28** and **29** having wing nuts **30—30** for clamping opposite ends of the cable stub **10** into position on this abutment. As viewed in Fig. 1, the clamp **28** is closed over the cable stub **10** while the clamp **29** is pivoted outwardly into its open position.

The upright member **18** is provided with a pair of identical plungers **34—34**, which are mounted threadedly within sleeves **36—36** for transverse movement through this upright member when the plungers are rotated. Rotation of the plungers **34—34** is accomplished by actuating a pair of operating handles **38—38** secured to the outer ends of the plungers. The inner ends of the plungers are provided with frustoconical tips, such as the tip **40**, which protrude inwardly beyond the sleeves **36—36** when the plungers are at the limit of their inward transverse movement through the upright member **18**. In this innermost position, the frustoconical tips of the plungers **34—34** also project over a horizontal steel support bar **44** mounted transversely of the base **16**.

The abutment **26** is provided with a shoulder **46** mounted at the same level as the top surface of the horizontal support bar **44**, as shown in Fig. 2. Straddling the channels **21** and **22** at a point intermediate the upright member **18** and the abutment **26** is a transverse block **48**. The upper surface of the block **48** is below the level of the upper surfaces of the support bar **44** and the

shoulder **46**. The block **48** is made of an electrical insulating material, such as phenol fabric.

The incomplete cable terminals **12—12** are supported by a pair of elongated composite plates **50—50**, which extend from the support bar **44** to the shoulder **46** of the abutment **26**. Each of the terminals **12—12** includes an elongated box-like plastic shell **52** having two rows of holes (not shown) formed in the bottom thereof, and two rows of terminal posts **54—54** and **56—56** which extend through the holes and project slightly below the bottom of the shell. These two rows of terminal posts also project through the composite plates **50—50** when the terminals **12—12** are mounted thereon.

As is shown best in Fig. 2, when the plungers **34—34** have been moved to their innermost position, their frustoconical tips, such as the tip **40**, engage one end of the composite plates **50—50** and wedge this end down against the support bar **44**. At the same time, the other end of the plates **50—50** is wedged against the shoulder **46** of the abutment **26**. As a result of this arrangement, a group of the terminal posts **54—54** and **56—56** which are located near the center of the plates **50—50** are pressed into engagement with the transverse block **48**, thereby causing the plates **50—50** to be bent into a bow shape about the block **48** as a fulcrum.

The purpose of this mounting is described in greater detail in the aforementioned Dewees patent. First, the two rows of terminal posts **54—54** and **56—56** are electrically connected to a plurality of conductors **60—60** (Fig. 1) which emanate from and make up the body of the cable stub **10**. These two rows of terminal posts extend downwardly from a plurality of bases, of which the bases **62** and **63**, respectively, are shown in Fig. 3, seated in the bottom of the shell **52** in two corresponding rows. Within the shell **52**, a plurality of flat terminals **64—64** and **66—66** rise upwardly from these bases. The conductors **60—60** are fanned out from opposite ends of the cable stub **10**, and are soldered individually to the upper ends of the flat terminals **64—64** and **66—66**.

The next operation involves electrically testing the partially assembled terminals **12—12** to be sure that all the soldered connections are complete and that there are no short circuits. Apparatus embodying the present invention is primarily useful in mounting the cable terminals **12—12** during this electrical testing operation. Following this operation, the shells are filled with a suitable liquid casting resin, and the resin is cured at elevated temperatures in an oven to complete the manufacture of the terminals.

The casting resin might be composed of a polyester of a linear polyhydric alcohol and an unsaturated polybasic acid, mixed with a vinyl compound and filler material. The polyester might be a propylene glycol polyester of fumaric, maleic or orthophthalic acid. The vinyl compound may be styrene, and the filler material may be powdered silica to which a small amount of glass fibers may be added. Resins of this general nature tend to polymerize, especially in the presence of small amounts of peroxide catalysts, into hard, dense products, and the polymerization reaction may be accelerated by heating them.

When an uncured resin of this type is poured into an elongated shell composed of polystyrene, such as the plastic shell **52** described hereinabove, and the resin is cured in the shell by heating it to a suitable temperature, the resin becomes denser and it shrinks more than it ordinarily would from mere heating and cooling alone. This shrinkage of the resin tends to warp the plastic shells, and unless special precautions are taken, the shells tend to become distorted. Of course, the narrow, elongated configuration of the shells also contributes to their tendency to become warped during the heating and cooling steps. It was found that after the heating and cooling operation, some of the shells were bowed with the two ends thereof higher than the center portion of the bottoms of the shells, while others tended to twist sidewise.

In order to overcome this tendency and to produce finished products in which the shells are perfectly straight, the shells are bowed, in the manner described hereinabove, in a direction opposite to that in which they tend to become bowed during the curing and cooling steps. This bowing is just sufficient to counteract that produced during the heating and cooling cycles, and as a result thereof, the molded terminals which finally result are perfectly straight without any upward bowing of the ends thereof. Moreover, the composite plates **50—50** prevent the shells from becoming twisted sidewise during the heating and cooling steps.

The composite plates **50—50** are composite structures composed of an upper metal plate **70**, a lower metal plate **72** which is segmental in structure, and a thin layer **74** of insulating material cemented sandwich-fashion between these two metal plates. The two plates **70** and **72** are approximately coextensive in length and width. The upper plate **70** is provided with two parallel longitudinal grooves **76** and **78**, best shown in Fig. 4, which provide clearance for the two rows of bases, of which the bases **62** and **63** are representative, which are seated in the bottom of the shell **52**. In the bottoms of the grooves **76** and **78** are formed two rows of keyhole shaped slots **80—80** and **82—82**, respectively. These slots are spaced at intervals corresponding with the spacing of the terminal posts **54—54** and **56—56** which protrude downwardly from the bottom of the shell **52**. Likewise, the segmental lower plate **72** is provided with two rows of keyhole shaped slots **84—84** and **86—86** aligned with and arranged in a pattern corresponding to that of the keyhole shaped slots **80—80** and **82—82** in the upper plate **70**. Of course, the intermediate insulating layer **74** must be provided with a plurality of slots **88—88** which are aligned with the slots in the two metal plates.

The enlarged circular portions of the slots **80—80** and **82—82** are of the same size as the corresponding circular portions of the slots **84—84** and **86—86**. However, the short straight portions of the slots **84—84** and **86—86** are narrower than the corresponding portions of the slots **80—80** and **82—82**. This construction permits the terminal posts **54—54** and **56—56** to extend through the slots **80—80** and **82—82** in the upper metal plate **70** without making electrical contact therewith.

Although the terminal posts may make electrical contact with the sides of the slots **84—84** and **86—86** in the segmental lower metal plate **72**, this lower plate is cut into a plurality of separate segments **90—90** in order to insulate the terminal posts from each other. The segments **90—90** are formed by two series of diagonal slots **92—92** and **93—93**. Each of the diagonal slots **92—92** extends from the enlarged circular portion of one of the keyhole shaped slots **84—84** to the enlarged circular portion of an adjacent one of the keyhole shaped slots **86—86**. The diagonal slots **92—92** are parallel to each other, and if they were projected beyond the keyhole shaped slots which they connect, they would intersect the sides of the segmental plate **72** at an angle of about 45°.

The diagonal slots **93—93** also extend in a parallel pattern which is nearly perpendicular to but does not actually intersect the parallel pattern of the diagonal slots **92—92**. The diagonal slots **93—93** extend across the entire width of the segmental plate **72** and intersect the longitudinal sides thereof at an angle of about 50°. Each of the diagonal slots **93—93** passes through the enlarged circular portion of one of the keyhole shaped slots **84—84** and also through the enlarged circular portion of one of the keyhole shaped slots **86—86**. The angles 45° and 50° specified herein are dictated by the geometrical arrangement of the terminal posts. Thus, each of the terminal posts **54—54** and **56—56** extends through one of the segments **90—90** of the plate **72**, and is separated

by the diagonal slots **92—92** and **93—93** therein from all of the other terminal posts.

The enlarged circular portions of the keyhole shaped slots **80—80**, **82—82**, **84—84**, **86—86** and **88—88** facilitate the operation of mounting each shell **52** onto one of the composite plates **50—50**. One of a plurality of nuts **94—94** is already loosely threaded onto each one of the terminal posts **54—54** and **56—56** at the time the shell **52** is brought into engagement with its composite plate **50**. As the terminal posts are inserted through the keyhole shaped slots, the nuts **94—94** readily pass through the enlarged circular portions of the slots. After the nuts **94—94** have passed entirely through the slots in the upper plate **70**, the intermediate insulating layer **74**, and through the lower plate **72** of the composite plate **50**, the shell **52** is slid to the right, as viewed in Fig. 1, until the nuts are positioned beneath the straight portions of the keyhole shaped slots, as shown in Figs. 3 and 4. The nuts are then tightened to secure the shell **52** firmly in place on the composite plate **50**.

In one commercial embodiment of the invention, both the metal plate **70** and the segmental metal plate **72** are approximately 18½ inches long, from 1½ to 2½ inches wide, and about ¼ inch thick. Each of the two plates **70** and **72** contains a total of twenty of the keyhole shaped slots. In both of the metal plates the enlarged circular portions of the slots have a radius of about ¼ inch. The straight portions of the slots terminate in rounded portions each having a radius of about .281 inch in the upper plate **70**, while in the lower plate **72** the corresponding rounded ends of the straight portions have a radius of about .096 inch. The thickness of the intermediate layer **74** of insulation was a very small fraction of an inch, so that this layer resembled a thin membrane.

As shown in greater detail in Fig. 5, the layer **74** is composed of two sheets **96—96** of gauze fabric, such as cotton, which are impregnated and coated with rubber cement. This cement securely bonds the plate **70** to the segments **90—90** of the segmental plate **72**, while the sheets **96—96** of cotton gauze prevent the metal plate **70** from making contact at any point with the segmental plate **72**. The cotton gauze sheets **96—96** are an important safeguard due to the fact that the insulating layer **74** is so thin.

In this same commercial embodiment of the invention, the diagonal slots **92—92** and **93—93** were not cut in the lower plate **72** until after this plate had been bonded to the upper plate **70** by the intermediate layer **74**. A commercially obtainable rubber cement known by the tradename "Plastilok" was employed. First, one coat of this cement was applied to one face of each of the two metal plates, in which the keyhole shaped slots had been previously stamped. Then, a sheet of cotton gauze was applied over the cement coat on both metal plates. Next, another coat of the rubber cement was applied over the gauze sheets. Both plates were then heated for thirty minutes at 190° F. The preheated coated faces of the plates were pressed together under 150 lbs. per sq in. pressure and heated at 400° F. for ten minutes. After the assembly had cooled, the diagonal slots **92—92** and **93—93** were cut in the plate **72** to create the segments **90—90** thereof. As the final step in the manufacture of the composite plates **50—50**, the gauze sheets **96—96** and the rubber cement in the intermediate layer **74** were punctured to form the slots **88—88** therein in alignment with the keyhole shaped slots in the plates **70** and **72**. In the resultant assembly, the upper metal plate **70** gave adequate structural strength and rigidity, while the insulating layer **74** and the diagonal slots **92—92** and **93—93** electrically isolated the segments **90—90** of the lower plate **72** from each other.

Obvious variations may be made in the composite plate structure and in the method of making such structure, without departing from the spirit and the scope of the invention.

What is claimed is:

1. A composite plate for supporting cable terminals having a plurality of individual terminal posts while performing electrical tests thereon, which comprises a pair of generally coextensive metal plates mounted parallel and spaced closely to each other, each of said plates having a plurality of similar slots aligned and arranged in a pattern suitable to permit the individual terminal posts of a cable terminal to extend through the composite plate, the slots in one of said plates being slightly larger than the corresponding slots in the other plate so that the terminal posts extending through the aligned slots are prevented from electrically contacting the plate having the larger slots therein, the plate having the smaller slots being divided into a plurality of isolated segments to insulate the terminal posts from each other, and a layer of insulating material sandwiched between and bonded to the pair of metal plates.

2. A composite plate for supporting cable terminals having a plurality of individual terminal posts while performing electrical tests thereon, which comprises a pair of generally coextensive steel plates mounted parallel and spaced closely to each other, each of said plates having a plurality of keyhole shaped slots aligned and arranged in a pattern suitable to permit the individual terminal posts of a cable terminal to extend through the composite plate, the slots in one of said plates being slightly larger than the corresponding slots in the other plate so that the terminal posts extending through the aligned slots are prevented from electrically contacting the plate having the larger slots therein, the plate having the smaller slots being divided into a plurality of isolated segments to insulate the terminal posts from each other, and a thin layer of insulating material sandwiched between and bonded to the pair of steel plates, said insulating material comprising at least one sheet of fabric gauze impregnated and coated with rubber cement.

3. A composite plate for supporting cable terminals having a plurality of individual terminal posts while performing electrical tests thereon, which comprises a pair of generally coextensive metal plates mounted parallel and spaced closely to each other, both of said plates having a plurality of keyhole shaped slots each of which slots includes an enlarged circular portion communicating with a short straight portion which terminates in a rounded portion, the enlarged circular portions of the slots in the two plates being aligned and arranged in a pattern suitable for the individual terminal posts of a cable terminal to extend through the composite plate, the straight portions of the slots in one of said plates being slightly larger than the corresponding portions of the slots in the other plate so that the terminal posts extending through the aligned slots are prevented from electrically contacting the plate having the larger slots therein, the plate having the smaller keyhole shaped slots therein being divided into a plurality of isolated segments by a plurality of diagonal slots which interconnect the keyhole shaped slots and extend to the outer edges of this plate, thereby preventing any of the terminal posts from being electrically connected to each other through this plate, and a layer comprising rubber sandwiched between and bonded to the pair of metal plates.

4. A composite plate for supporting cable terminals having a plurality of individual terminal posts while performing electrical tests thereon, which comprises a pair of generally coextensive metal plates mounted parallel and spaced closely to each other, both of said plates having a plurality of keyhole shaped slots each of which slots includes an enlarged circular portion communicating with a short straight portion which terminates in a rounded portion, the enlarged circular portions of the slots being aligned in the two plates and being arranged in a pattern suitable for the individual terminal posts of a cable terminal to extend through the composite plate, the straight portions of the slots in one of said plates

being slightly larger than the corresponding portions of the slots in the other plate so that the terminal posts extending through the aligned slots are prevented from electrically contacting the plate having the larger slots therein, the plate having the smaller keyhole shaped slots therein being provided with a plurality of diagonal slots which interconnect the keyhole shaped slots and extend to the outer edges of this plate, thereby preventing any of the terminal posts from being electrically connected to each other through this plate, and a thin layer of insulating material sandwiched between the pair of steel plates to insulate them from each other and to bond them together, said insulating material comprising at least one sheet of cotton gauze impregnated and coated with a heat cured rubber cement.

5. The method of making plates designed to support cable terminals which have a plurality of individual terminal posts protruding therefrom, which comprises the steps of stamping a plurality of slots in a metal plate in a pattern designed to receive the individual terminal posts of a cable terminal, stamping in another metal plate a plurality of slightly larger slots arranged in a similar pattern, placing the plates side by side with the slots therein in alignment, bonding the plates together with an intermediate layer of insulating cement, and cutting a series of diagonal slots in the plate having the smaller slots to divide this plate into a plurality of isolated segments each of which receives one of the individual terminal posts and insulates them from each other.

6. The method of making plates designed to support cable terminals which have a plurality of individual terminal posts protruding therefrom, which comprises the steps of stamping a plurality of generally keyhole shaped slots in a metal plate in a pattern designed to receive the individual terminal posts of a cable terminal, stamping in another metal plate a plurality of slightly larger generally keyhole shaped slots arranged in a similar pattern, placing the plates side by side with the slots therein in alignment, bonding the plates together with an

intermediate layer of rubber cement, and cutting a series of parallel diagonal slots in the plate having the smaller keyhole shaped slots to interconnect the keyhole shaped slots therein and divide this plate into a plurality of isolated segments each of which receives one of the individual terminal posts and insulates them from each other.

7. The method of making plates designed to support cable terminals which have a plurality of individual terminal posts protruding therefrom, which comprises the steps of stamping a plurality of generally keyhole shaped slots in a metal plate in a pattern designed to receive the individual terminal posts of a cable terminal, stamping in a similar metal plate a plurality of slightly larger generally keyhole shaped slots arranged in a similar pattern, coating one face of each of the two plates with a layer of a heat curable rubber cement, applying at least one sheet of cotton gauze to each of the cement coatings, placing the coated faces of the plates together with their keyhole shaped slots in alignment, heating the plates while pressing them together under pressure until the cement is cured, and cutting a series of parallel diagonal slots in the plate having the smaller keyhole shaped slots therein to interconnect the keyhole shaped slots and divide this plate into a plurality of isolated segments each of which receives one of the individual terminal posts and insulates them from each other.

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