April 6, 1948. L. A. BARTELHEIM ET AL 2,438,959

METHOD OF ASSEMBLING ARCUATE TERMINAL BANKS

Filed Dec. 12, 1942 3 Sheets-Sheet 1

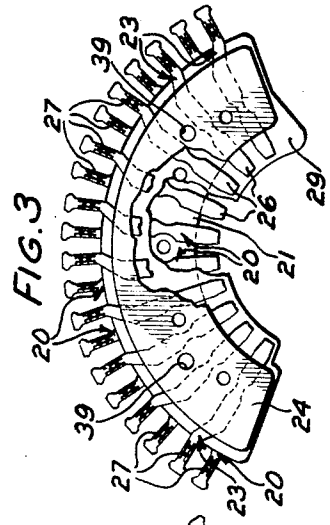


FIG. 3

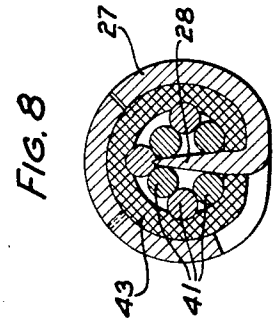


FIG. 8

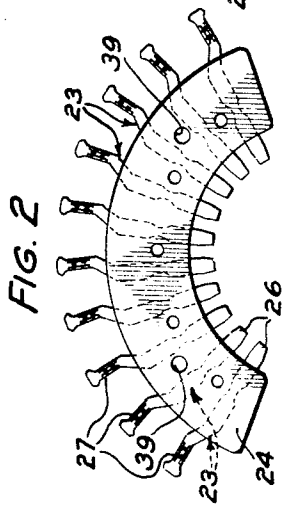


FIG. 2

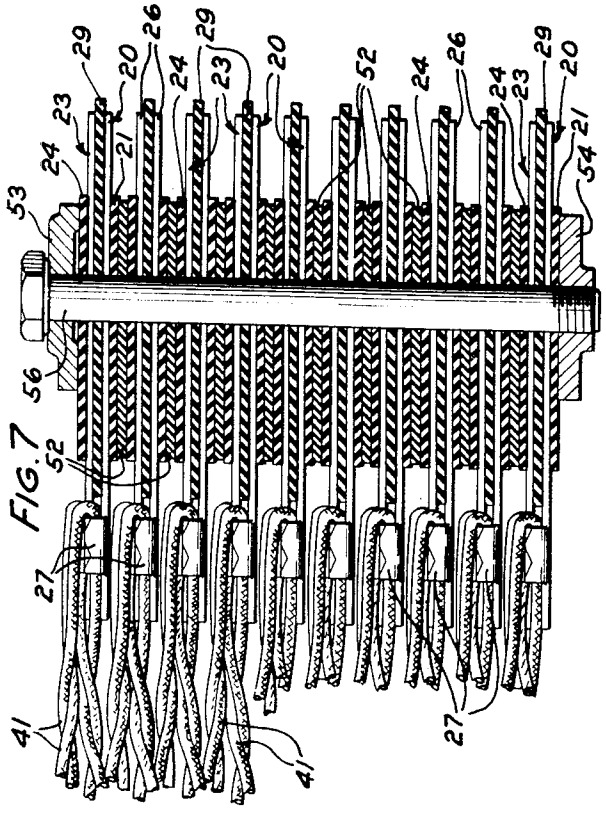


FIG. 7

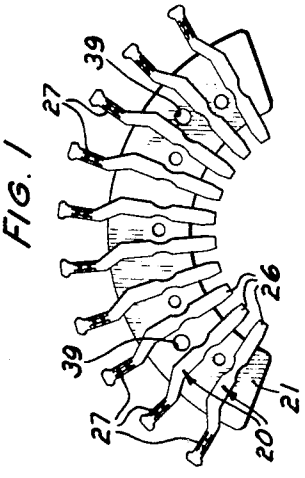


FIG. 1

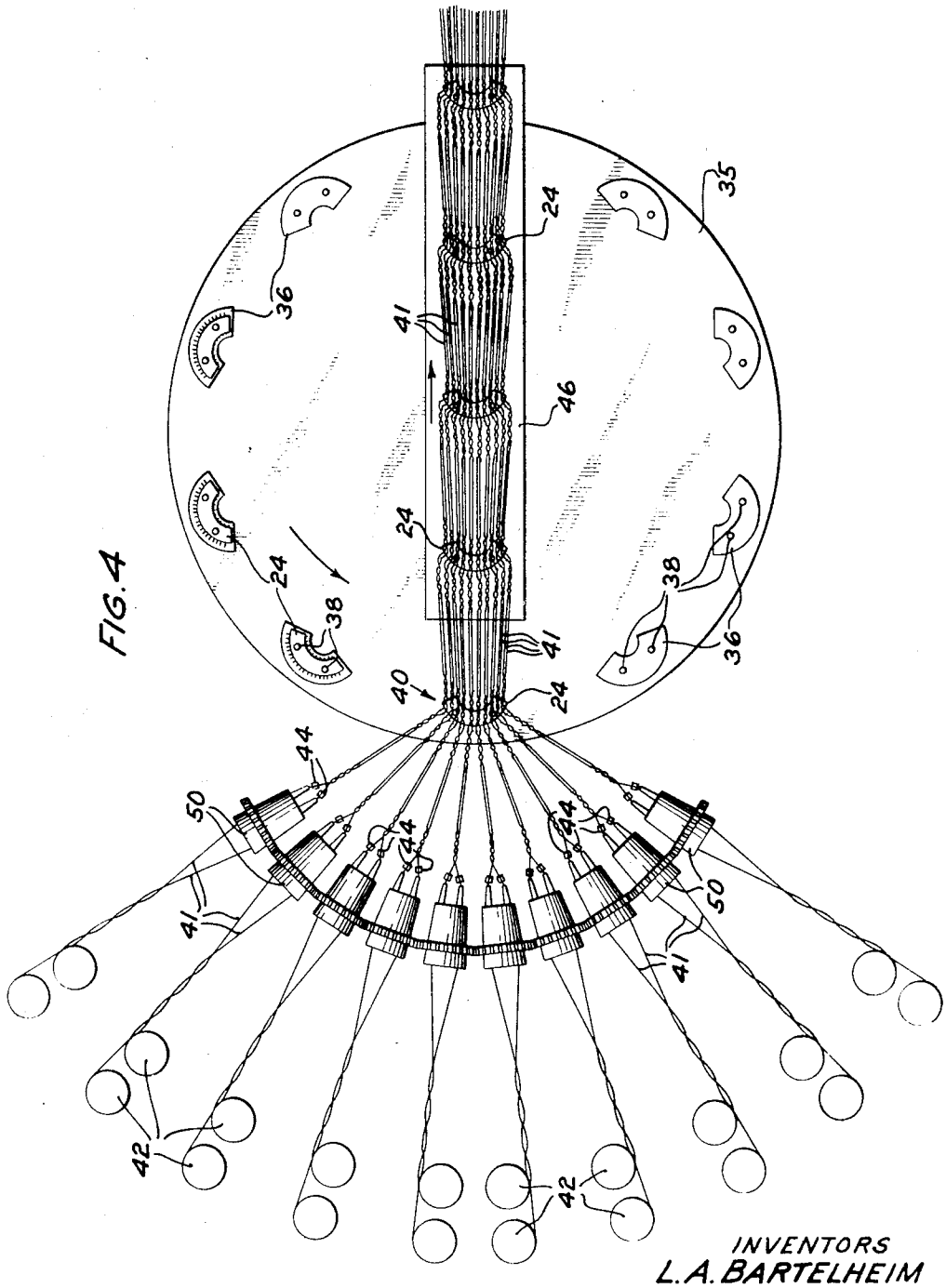
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FIG. 4



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METHOD OF ASSEMBLING ARCUATE TERMINAL BANKS

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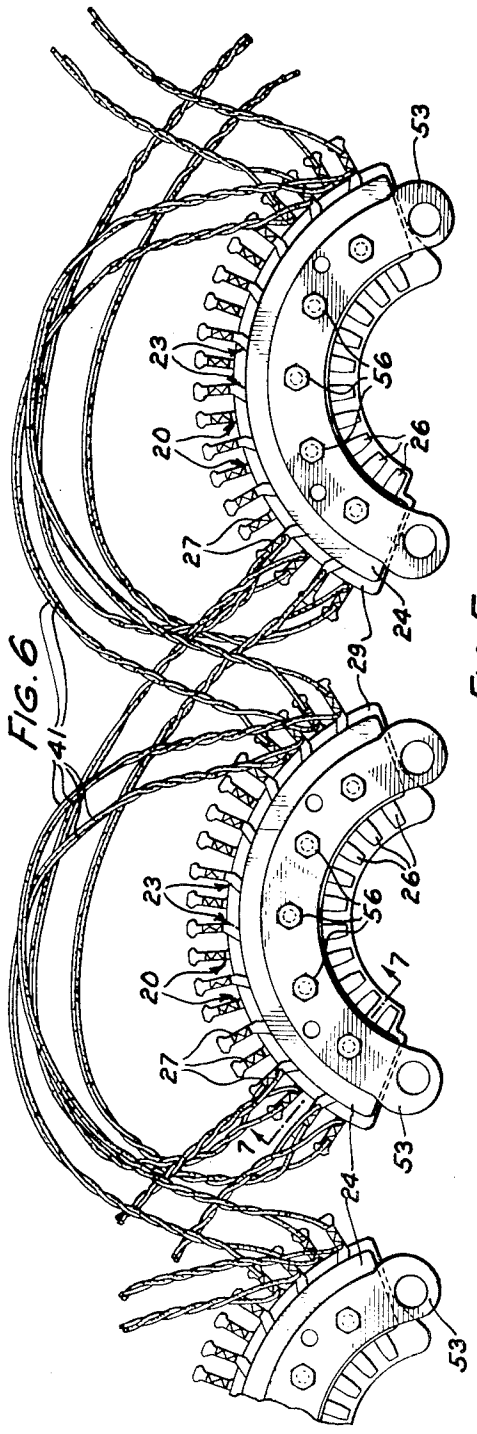


FIG. 6

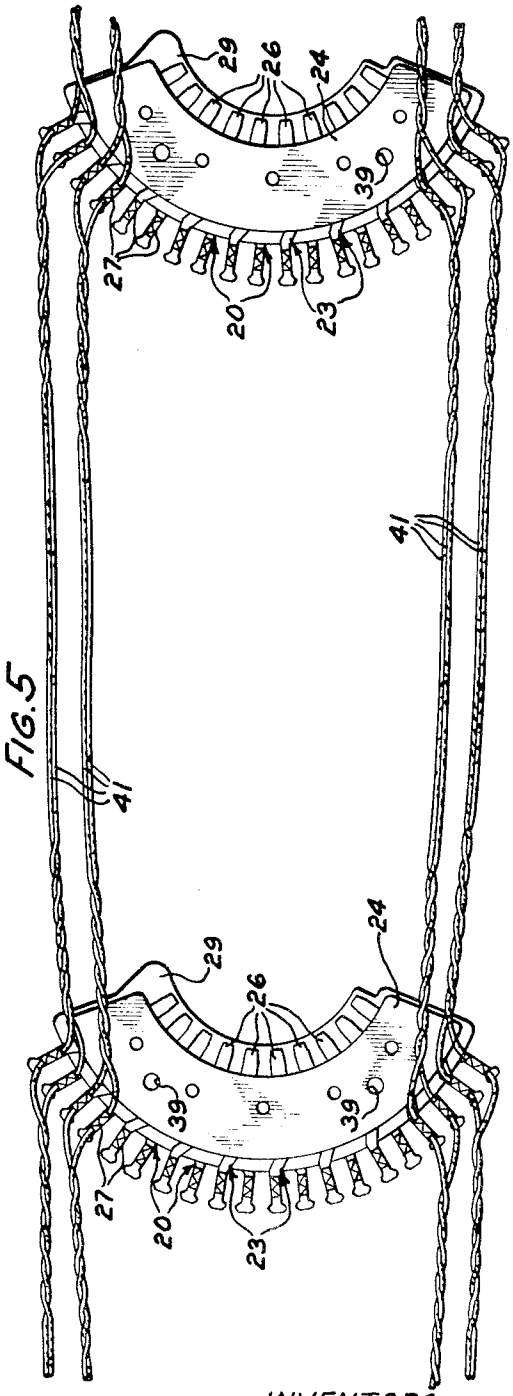


FIG. 5

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METHOD OF ASSEMBLING ARCUATE TERMINAL BANKS

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17 Claims. (Cl. 29—155.55)

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This invention relates to method of assembling arcuate terminal banks, and more particularly to improvements in the manufacture of contact bank equipment such as is used in switching mechanisms for extending connections in automatic telephone systems.

In certain types of telephone systems, automatic switching mechanisms are employed in which wipers are operated to travel along an interconnected series of banks of contacts to establish electrical connections between the wipers and selected contacts of the several banks. Heretofore, it has been the practice in some instances to manufacture these banks of contacts as separate and individual units, each comprising a predetermined number of individual contacts arranged in arcuate layers with separating insulators interposed between the layers. The required number of such banks of contacts were then mounted in proper relation to each other on a supporting frame, after which the corresponding contacts of the several banks were wired or interconnected by first stripping the insulation from the connecting wires at predetermined intervals and then manually fastening and soldering the bared wire portions to the terminal portions of the contacts.

An object of the present invention is to reduce the manufacturing cost and improve the quality of contact bank equipment of the type referred to.

In accordance with one embodiment of the invention, a simple and improved method of manufacturing contact bank equipment is provided in which the contacts are formed with solderless terminal portions and are attached to separate insulating cards, after which the separate cards of the contacts are electrically connected to continuous stranded conducting wires at spaced intervals by means of the terminal portions of the contacts which are clinched to the wires and are formed with tangs which pierce through the insulation to make electrical contact with the stranded conducting wires. The thus formed continuous string of interconnected cards of contacts is then cut into predetermined lengths, each comprising a predetermined number of interconnected cards of contacts, after which the required number of these lengths or so-called "levels" of interconnected contact cards are stacked and clamped together to form an interconnected series of contact banks.

In the application of the method of the present invention to the manufacture of contact bank equipment of the type used for extending tip and

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ring connections in so-called step-by-step telephone systems, the tip and ring contacts are attached to separate cards which are subsequently arranged in pairs with a card of ring contacts superposed upon a card of tip contacts and a separating insulator interposed therebetween. These pairs of contact cards are then electrically connected by means of continuous conducting wires to which corresponding tip and ring contacts on successive cards are connected at spaced intervals. In order to control cross talk, the connecting wires of each pair of tip and ring contacts may be twisted together between successive pairs of cards as they are assembled into a continuous string of interconnected pairs of contact cards. This continuous string of interconnected pairs of tip and ring contact cards is then cut into predetermined lengths, after which the required number of these lengths or "levels" are assembled into an interconnected series of tip and ring contact banks.

A more complete understanding of the above referred to application of the method of the invention will be had from the following detailed description thereof when read in conjunction with the accompanying drawings, in which

Fig. 1 shows a layer of tip contacts attached to the upper side of an insulating card;

Fig. 2 shows a layer of ring contacts attached to the underside of an insulating card;

Fig. 3 shows a sub-assembly comprising a card of ring contacts superposed upon a card of tip contacts with a separating insulator interposed therebetween;

Fig. 4 illustrates schematically a preferred method of forming a string or "level" of interconnected tip and ring contact card sub-assemblies;

Fig. 5 is an enlarged plan view of a portion of a string or "level" of interconnected tip and ring contact card subassemblies, with some of the conducting wires omitted for clearness;

Fig. 6 is a plan view of a portion of an interconnected series of tip and ring contact banks formed by stacking and clamping together the required number of "levels" of interconnected tip and ring contact card sub-assemblies of the form shown in Fig. 5;

Fig. 7 is an enlarged cross sectional view taken on line 7—7 of Fig. 6, and

Fig. 8 is an enlarged cross sectional view through the terminal portion of one of the contacts.

The method illustrated in the drawings comprises the initial step of attaching a plurality

of individual contacts to each of a plurality of insulator cards. As shown in Fig. 1, a plurality of tip contacts 20, 20 are arranged in an arcuate layer and attached to the upper side of an arcuate insulator card 21. A plurality of ring contacts 23, 23 are similarly arranged and attached to the underside of each of a plurality of insulator cards 24, 24 similar to the cards 21, as shown in Fig. 2. It will be noted that the tip and ring contacts are of similar construction, each having a wiper contacting portion 26 at one end and a U-shaped solderless terminal portion 27 at its opposite end. The terminal portion may be formed with one or more tangs 28 (Fig. 8) for piercing through the insulation to make electrical contact with the stranded conducting wires. The terminal portions of the tip and ring contacts are laterally offset in opposite directions for the purpose hereinafter described.

The number of tip and ring contacts attached to each insulator card may vary, of course, in accordance with the particular requirements of the equipment to be manufactured therefrom. In the illustrated embodiment of the invention, each tip contact card is provided with ten contacts and each ring contact card is likewise provided with ten contacts.

After a supply of tip and ring contact cards have been prepared in the manner described above, they are arranged or assembled in pairs with a card of ring contacts superposed upon a card of tip contacts and a separating insulator 29 interposed therebetween, as shown in Fig. 3. When arranged in this manner, the offset terminal portions 27 of the ring contacts are disposed between the oppositely offset terminal portions of the tip contacts, while the wiper contacting portions 26 of the ring contacts are disposed above the wiper contacting portions of the tip contacts, being separated therefrom only by the separating insulator 29.

The thus formed pairs of tip and ring contact cards are next formed into a continuous string of interconnected pairs of contact cards by clinching and thereby electrically connecting the terminal portions of corresponding contacts on successive pairs of cards to continuous conducting wires at uniformly spaced intervals. This wiring operation may be performed by a machine of the type illustrated schematically in Fig. 4. The machine may comprise, for example, a rotary table 35 equipped with a series of fixtures or jigs 36, 36, each adapted to receive and hold a pair of tip and ring contact cards with a separating insulator interposed therebetween. By means of pilot pins 38, 38, adapted to enter pilot holes 39, 39 (Figs. 1, 2 and 3) in the several insulator cards, the tip and ring contact cards and the intermediate separating insulator are properly positioned with respect to each other. The table may be indexed periodically to advance the previously loaded jigs, one at a time, to a clinching position 40 where ten pairs of conducting wires 41, 41 drawn from a corresponding number of supply spools 42, 42 may be clinched simultaneously to the terminal portions of the ten pairs of tip and ring contacts by means of cooperating punch and die members (not shown). By this operation, the U-shaped terminal portions of the contacts are wrapped around the insulated stranded conducting wires 41, and the tangs 28 (Fig. 8) are caused to pierce through the insulating covering 43 and make electrical contact with the stranded wires.

A series of reciprocatory wire gripping and feeding fingers 44, 44, may be provided, whereby the ten pairs of continuous wires may be withdrawn simultaneously from the respective supply spools, advanced predetermined distances, and then inserted in the terminal portions of the ten pairs of tip and ring contacts previously indexed to the clinching position. As the ten pairs of wires are advanced toward the clinching position, the previously connected pairs of tip and ring contact cards may be fed forwardly across the center of the rotary table and onto a conveyor belt 46.

In order to control cross talk, it may be necessary in some instances to twist together the connecting wires of each pair of tip and ring contacts between successive pairs of interconnected tip and ring contact cards. This twisting operation may be performed prior to each clinching operation, and for this purpose a series of rotary twisting heads 50, 50 may be provided between the wire supply spools and the feed fingers 44, one for each pair of tip and ring contact wires. Each of these twisting heads may be provided with a pair of spaced orifices for the passage of the wires therethrough so that by rotating the twisting heads, the wires are twisted together, as shown in Fig. 4.

In order to prevent an accumulation of twists in the wires between the twisting heads and the supply spools, the direction of rotation of the twisting heads may be reversed for successive operating cycles so that during each operating cycle of the twisting heads, the several twists previously introduced in the wires between the supply spools and the twisting heads are removed or neutralized. This eliminates the necessity of revolving the supply spools in order to prevent accumulation of twists between the supply spools and the twisting heads.

It has been found that by placing the twists close to the terminals, cross talk is more effectively controlled. This may be accomplished by causing the twisting units to operate only at the beginning and at the end of the forward movements of the wire feeding fingers, and by causing the twisting to take place adjacent the twisting units. As a result, all of the twisting will be confined to the portions of the wires adjacent the terminals, as shown in Figs. 4 and 5.

The continuous string of electrically interconnected pairs of tip and ring contact cards is subsequently severed into predetermined lengths, each length comprising a predetermined number of interconnected pairs of contact cards, and a predetermined number of these lengths or "levels" of interconnected contact cards are then stacked and assembled into a series of interconnected banks of tip and ring contacts, as shown in Figs. 6 and 7. This latter step of the method involves shifting the interconnected pairs of contact cards from the positions in which they are shown in Fig. 5 to the arrangement in which they are shown in Fig. 6. While so arranged, the several "levels" of interconnected pairs of contact cards are placed in superposed layers with spacing plates 52, 52 interposed therebetween, and each of the thus formed interconnected stacks or banks of contact cards is compressed between upper and lower retaining plates 53 and 54 held together by a plurality of through bolts 56, 56.

It is to be understood that the invention is not limited to the particular embodiments thereof herein illustrated and described, but is capable of other applications within the scope of the appended claims.

What is claimed is:

1. A method of making a series of interconnected contact banks, which comprises attaching a plurality of contacts to each of a plurality of insulator cards, electrically connecting corresponding contacts on a series of insulator cards to continuous conducting wires at spaced intervals to form a continuous string of electrically interconnected contact cards, intertwisting the wire connecting one set of corresponding contacts with another wire connecting another set of corresponding contacts in the area between the points of connection of said wires with their associated contacts, cutting the thus formed string of contact cards into predetermined lengths, and then assembling a predetermined number of such lengths of interconnected contact cards into a series of interconnected contact banks.

2. A method of making a series of interconnected contact banks, which comprises attaching a plurality of contacts to each of a plurality of insulator cards, arranging the thus formed cards of contacts in pairs with the contact cards of each pair arranged one above the other, electrically connecting corresponding contacts on a series of pairs of contact cards to continuous conducting wires at spaced intervals to form a continuous string of electrically interconnected pairs of contact cards, twisting together the connecting wires of the upper contacts with the connecting wires of the associated lower contacts, cutting the thus formed string of interconnected pairs of contact cards into predetermined lengths, and then assembling a predetermined number of said lengths of interconnected pairs of contact cards into a series of interconnected contact banks.

3. A method of making a series of interconnected contact banks which comprises connecting a plurality of pairs of conductors to the contacts on an insulator card, intertwisting each pair of conductors in one direction, connecting said pairs of conductors to the contacts of another insulator card, intertwisting each pair of said conductors in the opposite direction, connecting said pairs of conductors to the contacts of another insulator card, repeating these steps to form a series of lengths of interconnected insulator cards, and assembling a predetermined number of such lengths of interconnected cards into a series of interconnected contact banks.

4. A method of making a length of interconnected insulator cards which comprises successively feeding insulator cards with contact terminals attached thereto to a work station, feeding a plurality of converging pairs of conductors to said work station, electrically attaching said conductors to said contact terminals, intertwisting pairs of conductors as they are advanced, electrically attaching said conductors to the contact terminals of another insulator card, intertwisting said pairs of conductors in the opposite direction, and repeating these steps to form lengths of interconnected cards.

5. The method of assembling arcuate terminal banks, which comprises, longitudinally advancing pairs of insulation covered wires, twisting each pair between successive local zones, electrically connecting corresponding terminals of successive individual arcuate groups to the same pairs of wires at the successive zones, and thereafter assembling the groups in banks.

6. The method of electrically connecting arcuate groups of terminals lying in a common plane, which comprises, disposing several pairs each consisting of two elongated conductors twisted about each other so that successive local zones of each twisted pair of conductors are spaced apart, positioning the corresponding terminals of successive similar arcuate terminal groups adjacent to the same conductors at the successive spaced apart zones, and simultaneously attaching the conductors to the terminals at said zones.

7. The method of electrically connecting arcuate groups of terminals lying in a common plane, which comprises, disposing several pairs each consisting of two wires twisted about each other so that a predetermined number of local zones at each of which the twisted wires of each pair are spaced apart are periodically produced throughout the length of the wires, positioning the corresponding terminals of successive similar arcuate terminal groups adjacent to the same wire at the successive spaced apart zones, and simultaneously attaching the wires to the terminals at said zones.

8. The method of electrically connecting arcuate groups of terminals lying in a common plane, which comprises, disposing several pairs of wires so that successive local zones of each pair are spaced apart, twisting each complementary pair of wires about each other between said spaced apart zones, positioning the corresponding terminals of successive similar arcuate terminal groups adjacent to the same wires at the successive spaced apart zones, and simultaneously connecting the terminals of each group to the adjacent wires at said zones.

9. The method of electrically connecting arcuate groups of terminals lying in a common plane, which comprises, disposing several pairs of insulated wires so that successive local zones of each pair are spaced apart, twisting each complementary pair of wires about each other on opposite sides of each of said zones, placing the corresponding terminals of successive complementary groups adjacent to the same wires at the successive zones, and simultaneously clamping the terminals to the adjacent wires to produce electrical connections through the insulation.

10. The method of electrically connecting arcuate groups of terminals, which comprises, longitudinally advancing a plurality of elongated conductors, oppositely twisting adjacent pairs of said conductors about each other on opposite sides of successive local zones, periodically positioning successive groups of terminals at the successive zones along said conductors, and thereafter electrically connecting the terminals of a series of groups to the adjacent conductors.

11. The method of electrically connecting arcuate groups of terminals, which comprises, longitudinally advancing a plurality of wires, oppositely twisting adjacent pairs of said wires about each other on opposite sides of successive local zones, periodically positioning successive groups of terminals at the successive zones along said wires, and thereafter simultaneously electrically connecting all of the terminals of each group to the same wires at the successive zones.

12. The method of electrically connecting arcuate groups of terminals, which comprises, longitudinally advancing several pairs of wires, twisting each complementary pair of wires about each other between successive zones thereof, positioning successive groups of terminals at the successive zones, and thereafter electrically connecting all of the terminals of each group to the corresponding pairs of previously twisted wires at the successive zones.

13. The method of electrically connecting arcuate groups of terminals, which comprises, periodically longitudinally advancing several pairs of wires, twisting the wires of each pair about each other on opposite sides of successive zones spaced equi-distance along the wires, positioning successive similar groups of terminals at the successive zones, and thereafter simultaneously electrically connecting all of the terminals at each group to the same wires at the successive zones.

14. The method of assembling arcuate terminal banks, which comprises, longitudinally advancing pairs of wires, twisting each pair between successive zones, clamping corresponding sets of terminals of successive similar individual arcuate groups to the same pairs of wires at the successive zones, and assembling said groups in banks disposed laterally adjacent to each other.

15. The method of electrically connecting successive similar groups of terminals, which comprises, longitudinally advancing pairs of insulation covered wires, twisting each pair of wires about each other on the opposite sides of successive local zones, electrically connecting corresponding terminals of successive similar groups to the same pairs of wires at the successive zones, and thereafter assembling the groups in stacks.

16. The method of electrically connecting successive similar groups of terminals, which comprises, longitudinally advancing pairs of insulation covered wires convergingly toward a common locality, twisting each pair of wires about each other on opposite sides of successive local zones while proceeding toward said locality, electrically connecting corresponding terminals of successive

similar groups to the same pairs of wires at said locality, and thereafter assembling the groups in stacks.

17. The method of electrically connecting successive similar groups of terminals, which comprises, longitudinally advancing pairs of insulation covered wires convergingly toward a common locality, twisting each pair of wires about each other on opposite sides of successive local zones while proceeding toward said locality, and electrically connecting corresponding terminals at successive similar pairs of terminals to the same pairs of wires at said locality.

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