Dec. 12, 1939. R. L. LUNSFORD 2,182,968

METHOD OF MAKING ELECTRICAL CONNECTIONS

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FIG. 2

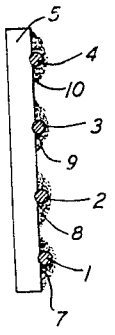


FIG. 3

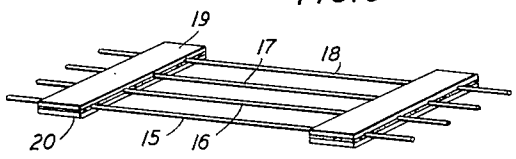


FIG. 1

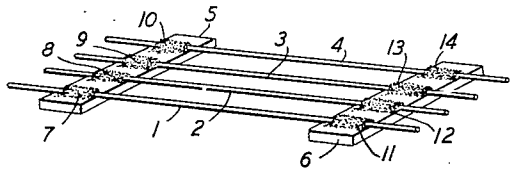


FIG. 6

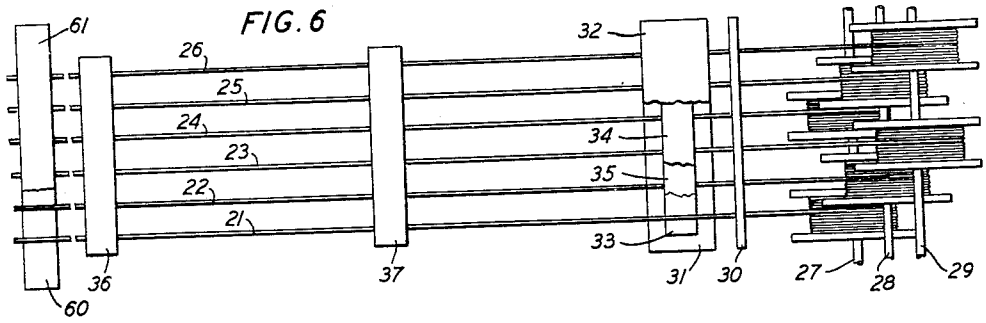


FIG. 7

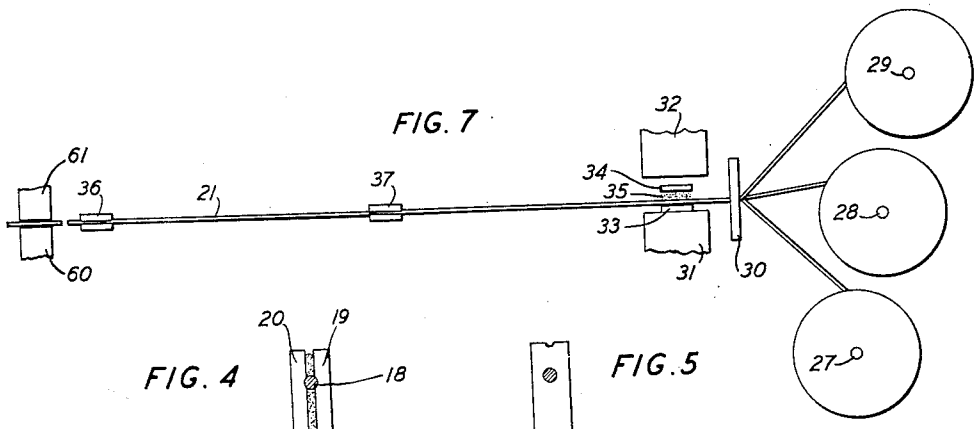


FIG. 4

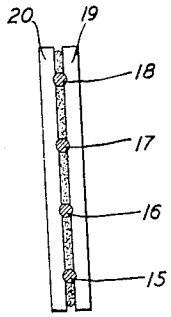


FIG. 5

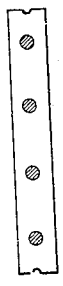

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FIG. 8

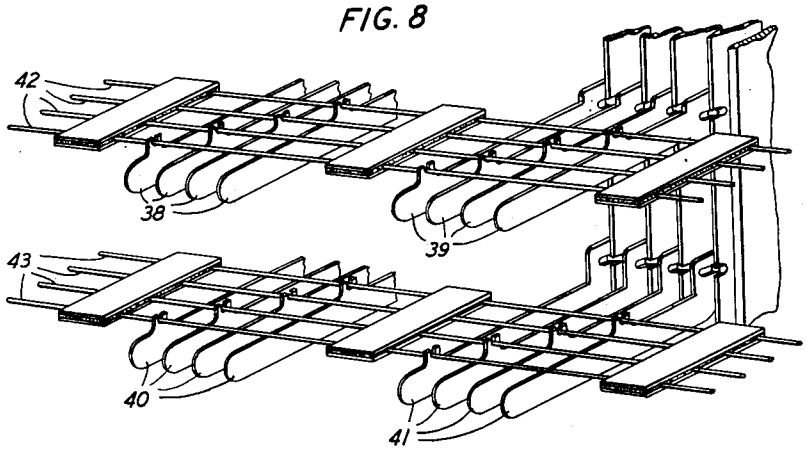



FIG. 9

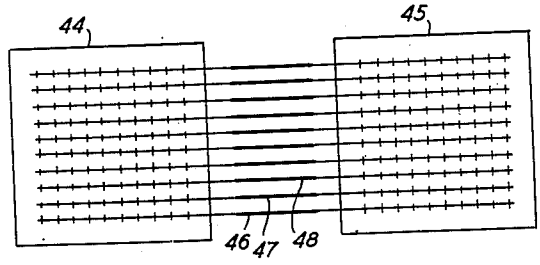
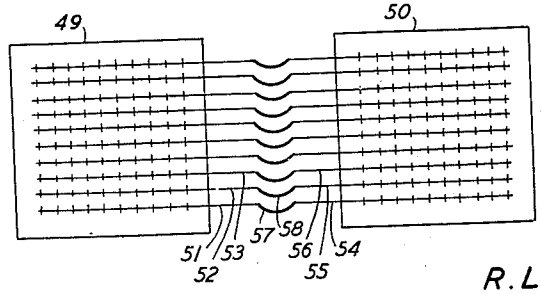



FIG. 10

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2,182,968

# UNITED STATES PATENT OFFICE

2,182,968

## METHOD OF MAKING ELECTRICAL CONNECTIONS

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Application February 28, 1935, Serial No. 8,594

6 Claims. (Cl. 174—72)

This invention relates to methods of making electrical connections and particularly to methods for making multiple connections in telephone switchboards.

The objects of the invention are to simplify and improve the methods of making cable connections; and to effect a saving of time and labor in the process of multipling switchboard terminals.

Connecting cables for multipling the terminal sets in a telephone switchboard have been devised heretofore in which a plurality of flexible conductors and threads of some insulating material, such as cotton, are woven together in a flat band or ribbon, the conductors being exposed at proper intervals to permit of their connection to the terminal sets which it is desired to connect in multiple relation. A cable of this type is shown in the patent to McBerty No. 1,054,784 of March 4, 1913.

According to the present invention advantages are obtained over these prior multipling devices by the use of a unitary cable structure in which a plurality of bare wire conductors are held in spaced parallel relation by a series of insulating bonds arranged at suitably spaced intervals along the length of said conductors, each bond comprising a strip of insulating material placed on one side of said conductors and secured to them by some suitable adhesive material such as thermoplastic cement.

A feature of the invention is a method of multipling switchboard terminal sets which consists in providing said terminals with notches or recesses, arranging said terminals with notches in line, preparing a connecting cable by fixing a plurality of bare conductors in spaced relation to each other, placing a series of insulating members in proximity to said conductors at spaced intervals along the length thereof, securing said conductors to said insulating members by the application of a cementing substance to form a unitary cable structure, placing said cable in position with the conductors thereof in the notches of said terminals, and securing said conductors to said terminals.

Another feature of the invention is the method of multipling switchboard terminals in which the connecting cable is prepared by fixing a plurality of bare wire conductors in spaced relation to each other, placing a series of insulating strips in spaced relation along one side of said conductors, placing a second series of insulating strips in spaced relation along the other side of said conductors, and opposing the insulating strips of said first series, cementing the opposing strips together to form bonds holding said conductors, and applying said conductors to the terminals to be multipled.

These and other features of the invention will be described more fully in the following specification which should be considered in connection with the accompanying drawings.

Referring to the drawings:

Fig. 1 shows a portion of a cable structure made in accordance with this invention;

Fig. 2 is a cross-section of the cable structure shown in Fig. 1;

Fig. 3 shows an alternative form of the cable structure;

Fig. 4 is a cross-section of the cable structure shown in Fig. 3;

Fig. 5 illustrates a modification of the cable structure shown in Fig. 4;

Figs. 6 and 7 show two views of a cable in the process of manufacture;

Fig. 8 illustrates the manner in which the completed cable structure is applied to the sets of terminals to be multipled; and

Figs. 9 and 10 illustrate adjacent switches or switchboards connected in multiple by means of the connecting cables.

The connecting cables to which this invention relates are particularly useful for connecting in multiple the successive sets of electrical terminals in automatic switches and switchboards for telephone systems. These cables may be applied to various types of automatic switches and switchboards, such as those illustrated in the patent to F. Aldendorff 1,663,230 of March 20, 1928; in the patent to J. N. Reynolds 1,139,722 of May 18, 1915; and in the application of J. N. Reynolds, Serial No. 702,453 filed December 15, 1933, issued as Patent 2,021,329, Nov. 19, 1935.

The method of multipling switchboard terminals now in common use is to apply the connecting strap wires individually to the terminals by hand and to stretch or tension each wire by some suitable means while the soldered joints are made. This requires considerable time and skill on the part of the workman. With the cable structure of the present invention time is saved and less skill is required, thus lending itself to economical mass production. This structure includes in a single unit as many parallel strap wires as there are terminals in each of the sets to be multiplied. The wires are held in fixed spaced relation by insulating bonds which occur at suitable intervals along the length of the wires. The structure thus formed is rigid, and when applied and, sol-

dered, it adds to the strength of the terminal bank. Moreover, its application is comparatively easy, the wires require no stretching, and greater speed is possible in making the soldered joints.

Referring to Figs. 1 and 2, the connecting cable here shown comprises a plurality of bare wire conductors 1, 2, 3 and 4 which are cemented to a series of insulating bonds. Two of these bonds, 5 and 6, are shown. The insulating bonds may be made of any suitable insulating material, such as cellulose acetate, cellulose nitrate, or phenol fibre. These bonds are applied to one side of the conductors, and the conductors are cemented to the bonds by means of suitable cementing material. For this purpose a lacquer may be used such as that commonly employed for insulating the butts of electric cables. Also, a cement of the thermoplastic type may be used to advantage. Cements of this type may be derived by treating such substances as cellulose acetate or cellulose nitrate with some plasticizing substance.

The strap wires 1, 2, 3 and 4 are thus secured to the bond strip 5 by portions 7, 8, 9 and 10 of the cement, and likewise they are secured to the bond strip 6 by portions 11, 12, 13 and 14 of the cement. While only four conductors are shown in the structure of Fig. 1, it is obvious that the number of conductors in the cable can be varied and will depend upon the number of terminals in the sets to be multipled. It is also apparent that the spacing of the insulating strips may be varied in accordance with the requirements.

In the connecting cable shown in Figs. 3 and 4, the strap wires 15, 16, 17 and 18 are secured in spaced relation by a somewhat different form of insulating bond. In this case each of the bonds consists of a pair of insulating strips 19 and 20 placed on opposite sides of the conductors and cemented to each other and to the conductors by means of some suitable cementing substance such as that described in connection with Fig. 1.

One method of manufacturing these connecting cables is illustrated in Figs. 6 and 7. The desired number of strap wires 21, 22, 23, 24, 25, 26, are drawn from spools mounted on shafts 27, 28 and 29 through a spacing guide 30 and between the members 31 and 32 of a press and are temporarily held under suitable tension by a holding device or jig having members 60 and 61. The two insulating strips 33 and 34 of a bond are placed on opposite sides of the strap wires between the press members, and the proper amount of cement 35 is placed between the insulating strips. Either the cement alone or both the cement and the insulating strips 33 and 34 may be subjected to heat, and while in a heated condition the insulating strips are pressed together by the downward movement of the press member 32. The cable structure is then drawn forward the proper distance, and the next bond is similarly formed.

Another modification of the method of making the cable is to fix the wires in a jig and provide a series of presses along the length thereof so that a plurality of bonds can be made simultaneously.

It is obvious that the single insulating strip bond shown in Fig. 1 can be made by these and other modifications of the method.

By using a thermoplastic cement such as one having a cellulose nitrate base, a quick drying action is attained. These cements are plastic when subjected to heat and harden or dry rapidly when the temperature is lowered. If desirable, the drying action of the cement can be hastened by applying a blast of cold air to the bond either before or after it has been withdrawn from the press 31, 32.

The bonds shown in Figs. 3 and 4 and the bonds 36 and 37 are formed by applying pressure sufficient to bring the opposing insulating strips to a point where they are separated by a thin layer of the cementing substance, but not sufficient to bring them into physical engagement with each other. If desirable the opposing insulating strips and the applied cementing substance may be subjected to sufficient pressure and temperature to substantially weld them together. Fig. 5 shows an insulating bond made in this manner.

The connecting cable can be prepared initially in lengths suitable for the multiple terminals to which it is to be applied, or it can be made in stock lengths and later cut to meet the requirements of the switch for which it is to be used.

Fig. 8 illustrates four sets of switch terminals 38, 39, 40 and 41, each set comprising four individual terminals. Terminal sets 38 and 39 are in alignment with each other and with other terminal sets, not shown, constituting a row. Likewise, terminal sets 40 and 41 together with others, not shown, constitute a second row of terminals. These terminals are provided with notches for receiving the multiple strap wires, and the notches of corresponding terminals in each of the successive sets in a row are in alignment with each other. This alignment is secured as shown in the figure by progressively offsetting the notches of the several terminals in each set. After the cable lengths 42 and 43 have been prepared, they are applied to the terminals as seen in Fig. 8 with each of the several strap conductors resting in the aligned notches of the corresponding terminals of the successive sets. Following this, the strap conductors are soldered to the terminals at the several points of contact in the respective notches.

In Fig. 9 two switches or switchboards 44 and 45 are mounted in line with each other. Here it is necessary not only to multiple the successive terminal sets in each switchboard but also to extend the multiple from one switchboard to the next. This is accomplished by preparing the connecting cables 46, 47, 48, etc., in sufficient lengths to extend across as many of the separate switchboards 44, 45, etc., as it is necessary to include in the multiple.

Fig. 10 shows two adjacent switches or switchboards 49 and 50 and illustrates a different method of joining the multiple of one switchboard to another. In this arrangement the terminal sets of switchboard 49 are multipled by the connecting cables 51, 52, 53, etc.; and the terminal sets of switchboard 50 are multipled by the connecting cables 54, 55, 56, etc.; and corresponding connecting cables of the two switchboards are joined together by the short jumper wires 57, 58, etc.

In both Figs. 9 and 10 the exposed conductors between the adjacent switches may be covered with some suitable insulating varnish.

What is claimed is:

1. The method of connecting a plurality of electrical terminal sets in multipled relation which comprises providing the individual terminals of said sets with recesses, arranging said terminals with the recesses thereof in line, preparing a connecting cable by arranging a plurality of conductors in spaced relation, placing a series of insulating members in proximity to said

conductors, cementing said insulating members to said conductors to form a unitary cable structure, applying said cable structure to said terminals with the conductors resting in said recesses, and securing said conductors to said terminals.

2. The method of connecting electrical terminal sets in multiple relation which comprises providing the individual terminals of each set with notches, arranging the corresponding terminals in the several sets with their notches in line, preparing a connecting cable by arranging a plurality of bare wire conductors in spaced parallel relation, placing a series of insulating strips in spaced relation along one side of said conductors, placing a second series of insulating strips in spaced relation along the other side of said conductors and opposing the insulating strips of said first series, cementing the opposite strips together to form bonds holding said conductors, applying said conductors to said terminal sets in such a way that each conductor rests in the notches of corresponding terminals of the successive sets, and securing said conductors to said terminals.

3. The method of multipling the terminal sets of a switchboard which comprises providing the terminals of said sets with recesses, arranging said terminals with the recesses in line, preparing a connecting cable by arranging a plurality of bare wire conductors in spaced relation, placing a series of insulating strips in proximity to said conductors along the length thereof, cementing said insulating strips to said wire conductors to form a unitary cable structure, cutting said cable structure to suitable lengths, applying the prepared structure to said terminals with the wire conductors thereof resting in the recesses of said terminals, and soldering said conductors to said terminals.

4. The method of connecting a plurality of electrical terminal sets in multiple relation which comprises providing the individual terminals of said sets with recesses, arranging said terminals with the recesses thereof in line, preparing a connecting cable by arranging a plurality of conductors in spaced relation, placing a series of insulating members in proximity to said conductors, securing said insulating members to said conductors with a thermo-plastic substance to form a unitary cable structure, applying said cable structure to said terminals, and securing said conductors to said terminals in the recesses thereof.

5. The method of connecting a plurality of electrical terminal sets in multiple relation which comprises providing the individual terminal sets with recesses, arranging said terminals with the recesses in line, preparing a connecting cable by arranging a plurality of bare wires in spaced relation, placing a series of insulating members in proximity to said wires, subjecting said insulating members to heat to cement said wires thereto to form a unitary cable structure, applying said cable structure to said terminals with the wires resting in said recesses, and securing said wires to said terminals.

6. The method of connecting a plurality of terminal sets in multiple relation which comprises providing the individual terminals of said sets with apertures, arranging said terminals with the apertures thereof in line, preparing a connecting cable by arranging a plurality of bare conductors in spaced relation, placing a series of insulating strips in proximity to said conductors at spaced intervals along the length thereof, depositing a thermo-plastic substance on said insulating strips at the points of proximity to said conductors, subjecting said insulating strips and thermo-plastic substance to temperature and pressure to cement said insulating strips to said conductors to form a unitary cable structure, applying said cable structure to said terminals with the conductors resting in said apertures, and securing said conductors to said terminals.

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