Feb. 25, 1958 C. J. ROACH 2,824,358

METHOD OF MANUFACTURING UNITS OF WIRED TERMINAL BANKS

Original Filed June 7, 1951 4 Sheets-Sheet 1

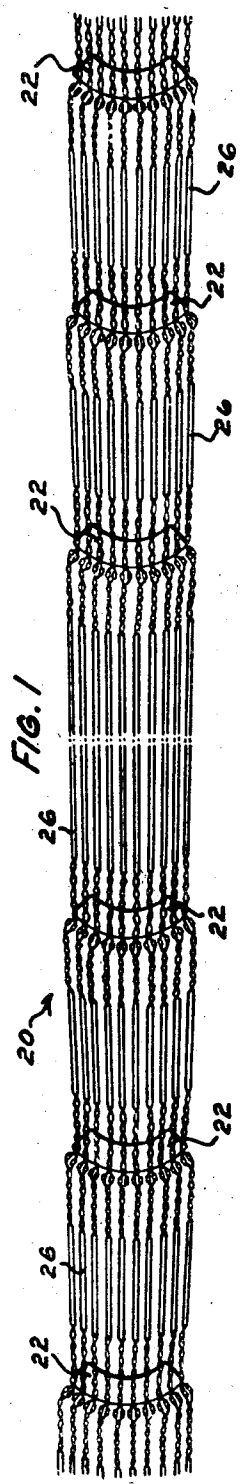


FIG. 1

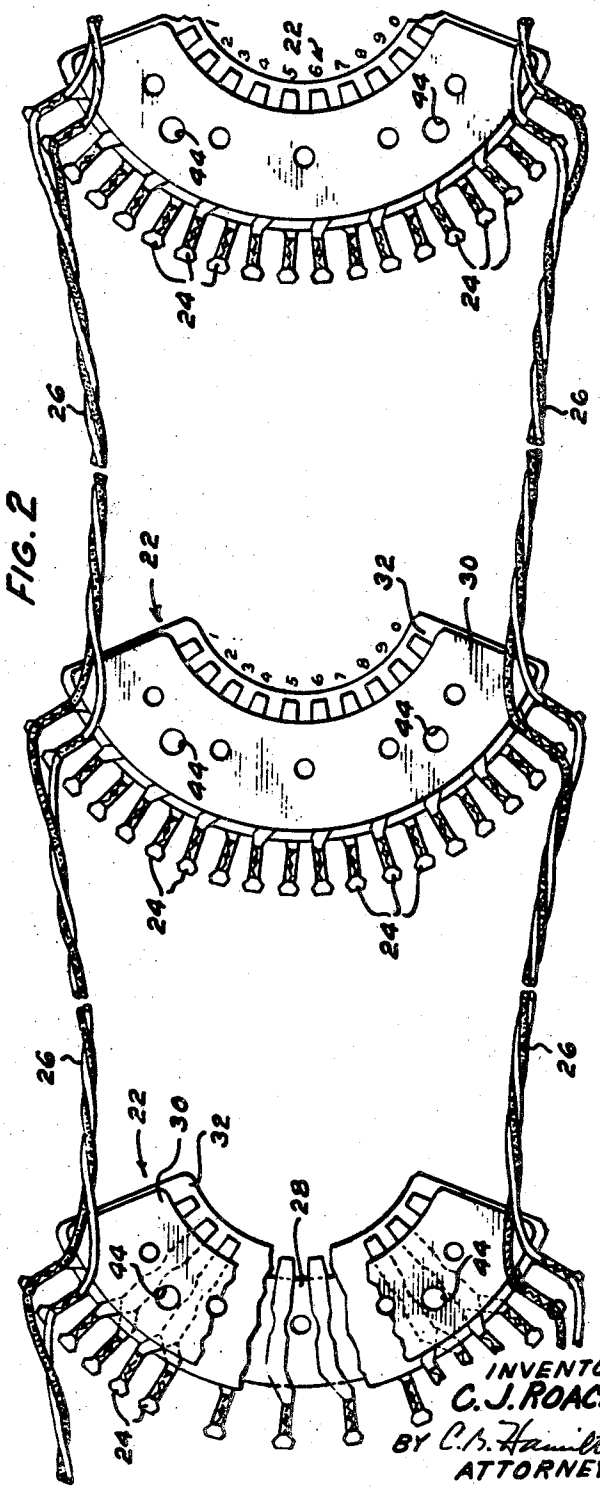


FIG. 2

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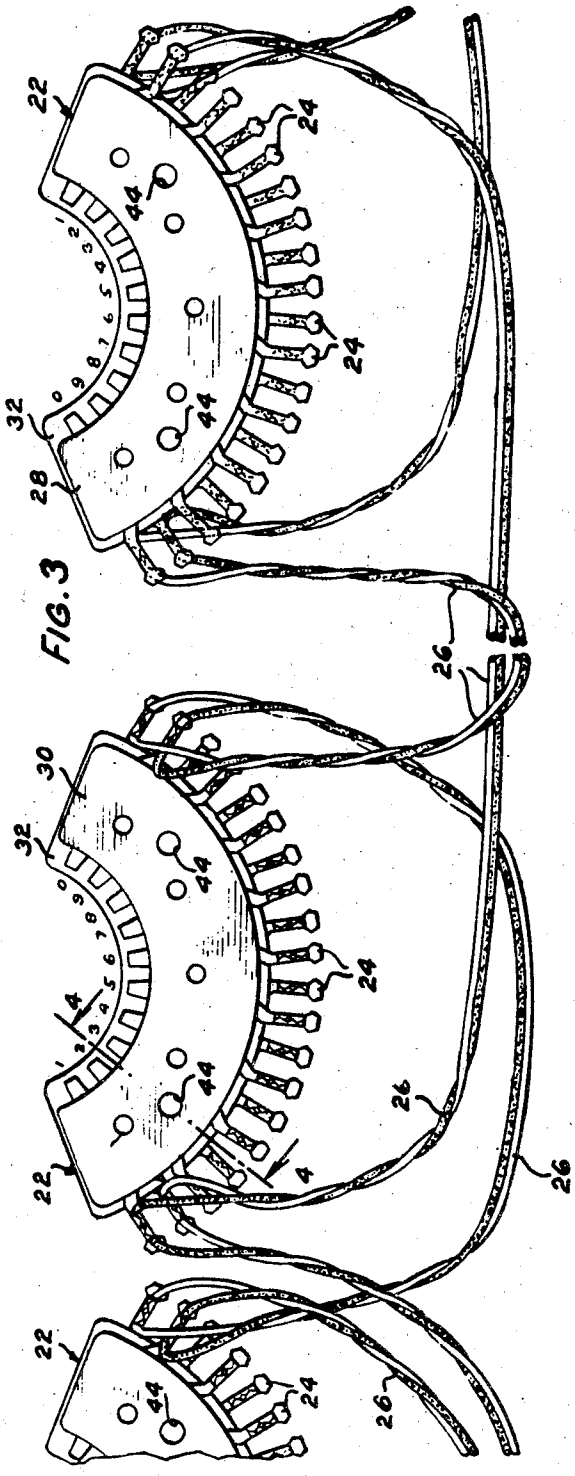


FIG. 3

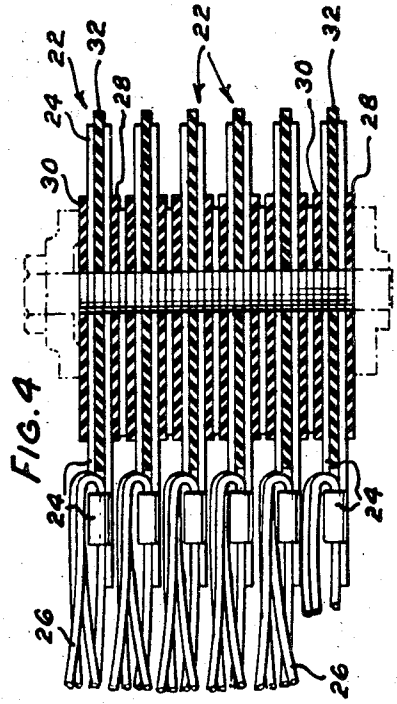


FIG. 4

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METHOD OF MANUFACTURING UNITS OF WIRED TERMINAL BANKS

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FIG. 5

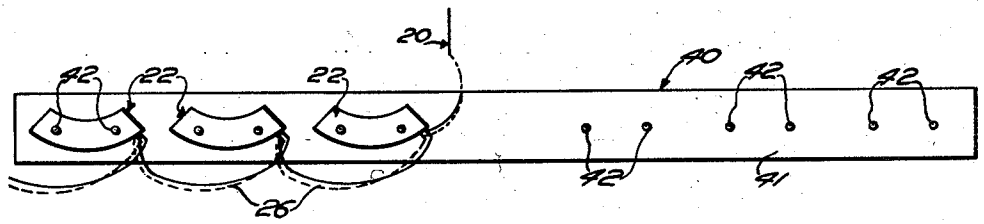


FIG. 6

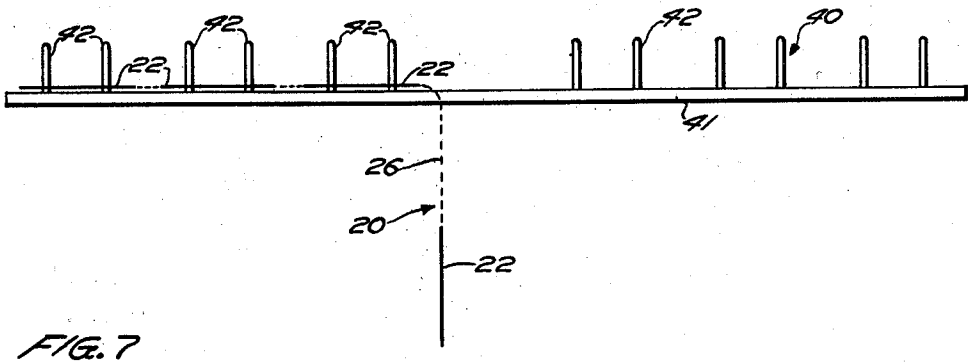


FIG. 7

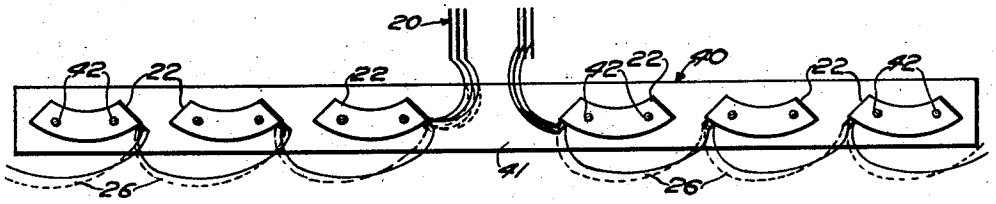
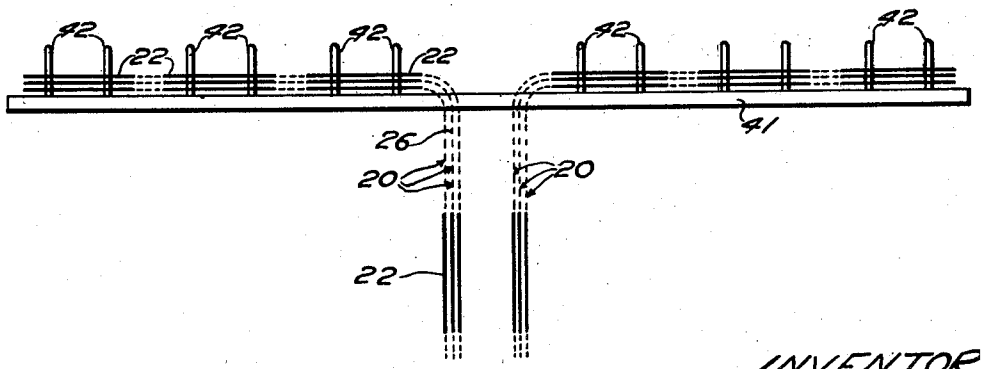


FIG. 8



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FIG. 9

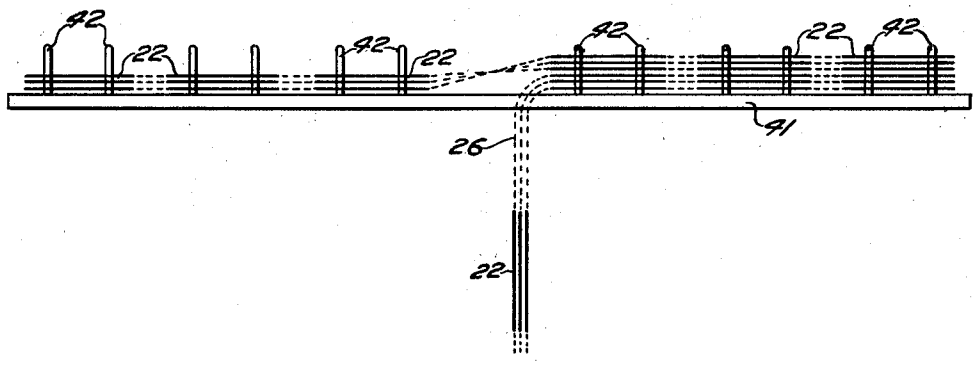


FIG. 10

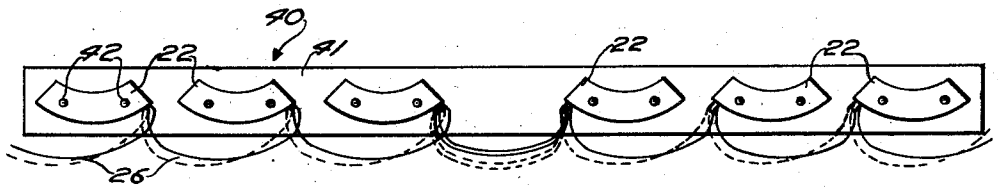
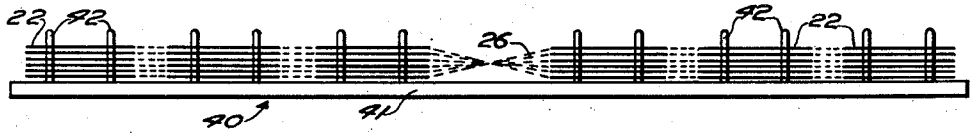


FIG. 11



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United States Patent Office 2,824,358
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2,824,358

METHOD OF MANUFACTURING UNITS OF WIRED TERMINAL BANKS

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Original application June 7, 1951, Serial No. 230,381, now Patent No. 2,713,194, dated July 19, 1955. Divided and this application June 23, 1955, Serial No. 517,578

6 Claims. (Cl. 29—155.55)

This invention relates to a method of manufacturing units of wired terminal banks for use in automatic telephone switching apparatus and is a division of the copending application, Serial No. 230,381, filed June 7, 1951, by C. J. Roach, now Patent No. 2,713,194, issued July 19, 1955, on a method of manufacturing modified slip multiple terminal banks.

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 wires, with the levels of multiples in one half of the unit interconnected with different levels of multiples in the other half of the unit, and with the multiples of the two halves of the unit interconnected so that the terminals on the cards 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 terminal banks was made by forming ladders of cards with a number of cards in each ladder equal to one half the number of banks in the unit and with each card having a predetermined number of pairs of terminals mounted thereon and with corresponding terminals on the cards connected together by wires. A predetermined number of ladders were then stacked into two complete sets of terminal banks, one for each half of the unit, and in each set corresponding terminals in each level were connected together in multiples. The two complete sets of terminal banks were then placed end to end with the terminals on the cards in the second set arranged in reverse order relative to the terminals on the cards in the first set, and the multiples of one of the sets were connected to terminals on a first terminal strip and the multiples of the other set were connected to terminals on a second terminal strip and thereafter the terminals on the two terminal strips were selectively interconnected by soldering wires thereto to electrically interconnect the multiples in one half of the unit to the multiples in the other half of the unit in their proper relation.

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

In fabricating a unit of wired terminal banks a plurality of cards, each card having a predetermined number of pairs superposed terminals thereon, are formed into ladders with the corresponding pairs of terminals on the cards connected in multiple by pairs of twisted wires and with the wires of each pair connected to the terminals of one half the ladder in one position and with the wires of each pair connected to the terminals on the other half of the ladder in a reverse position. The ladders are assembled in a unit of wired terminal banks by selecting a predetermined number of ladders and dividing them into a first group and a second group, selecting one of the ladders of the first group and arranging the cards in the first half thereof in a horizontal row to form one half of the bottom level of cards and placing the cards in the first half of successive ladders of the remaining ladders in the first group on corresponding cards of the preceding ladder, selecting a ladder from the second group of ladders and inverting the cards end for end in the second half thereof and arranging them in a row adjacent the other row of cards to form the other half of the bottom level of cards of the unit of terminal banks, inverting the cards in the second half of successive ones of the remaining ladders of the second group and laying them on the corresponding cards of the preceding ladder, selecting the uppermost ladder of the first group and inverting the cards in the second half thereof and laying them on the corresponding cards of the uppermost ladder of the second group, selecting the ladder next adjacent the uppermost ladder and successively the next adjacent ladders of the first group and inverting the cards in the second half of each ladder and laying them on the corresponding cards of the preceding ladder, selecting the uppermost ladder of the second group and laying the cards in the first half of the latter on corresponding cards of the uppermost ladder in the first group, selecting the ladder next adjacent the uppermost ladder and successively the next adjacent ladders of the second group and laying the cards in the first half of each of the ladders on corresponding cards of the preceding ladder, and securing the cards together in assembled relation.

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 one embodiment of the invention, in which—

Fig. 1 is a plan 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 multiple bank equipment formed with the ladders;

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

Figs. 5 and 6 are plan and front views, respectively, of a fixture for assembling the ladders thereon into a unit of multiple bank equipment and showing a portion of one of the ladders thereon;

Figs. 7 and 8 are views similar to Figs. 5 and 6, diagrammatically showing one stage of the method of assembling the ladders into a unit of multiple bank equipment;

Fig. 9 is a front view similar to Fig. 8 showing an intermediate stage in the method of assembling the ladders into banks; and

Figs. 10 and 11 are plan and front views, respectively, showing the ladders assembled into a unit of multiple bank equipment.

In the fabrication of a unit 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 extend 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 the wires **26** and has prongs thereon which pierce the insulating sleeve of the wires 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 **24** 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 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 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 **22** thereon in predetermined spaced relation. The cards **22** are provided with aligning apertures **44** for receiving the aligning pins **42**.

A predetermined number of ladders are divided into 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 fixture **40** as indicated in Fig. 5. 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 fixture **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 rack **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. 7 and 8.

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 portions 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. 10 and 11.

This 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. 7–11 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 fixture in horizontal rows with corresponding cards thereof in vertical banks, and the ladders of the second groups are selected in succession and the cards in the second half thereof are individually inverted end for end and arranged on the assembling fixture in horiztonal rows and in superposed vertical banks as indicated in Figs. 7 and 8. 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 are individually inverted end for end and placed on the corresponding cards of the preceding ladder (Fig. 9), 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. 10 and 11.

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 the above-described method except for the step of inverting the cards.

It is to be understood that the above-described ar-

rangements 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 comprises 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, selecting a predetermined number of ladders and dividing them into two groups, selecting one of the ladders in each of the groups and placing the cards in the first half of the ladder of one group in a row and the cards in the second half of the ladder of the other group in the same row to form the bottom level of cards of the unit of terminal banks, selecting successive ones of the remaining ladders in each of the groups and placing the cards in the first half of each latter of said one group and the cards in the second half of each ladder of said second group on the corresponding cards of the preceding ladders to form successive levels of terminals cards for the lower half of the unit of terminal banks, alternately selecting successive ones of the ladders in each group of partially assembled ladders and laying the cards in the unassembled half of each of the ladders onto the corresponding cards of the upper level of cards of the partially assembled unit to form successive levels of the upper half of the unit, and securing the cards together in assembled relation.

2. 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 the terminals arranged on the cards in pairs and with the corresponding pairs of terminals on the cards interconnected by pairs of wires, selecting a predetermined number of ladders and dividing them into a first group and a second group, selecting one of the ladders of the first group and placing the cards in the first half thereof in a row to form one half of the bottom level of cards ad simultaneously therewith selecting a ladder from the second group of ladders and placing the cards in the second half thereof in said row to form the other half of the bottom level of cards of the unit of terminal banks, placing the cards in the first half of each of successive ladders of the remaining ladders in the first group on corresponding cards of the preceding ladder and simultaneously therewith placing the cards in the second half of each of successive ones of the remaining ladders of the second group and laying them on the corresponding cards of the preceding ladder to form the lower portion of the unit of wired terminal banks, selecting the uppermost ladder of the first group and successively the next adjacent ladder of said group and placing the cards in the second half of each of the ladders on the corresponding cards of the uppermost level of cards of the assembled portion of the unit of wire terminal banks, and simultaneously therewith selecting the uppermost ladder of the second group and successively the next adjacent ladder of said group and placing the cards in the first half of each of the ladders on corresponding cards on the uppermost level of cards of the assembled portion of the unit of wire terminal banks, and securing the cards together in assembled relation.

3. 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 the terminals arranged on the cards in pairs and with the corresponding pairs of terminals on the cards interconnected by pairs of wires, selecting a predetermined number of ladders and dividing them into a first group and a second group, selecting one of the ladders of the first group and placing the cards in the first half thereof in a row to form one half of the bottom

level of cards, placing the cards in the first half of each of the remaining ladders in the first group on corresponding cards of the preceding ladder, selecting a ladder from the second group of ladders and placing the cards in the second half thereof in a row to form the second half of the bottom level of cards, placing the cards in the second half of each of the remaining ladders of the second group on the corresponding cards of the preceding ladder, selecting the uppermost ladder of the first group and placing the cards in the second half thereof on corresponding cards of the uppermost ladder of the second group, selecting the next adjacent ladder and successively the next adjacent ladder of the first group and placing the cards in the second half of each of the ladders on the corresponding cards of the preceding ladder, selecting the uppermost ladder of the second group and placing the cards in the first half of the ladders on corresponding cards of the uppermost ladder in the first group, selecting the next adjacent ladder and successively the next adjacent ladder of the remaining ladders in the second group and placing the cards in the first half of each of the ladders on the corresponding cards of the preceding ladder, and securing the cards together in assembled relation.

4. 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 the terminals arranged on the cards in pairs 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 each of the ladders in one relationship and in the second half of each of the ladders in the reverse relationship, selecting a predetermined number of ladders and dividing them into a first group and a second group, selecting one of the ladders of the first group and laying the cards in the first half thereof in a row to form one half of the bottom level of cards, selecting successive ladders in the first group and placing the cards in the first half of each of the ladders on corresponding cards of the preceding ladder, selecting a ladder from the second group and inverting the cards end for end in the second half thereof and placing them in a row to form the other half of the bottom level of cards of the unit of terminal banks, selecting successive ladders in the second group and inverting the cards end for end in the second half of each of the ladders and laying them on the corresponding cards of the preceding ladder, selecting the uppermost ladder of the first group and inverting the cards end for end in the second half thereof and laying them on the corresponding cards of the uppermost ladder of the second group, selecting the next adjacent ladder and successively the next adjacent ladder of the first group and inverting the cards end for end in the second half of each ladder and laying them on the corresponding cards of the preceding ladder, selecting the uppermost ladder of the second group and laying the cards in the first half of the ladder on corresponding cards of the uppermost ladder in the first group and selecting the next adjacent ladder and successively the next adjacent ladder of the remaining ladders in the second group and laying the cards in the first half of each of the ladders on corresponding cards of the preceding ladder, 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 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 each of the ladders in one relationship and in the second half of each of the ladders in the reverse relationship, selecting a predetermined number of ladders and dividing

them into a first group and a second group, selecting one of the ladders of the first group and placing the cards in the first half thereof in a row to form one half of the bottom level of cards and simultaneously therewith selecting a ladder from the second group of ladders and inverting the cards end for end in the second half thereof and placing them in said row to form the other half of the bottom level of cards of the unit of terminal banks, placing the cards in the first half of each of successive ladders remaining in the first group on corresponding cards of the preceding ladder and simultaneously therewith inverting the cards in the second half of each of successive ladders remaining in the second group and laying them on the corresponding cards of the preceding ladder to form the lower portion of the unit of wired terminal banks, selecting the uppermost ladder of the first group and successively the next adjacent ladder of said group and inverting the cards in the second half of each of the ladders and laying them on the corresponding cards of the uppermost level of cards of the assembled portion of the unit of wired terminal banks and simultaneously therewith selecting the uppermost ladder of the second group and successively the next adjacent ladder of said group and laying the cards in the first half of each of the ladders on corresponding cards of the uppermost level of cards of the assembled portion of the unit of wired terminal banks, 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 the terminals arranged on the cards in pairs 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 each of the ladders in one relationship and in the second half of each of the ladders in the reverse relationship, selecting a predetermined number of ladders and dividing them into a first group and a second group, selecting one of the ladders in each of the groups and arranging the cards in the first half of said one ladder of the first group in a row and inverting end for end and arranging each of the cards in the second half of said one ladder of the second group in the same row to form the bottom level of cards of the unit of terminal banks, selecting successive ones of the remaining ladders in each of the groups and placing the cards in the first half of each ladder of the first group on the corresponding cards of the preceding ladder and inverting and placing each of the cards in the second half of each ladder of the second group on the corresponding cards of the preceding ladder to form successive levels of terminal cards of the lower portion of the unit of terminal banks, selecting the uppermost ladder in each group of partially assembled ladders and laying the cards in the unassembled half of the selected ladder of the second group on the corresponding cards of the top ladder of said first group and inverting and laying the cards on the unassembled half of the selected ladder of the first group on corresponding cards of the top ladder of the second group, selecting successively the next adjacent ladders of the remaining ladders in each group and laying the cards in the unassembled half of each of the ladders of the second group onto the corresponding cards of the preceding ladder and inverting and laying the cards in the unassembled half of each of the ladders in the first group onto the corresponding cards of the preceding ladder to form successive levels of terminal cards of the remainder of the unit of terminal banks, and securing the cards together in assembled relation.

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2,438,959 Bartelheim et al. ---------- Apr. 6, 1948