July 19, 1955 C. J. ROACH 2,713,194

METHOD OF MANUFACTURING MODIFIED SLIP MULTIPLE TERMINAL BANKS

Filed June 7, 1951 4 Sheets-Sheet 1

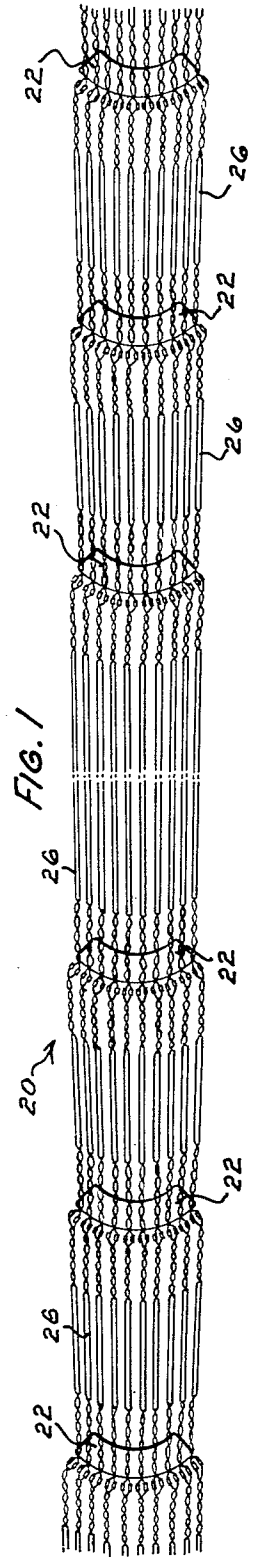


FIG. 1

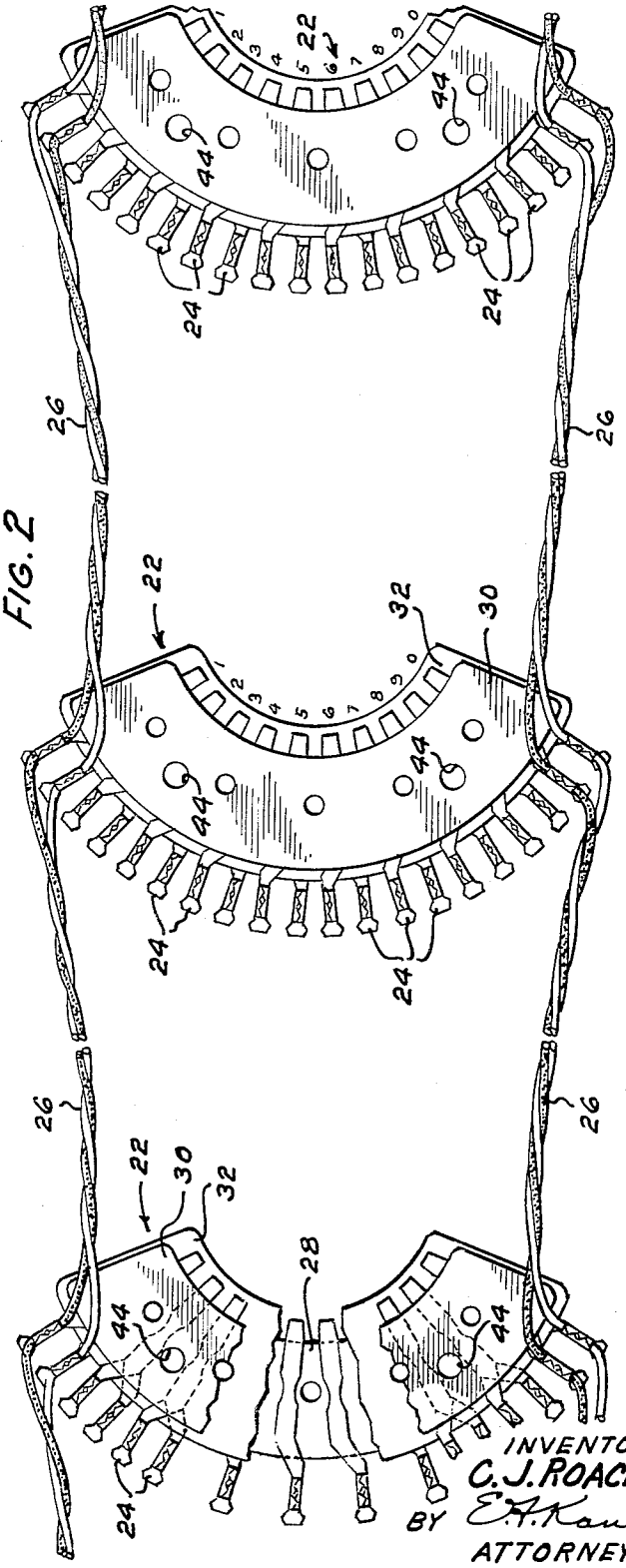


FIG. 2

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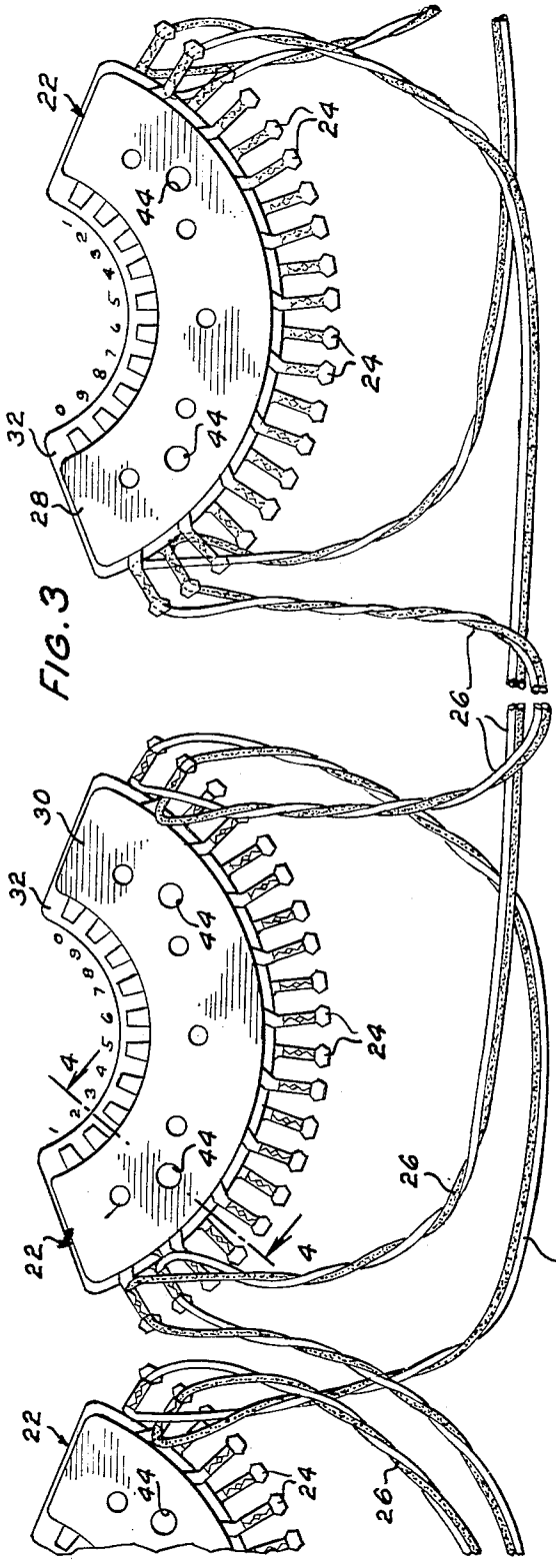


FIG. 3

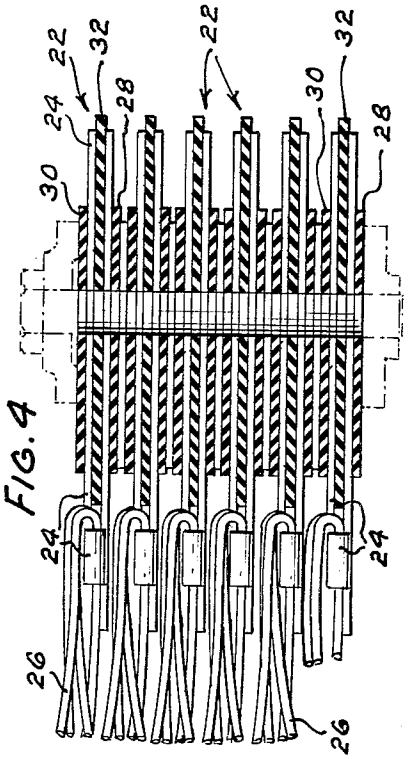


FIG. 4

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METHOD OF MANUFACTURING MODIFIED SLIP MULTIPLE TERMINAL BANKS

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FIG. 5

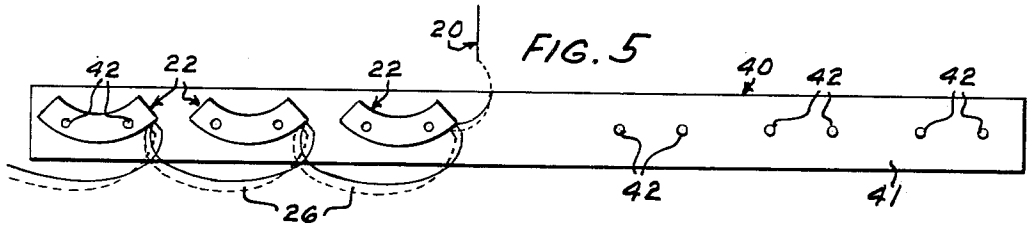


FIG. 6

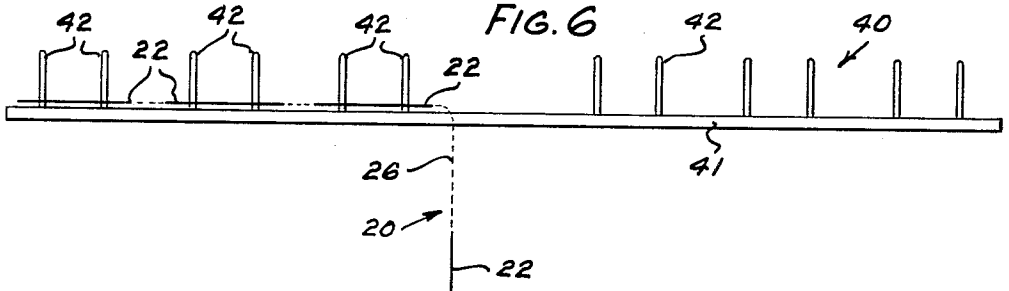


FIG. 7

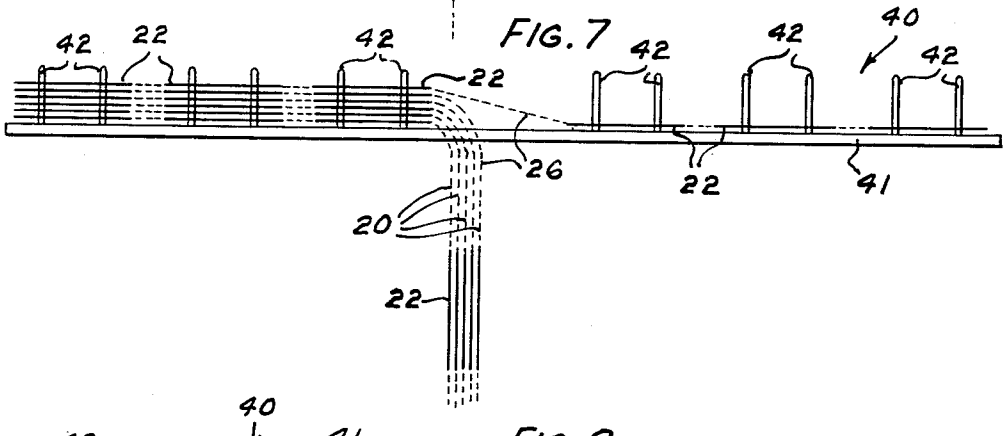


FIG. 8

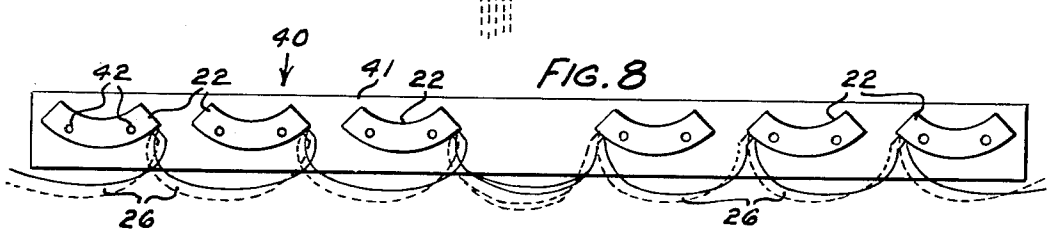
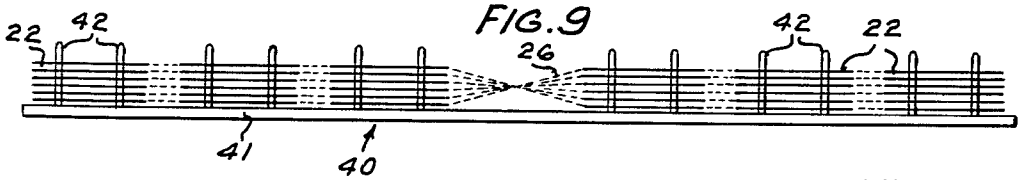


FIG. 9



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FIG. 10

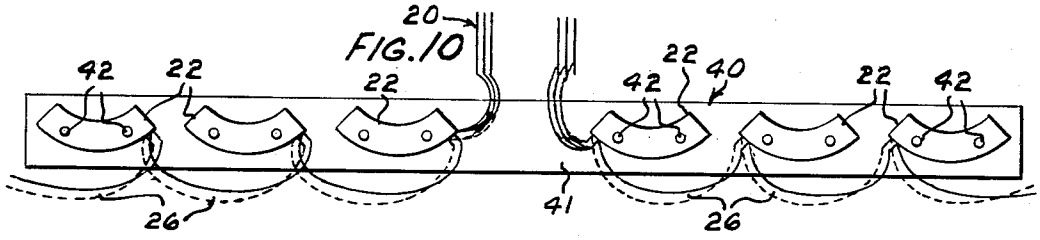


FIG. 11

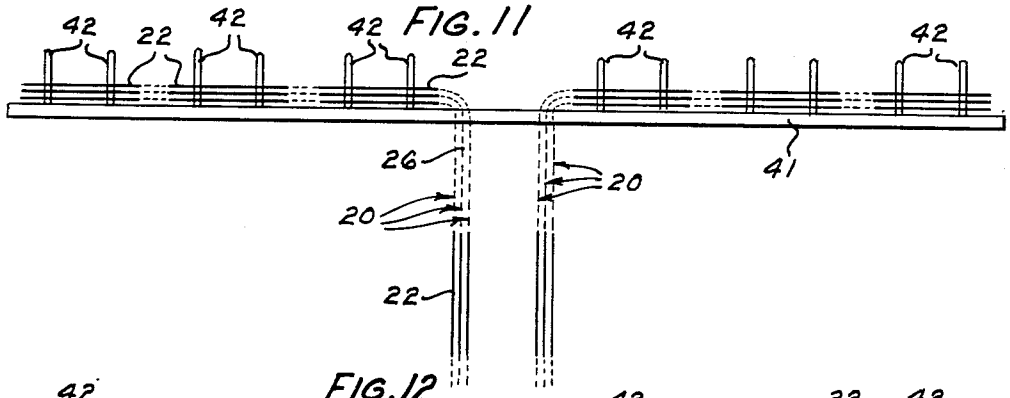


FIG. 12

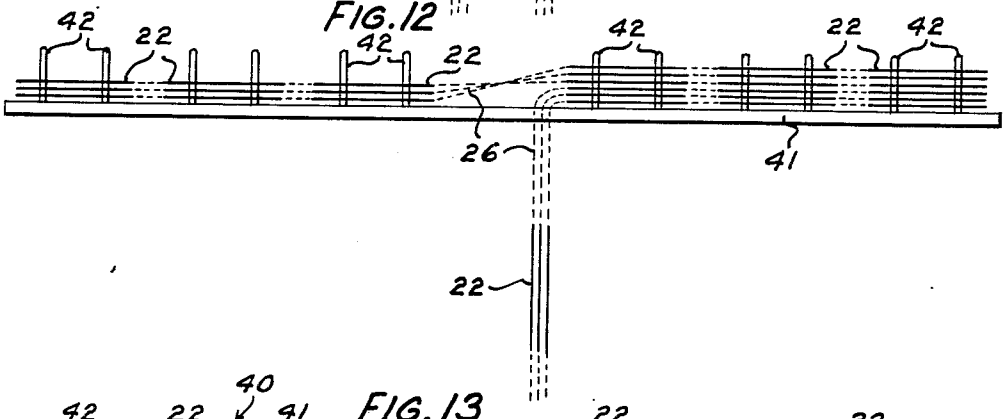


FIG. 13

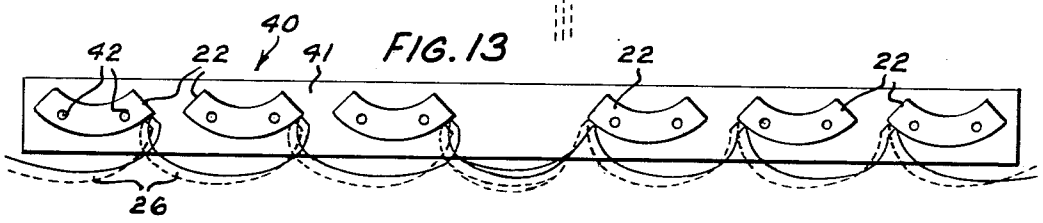
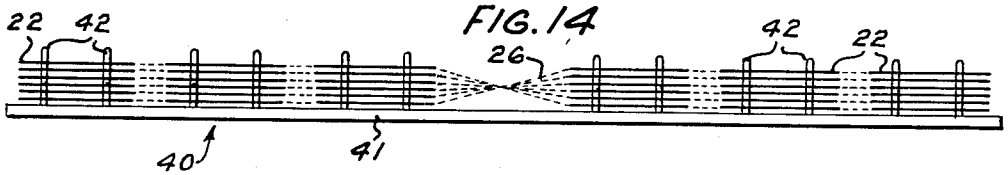


FIG. 14



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United States Patent Office 2,713,194
Patented July 19, 1955

2,713,194

METHOD OF MANUFACTURING MODIFIED SLIP MULTIPLE TERMINAL BANKS

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Application June 7, 1951, Serial No. 230,381

7 Claims. (Cl. 29—155.55)

This invention relates to methods of manufacturing units of wired terminal banks for use in automatic telephone switching apparatus.

In step by step automatic telephone switching apparatus special units of wired equipment are used for special purposes. One of such special units of wired equipment comprises a plurality of banks of terminals arranged in a horizontal row with a predetermined number of terminals in each bank, with the terminals grouped in pairs, one terminal above the other, with sets of ten pairs of terminals mounted on cards in an arc, with the cards in each bank arranged in a vertical stack to support the sets of terminals in different levels in the bank, with the corresponding terminals in each level in each bank in each half of the unit of equipment electrically connected together in multiples by conductor wires, with the multiples of terminals on one half of the unit interconnected with the multiples of terminals of the other half of the unit so that the upper level of terminals of one half of the unit are connected with the lower level of terminals on the other half of the unit and successively the next adjacent levels of multiples of one half of the unit are connected to the next adjacent levels of the multiples of the other half, and with the multiples of the two halves of the unit interconnected so that the terminals in each level of each bank in one half of the unit are disposed in an arc in one order such as 1, 2, 3, . . . 8, 9, 0, and in the other half of the unit are disposed in a reverse order, 0, 9, 8, . . . 3, 2, 1.

Heretofore this special unit of wired terminals was made by forming ladders of cards having a predetermined number of terminals mounted thereon in an arc in predetermined spaced relation to each other and with corresponding terminals on the cards connected together by conductor wires. A predetermined number of ladders were then assembled into two sets of terminal banks in each set of which corresponding terminals in each level of each bank were connected together in multiples. The two sets were then placed end to end and the multiples of one of the sets were connected to terminals on one terminal strip and the multiples of the other set were connected to terminals on another terminal strip and thereafter the terminals on the two terminal strips were selectively interconnected by soldering wires thereto to electrically interconnect the multiples in each half of the unit in their proper relation.

It is an object of the present invention to provide a simple method of fabricating units of wired terminal banks.

A feature of the invention is the fabrication of cards, each having a predetermined number of pairs of superposed terminals thereon, into ladders with the corresponding pairs of terminals on the cards interconnected by pairs of twisted wires which connect the corresponding pairs of terminals in multiples and the connections of which are arranged in one position on the terminals of one half of the ladder and in a reverse position on the terminals on the other half of the ladder, whereby the cards and terminals of the ladders may be assembled by selecting a group of ladders and arranging the cards in the first half of one of the ladders in a horizontal row and placing the cards in the first half of successive ladders of the group on the corresponding cards of the preceding ladder to form successive levels of cards for one half of the unit, selecting a predetermined one of the ladders and placing the cards in the second half thereof in a row and successively selecting the remaining ladders in the group in a predetermined sequence and placing the cards in the corresponding cards of the preceding ladder to form successive levels of cards for the other half of the unit.

Other objects and advantages of the present invention will become apparent by reference to the following detailed description thereof when considered in conjunction with the accompanying drawings, illustrating several embodiments of the invention, in which

Fig. 1 is a plan or face view of a group of arcuately shaped cards having pairs of superposed terminals thereon interconnected by pairs of twisted wires to form a ladder;

Fig. 2 is an enlarged view of an intermediate portion of the ladder shown in Fig. 1;

Fig. 3 is a plan view showing a portion of a unit of apparatus formed upon completion of the assembly of the ladders;

Fig. 4 is a cross-sectional view through one of the banks of cards taken on the line 4—4 of Fig. 3;

Figs. 5 and 6 are plan and front elevational views respectively of a rack for assembling the ladders thereon and showing one of the ladders partially assembled thereon;

Fig. 7 is a front view similar to Fig. 6 showing the ladlers being assembled thereon in an intermediate stage of assembly;

Figs. 8 and 9 are plan and side elevational views respectively showing a completed assembly of a series of ladders into a unit of multiple bank equipment;

Figs. 10 and 11 are plan and side elevational views respectively of an alternative embodiment of the method of forming a unit of multiple bank equipment;

Fig. 12 is a front elevational view similar to Fig. 11 showing the method of assembling the ladders into banks at an intermediate stage; and

Figs. 13 and 14 are plan and side elevational views of the unit of multiple bank equipment upon completion of the fabrication thereof.

In the fabrication of units of multiple terminal banks of the type disclosed herein for use in automatic telephone switching apparatus, a plurality of ladders 20 are formed in the manner disclosed in Patent 2,708,459 to K. H. Andren and C. J. Roach. Each ladder comprises a plurality of composite card units 22, hereinafter referred to as cards, on which are mounted pairs of superposed terminals 24, the cards and the terminals thereon being interconnected by pairs of twisted insulation covered wires 26. The cards 22 comprise a lower flat arcuate strip of insulating material 28 such as phenol fiber upon the upper surface of which are secured in angularly spaced relation a group of terminals 24, an upper arcuate strip 30 of insulating material on the lower surface of which is secured another group of angularly spaced and arcuately arranged terminals 24, and an intermediate arcuate strip 32 of insulating material interposed between the terminals on the upper and lower strips 28 and 30. The upper and lower terminals 24 are arranged in pairs with portions thereof in vertical alignment and overlapping relation to each other.

One end of the terminals extends inwardly beyond the supporting strips 28 and 30 to provide end portions

thereof adapted to be engaged by brushes of the automatic switching apparatus, and the other ends of each pair of terminals extend radially outwardly from the convexed edge of the mounting strips **28** and **30** and are offset laterally or angularly relative to each other to form connector portions. The connector portion of each terminal is wrapped around a wire **26** and has prongs thereon which pierce the insulating sleeve of the wire and engage the metallic core thereof to establish electrical connections therewith as clearly disclosed in the Patent 2,438,959 to L. A. Bartelheim and M. W. Lane.

Each pair of wires **26** is connected to corresponding pairs of terminals **24** on each of the cards **22** of the ladder. The individual wires **26** of each pair of wires, however, are not connected to all of the corresponding terminals of each pair of terminals connected to the pair of wires. Each wire of each pair of wires is connected to the upper terminal of each of the pairs of superposed terminals on the cards of one half of the ladder and is connected to the lower terminal of the pairs of superposed terminals on the cards of the other half of the ladder.

Each of the cards has ten pairs of terminals mounted thereon and there are usually ten or more cards in each ladder and ten ladders in each unit. However, for purposes of simplifying the disclosure of the invention the ladders **20** are shown as having only six cards therein and the unit of wired terminal banks fabricated therefrom as containing six ladders. The sections of wire **26** between the cards **22** are substantially of uniform length except those between the center pair of cards which are relatively longer to permit a change in the position of the cards in the second half of the ladder relative to the cards in the first half.

To facilitate the fabrication of a unit of multiple wired terminal banks, an assembling rack or fixture **40** is provided which may be supported at a convenient elevation by any suitable means. The rack comprises a plate **41** (Fig. 5) on which are mounted a plurality of pairs of upwardly projecting pins **42** for receiving the cards **42** thereon in predetermined spaced relation. The cards **22** are provided with aligning apertures **44** for receiving the aligning pins **42**. A group of a predetermined number of ladders **20**, are used to fabricate a unit of terminal banks. The cards in the first half of one of the ladders are assembled on the pins **42** on the left-hand end of the assembling rack **40** and arranged in a horizontal row with the cards disposed end to end and the wiper ends of the terminals directed rearwardly along one longitudinal edge of the rack and with the wires interconnecting the terminals directed forwardly toward the other longitudinal edge of the rack as indicated in Figs. 5 and 6. The second half of the ladder may be suspended from the assembling rack on the rear side thereof as indicated somewhat diagrammatically in the drawings. For purposes of simplicity and clearness of illustration all of the pairs of wires interconnecting the terminals on the cards have been omitted except one pair, the individual wires of which pair are shown by a full line and a dotted line respectively in Figs. 5, 8, 10, and 13. After the cards in the first half of the first ladder have been assembled on the rack **40** the cards of the first half of successive ladders of the remainder of the series are assembled on the pins **42** of the rack **40** as indicated in Fig. 7 to complete the partial assembly of one half of the unit of wired terminal banks. The assembly of the second half of the unit is accomplished by selecting the cards of the second half of the last applied or top ladder and inverting each of the cards individually end for end and placing them in a horizontal row on the pairs of pins **42** on the right-hand end of the rack as shown in Fig. 7. The cards in the second half of the next to the top ladder and successively the next adjacent ladder of the remainder of the series are then inverted

end for end and assembled in successive levels on corresponding cards of the preceding ladder.

When the assembling operation has been completed the unit will be arranged as indicated in Figs. 8 and 9 with the corresponding cards in the ladders arranged in vertical banks and with the cards in the first half of successive ladders disposed in successive levels in one order and with the cards in the second half of successive ladders individually inverted end for end and disposed in successive levels in a reverse order. Each pair of wires is disposed relative to the terminals connected thereto so that one wire of each pair will connect with the upper terminals in multiple and the other wire will connect all of the lower terminals. However, the terminals in the banks on the first half of the unit are arranged in one order and on the second half of the unit are arranged in a reverse order. Thus, the corresponding pairs of terminals on each card numbered 1, 2, 3, . . . 8, 9, 0 as indicated in Fig. 3 are disposed in the banks on the left-hand half of the unit with the number 1 terminal on the left, and in the banks on the right-hand half of the unit the terminals are reversed and the number 1 terminal is positioned on the right.

While, in the method just described the first half or left-hand end of the ladders were assembled first as indicated in Figs. 5, 6, and 7 and the second half or right-hand end of the ladders were assembled last, it will be understood that the second half, or right-hand portion of the ladders, as viewed in Figs. 5–9, may be assembled first on the tray **40** and the first half, or left-hand portion of the ladders may be assembled last to complete the fabrication of the unit of wired terminal banks.

In another embodiment of the invention the unit of wired terminal banks may be fabricated by the method illustrated in Figs. 10–14. In this alternate method a predetermined number of ladders are divided into two groups, a first group and a second group, each group preferably having the same number of ladders therein. The cards of the first half of one of the ladders in the first group of ladders are arranged in a horizontal row on the pins **42** on the left-hand half of the assembling tray **40** as indicated in Fig. 11. Thereafter the cards of the first half of successive ones of the remaining ladders of the first group are arranged in horizontal rows on corresponding cards of the preceding ladder. While the first half of the ladders of the first group are being assembled on the left-hand portion of the rack **40** by one operator the second half of the ladders of the second group may be assembled on the right-hand portion of the rack **40** by another operator. The cards of the second half of one of the ladders in the second group are individually inverted end for end and arranged in a horizontal row on the right-hand portion of the assembling tray **40** after which the cards of the second half of successive ones of the remaining ladders of the second group are individually inverted and arranged in horizontal rows on the corresponding cards of the preceding ladder. On completion of this stage of the assembling operation the cards and the ladders are arranged as indicated in Figs. 10 and 11.

The remaining portions of the ladders of the first and second group may now be assembled to complete the upper half of the unit of wired terminal banks. The cards in the second half of the uppermost ladder of the first group may be inverted end for end and laid on corresponding cards of the uppermost ladder of cards of the second group by one operator, and simultaneously therewith the cards in the first half of the uppermost ladder of the second group may be arranged in a horizontal row on corresponding cards of the uppermost ladder of the first group. The cards in the unassembled halves of the next adjacent ladders beneath the last previously assembled ladders and successively the next adjacent lower ladder of each of the groups of ladders are then assembled in successive horizontal rows on corresponding cards of the previously laid ladders. On completion of this assembling

operation a unit of wired terminal banks is formed as shown in Figs. 13 and 14 and which is identical to the unit in Figs. 8 and 9.

The latter method of assembling the unit of wired terminal banks may be practiced by a single operator in which case successive ladders of the two groups are not assembled simultaneously but are assembled alternately.

The unit of wired terminal banks may also be assembled by one or two operators according to a method similar to the one just described and as shown in Figs. 10–14 in which a predetermined number of ladders are selected and divided into two groups with an equal number of ladders in each group and in which the ladders of one group are selected in succession and the cards in one half of the ladders are arranged on the assembling tray in horizontal rows with corresponding cards thereof in vertical banks, and the ladders of the second group are selected in succession and the cards in the second half thereof are individually inverted end for end and arranged on the assembling tray in horizontal rows and in superposed vertical banks as indicated in Figs. 10 and 11. Thereafter, the uppermost ladder of the first group is selected and the cards in the free or loose half thereof are individually inverted end for end and are placed on corresponding cards of the uppermost ladder of the second group, and the next to the topmost ladder and successively the next adjacent ladder of the remaining ladders in the first group are selected and the cards in the second half thereof of each of the ladders are individually inverted end for end and placed on the corresponding cards of the preceding ladder (Fig. 12), after which the free or loose half of the uppermost ladder of the second group is selected and the cards thereof are placed on corresponding cards of the uppermost ladder of the first group and the next to the uppermost ladder and successively the next adjacent ladder of the remaining ladders in the second group are selected and the cards in the loose or free half thereof are placed on corresponding cards of the preceding ladder to complete the unit as shown in Figs. 13 and 14.

Similarly other units of wired terminal banks in which the cards in the right-hand half of the unit are inverted end for end to reverse the relationship of the terminals relative to those on the left-hand half of the unit but in which the cards in the left-hand end and the right-hand end of the ladders are not offset vertically relative to each other, or are offset in a different order than shown in the drawings, may be fabricated according to a method substantially the same as that disclosed in Figs. 5–9. The cards in the first half of the ladders may be assembled in horizontal rows on the assembling tray and in superposed relation to each other and upon completion of the assembly of the first half of the unit of terminal banks, the second half of a predetermined one of the ladders of the group is selected and the cards thereof are inverted end for end and arranged in a row on the right-hand end of the assembling tray after which the second half of the ladders remaining in the group are selected successively in a predetermined sequence and the cards in each of the ladders are inverted end for end and placed on the corresponding cards of the preceding ladder.

It should be understood that during the assembling of the ladders into banks, as successive cards are added to the banks, a separator card of insulation is placed between adjacent cards as is usual in the assembling of such banks, and upon completion of the arranging of the cards into banks each bank of cards is compressed and secured between retaining plates by a plurality of bolts as indicated in Fig. 4 and as disclosed in the Bartelheim et al. patent previously referred to.

Units of wired terminal banks in which the cards on the right-hand half of the unit are not inverted end for end but are arranged upright in the same relative position as the cards on the left-hand end thereof, may be fabricated substantially in accordance with any of the above-described methods except for the step of inverting the cards.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of this invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. A method of assembling a unit of wired terminal banks which consists in forming ladders of terminal cards with a predetermined number of cards in each ladder and with the terminals arranged on the cards in pairs and with the corresponding pairs of terminals on the cards interconnected by pairs of wires with the wires of each pair connected to the terminals in the first half of the ladders in one relationship and in the escond half of the ladders in the reverse relationship, selecting a group of ladders and arranging the cards in the first half of one of the ladders in a row and placing the cards in the first half of successive ladders of the group onto corresponding cards of the preceding ladder to form successive levels of cards for one half of the unit, selecting a predetermined one of the ladders and inverting the cards end for end in the second half thereof and placing them in a row, successively selecting the remaining ladders in the group in a predetermined sequence and inverting the cards end for end and placing them onto the corresponding cards of the preceding ladder to form successive levels of cards for the other half of the unit, and securing the cards together in assembled relation.

2. A method of making a unit of wired terminal banks which consists in forming a group of a predetermined number of ladders of terminal cards with a predetermined number of cards in each ladder and with a predetermined number of pairs of terminals on each card and with the corresponding pairs of terminals on each of the cards electrically connected at intervals to pairs of twisted wires and with the wires of each pair connected to the terminals in the first half of the ladders in one relationship and in the second half of the ladders in the reverse relationship, arranging the cards in the first half of one of the ladders in a horizontal row and placing the cards in the first half of successive ladders of the group onto corresponding cards of the preceding ladder to form successive levels of cards, inverting the cards in the second half of the ladder of the uppermost level and arranging them in a horizontal row, inverting the cards in the second half of the ladder of the next adjacent level and successively in the ladders in the next adjacent levels and laying them on the corresponding cards of the preceding ladders to form successive levels of cards in the second half of the unit in a reverse order to that of the levels of cards in the first half of the unit, and escuring the cards together in assembled relation.

3. A method of assembling a unit of wired telephone switching apparatus which consists in forming ladders of terminal cards with a predetermined number of cards in each ladder and with the terminals arranged on the cards in pairs and with corresponding pairs of terminals on the cards interconnected by pairs of wires, selecting a group of ladders and arranging the cards in the first half of one of the ladders in a row and placing the cards in the first half of succeessive ladders of the group onto corresponding cards of the preceding ladder to form successive levels of cards in the first half of the unit, selecting a predetermined ladder other than said one ladder and inverting each of the cards in the second half thereof and placing them in a row, successively selecting the remaining ladders in the group in a predetermined sequence and inverting the cards in the second half of each of the ladders and placing them onto the corresponding cards of the preceding ladder to form successive levels of cards in the second half of the unit in an order different from that of the level of cards in the first half of the ladder, and securing the cards together in assembled relation.

4. A method of assembling a unit of wired terminal banks which consist in forming ladders of terminal cards with a predetermined number of cards in each ladder and with the terminals on the cards disposed in pairs and in a predetermined arrangement and with the corresponding pairs of terminals on the cards interconnected by pairs of wires and with the wires of each pair connected to the terminals in the first half of the ladders in one relationship and in the second half of the ladders in the reverse relationship, selecting a group of ladders and arranging the cards in the first half of one of the ladders in a row and placing the cards in the first half of successive ladders of the group onto corresponding cards of the preceding ladder to form successive levels of cards in the first half of the unit with the terminals on the cards arranged in one sequence, selecting a predetermined ladder other than said one ladder and inverting each of the cards in the second half thereof end for end and placing them in a row, successively selecting the remaining ladders in the group in a predetermined sequence and inverting the cards end for end in the second half of each of the ladders and placing them onto the corresponding cards of the preceding ladder to form successive levels of cards in the second half of the unit with the terminals on the cards arranged in a reverse sequence to the terminals in the first half of the unit, and securing the cards together in assembled relation.

5. A method of assembling a unit of wired terminal banks which comprises forming ladders of terminal cards with a predetermined number of cards in each ladder and with a predetermined number of terminals on the cards arranged in pairs and with the corresponding pairs of terminals on the cards connected in multiples by pairs of wires and with the wires of each pair connected to the terminals of a selected number of cards of each ladder in one relationship and connected to the terminals of the remainder of the cards of each ladder in a reverse relationship, selecting a group of ladders and arranging said selected number of cards of one ladder in a row, placing said selected number of cards of successive ladders of the group onto corresponding cards of the preceding ladder to form successive levels of cards for the first portion of the unit with the terminals on the cards arranged in one sequence, selecting a predetermined ladder and inverting the remaining cards in the ladder end for end and placing them in a row, selecting the remaining ladders in a group in a predetermined sequence and inverting the remaining cards of each ladder end for end and placing them on the corresponding cards of the preceding ladders to form successive levels of cards in the second portion of the unit with the terminals on the cards arranged in a reverse sequence, and securing the cards together in assembled relation.

6. A method of assembling a unit of wired terminal banks which comprises forming ladders of terminal cards with a predetermined number of cards in each ladder and

with a predetermined number of terminals on the cards arranged in pairs and with the corresponding pairs of terminals on the cards connected in multiples by pairs of wires and with the wires of each pair connected to the terminals of a selected number of cards of each ladder in one relationship and connected to the terminals of the remainder of the cards of each ladder in a reverse relationship, selecting a group of ladders and arranging said selected number of cards of one ladder in a row, placing said selected number of cards of successive ladders of the group onto corresponding cards of the preceding ladder to form successive levels of cards for the first portion of the unit, selecting a predetermined ladder other than said one ladder and inverting the remaining cards in the ladder end for end and placing them in a row, selecting the remaining ladders in the group in a predetermined sequence and inverting the remainder of the cards of each ladder end for end and placing them on the corresponding cards of the preceding ladders to form successive levels of cards in the second portion of the unit in an order different from that of the levels of the cards in the first portion of the unit, and securing the cards together in assembled relation.

7. A method of assembling a unit of wired terminal banks which comprises forming ladders of terminal cards with a predetermined number of cards in each ladder and with a predetermined number of terminals on the cards arranged in pairs and with the corresponding pairs of terminals on the cards connected in multiples by pairs of wires and with the wires of each pair connected to the terminals of a selected number of cards of each ladder in one relationship and connected to the terminals of the remainder of the cards of each ladder in a reverse relationship, selecting a group of ladders and arranging said selected number of cards of one ladder in a row, placing said selcted number of cards of successive ladders of the group onto corresponding cards of the preceding ladder to form successive levels of cards for the first portion of the unit with the terminals on the cards arranged in one sequence, inverting the remaining cards in the uppermost ladder and placing them in a row, inverting the remaining cards in the next adjacent level and successively in the ladders in the next adjacent levels and placing them on the corresponding cards of the preceding ladders to form successive levels of cards in the second portion of the unit with the terminals on the cards arranged in a reverse sequence to the terminals in the first portion of the unit, and securing the cards together in assembled relation.

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2,349,878	Malhiot	May 30, 1944
2,438,959	Bartelheim	Apr. 6, 1948
2,496,949	Malhiot	Feb. 7, 1950