July 10, 1951 E. L. EARLE ET AL 2,559,715

COMPRESSION-CONNECTING TERMINAL MEMBERS

Filed Dec. 20, 1948 2 Sheets-Sheet 1

FIG. 1

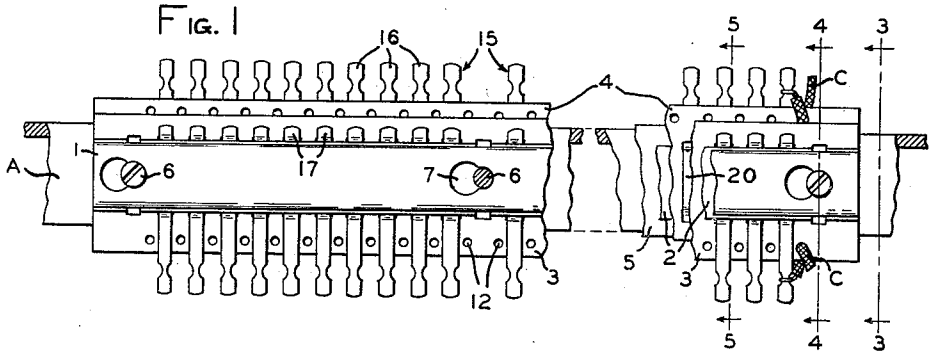


FIG. 2

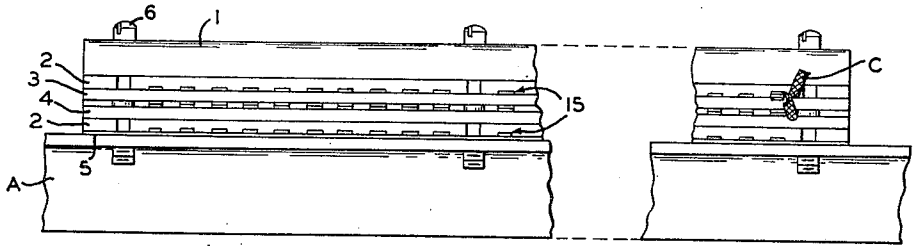


FIG. 3

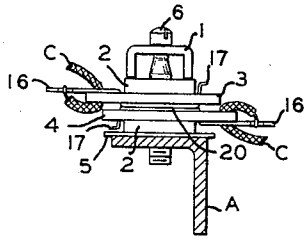


FIG. 4

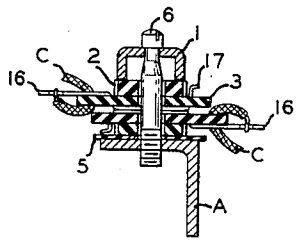
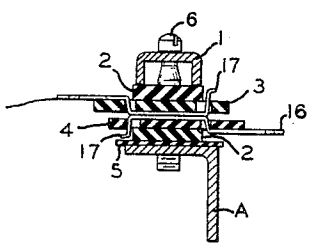


FIG. 5



INVENTORS:
EDWIN L. EARLE
RICHARD P. ARTHUR
JOHN I. BELLAMY

BY C. A. Soper

ATTORNEY

July 10, 1951 E. L. EARLE ET AL 2,559,715

COMPRESSION-CONNECTING TERMINAL MEMBERS

Filed Dec. 20, 1948 2 Sheets-Sheet 2

FIG. 6

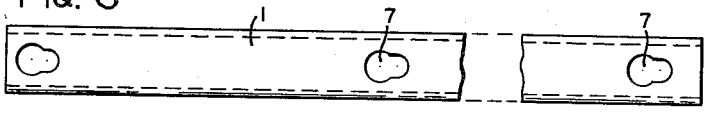


FIG. 6A

FIG. 7

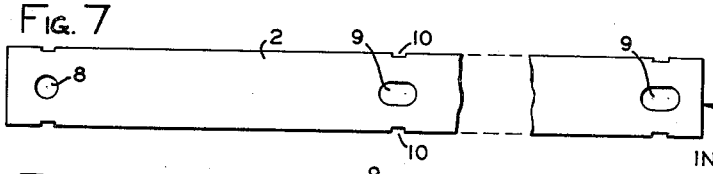


FIG. 7A

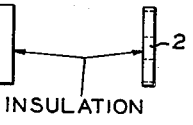


FIG. 8

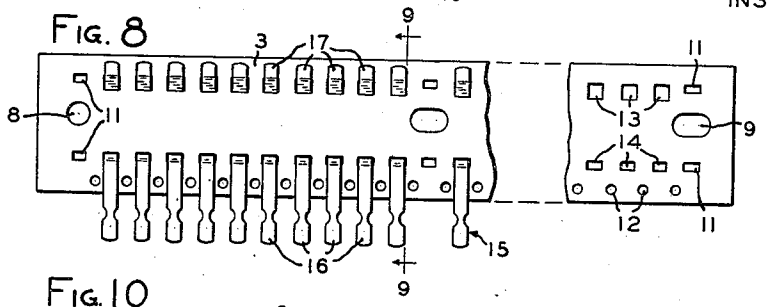


FIG. 9

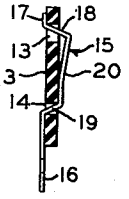


FIG. 10

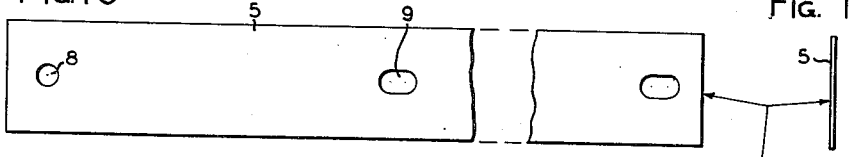


FIG. 10A

FIG. 11

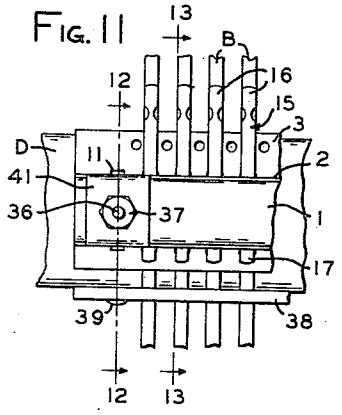


FIG. 12

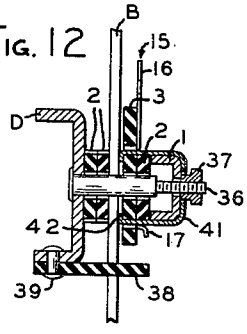


FIG. 13

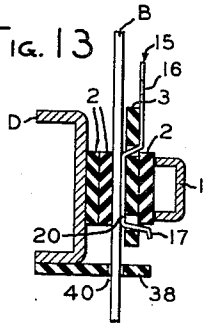


FIG. 14

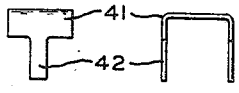


FIG. 14A

INVENTORS:
EDWIN L. EARLE
RICHARD P. ARTHUR
JOHN I. BELLAMY
BY C. R. Soper
ATTORNEY

Patented July 10, 1951

2,559,715

UNITED STATES PATENT OFFICE

2,559,715

COMPRESSION-CONNECTING TERMINAL MEMBER

Edwin L. Earle and Richard P. Arthur, Chicago, and John I. Bellamy, Wheaton, Ill., assignors to Kellogg Switchboard and Supply Company, Chicago, Ill., a corporation of Illinois

Application December 20, 1948, Serial No. 66,172

8 Claims. (Cl. 173—328)

1

This invention relates to compression-connecting terminal members. Its general object is to provide improved compression-connecting terminal apparatus for detachably connecting a number of conductors to terminal points.

A specific object is to provide compression-connecting terminal apparatus for detachably interconnecting a number of electrical conductors.

A further specific object is to provide compression-connecting terminal apparatus for detachably connecting a number of wires to common bare wire multiples to effect electrical connection therebetween.

The invention is of great utility, particularly where employed with automatic telephone switchboards of automatic telephone systems to connect conductors terminating on the frame structure with conductors leading to equipment mounted in drawer-like arrangements within the frame.

Two embodiments are disclosed which differ principally in the application of apparatus and the structural modifications therefor.

Features of the invention include the following:

1. The connecting terminal members are of individual spring form which insures adequate contact pressure when they are compressed in final assembly.

2. A rubbing engagement occurs between respective opposed terminal contact portions when the spring terminal members are being compressed into clamped assembly, which provides assembled contacts free of dirt and obstruction.

3. The individual spring terminal members are provided with a relatively short offset portion at one end which suffices to retain the member in position along its terminal retaining strip and which permits its ready removal and replacement.

4. Fanning-strip holes are provided in each terminal-retaining strip to relieve terminal strain and to retain entering conductors in a position which prevents their acute bending and breakage.

Of the drawings, Figs. 1 to 10 show the construction of one embodiment of the improved compression-connecting terminal apparatus employed to interconnect electrical conductors, and Figs. 11 to 14, show certain of the structure of Figs. 1 to 10 modified for employment with bus bars.

Figs. 1 and 2 show respectively a plan and a front side view of the terminal connecting assembly.

Figs. 3 to 5 show respectively a right end view taken along lines 3—3 of Fig. 1, and cross-sectional views taken along lines 4—4 and 5—5 of Fig. 1.

2

Figs. 6 to 8, and 10, and their associated auxiliary views, show certain of the parts included within the terminal assembly.

Fig. 9 shows a cross-sectional view taken along lines 9—9 of Fig. 8.

Fig. 11 shows a top view of the assembly modified according to the principles of the second embodiment.

Figs. 12 and 13 are respectively, cross-sectional views taken along lines 12—12 and 13—13 of Fig. 11.

Figs. 14 and 14A show respectively a side and an end view of the terminal assembly retaining clip.

Detailed description

In the first embodiment shown in Figs. 1 to 10, angle bar A serves as a supporting and lower clamping member for the detachable compression-connecting terminal apparatus mounted thereon.

Referring now to Figs. 1 to 5, there the terminal apparatus is shown to include opposed upper and lower terminal-retaining strips 3 and 4, and the associated terminal members 15 thereof, similar upper and lower insulating and spacing members 2, and lower frame insulating member 5, all suitably clamped together between upper channel bar 1 and lower angle bar A by studs 6 passing through provided openings in the parts and threaded into angle bar A.

The parts of the compression-connecting terminal apparatus shown in Figs. 1 to 5, will now be described with particular reference to Figs. 6 to 10.

The upper channel bar 1 extends across the assembly and is a relatively thick and rigid member which provides uniform clamping pressure throughout its length to parts clamped therebetween and bar A. Similar openings 7 of the illustrated keyhole shape are provided in the web of bar 1 at the ends thereof, and at intermediate points between the ends, through which clamping studs 6 pass to retain the parts uniformly compressed in clamped assembly. The keyhole shaped openings 7 are larger at one end than the heads of studs 6 and are smaller than such heads at the other end. The shape of openings 7 permits bar 1 to be assembled with the other parts loosely in place, with the heads of studs 6 passing through the enlarged portion of the openings 7 in bar 1. The stud heads serve to retain the bar in place when it is moved longitudinally a con-

trolled distance to bring the smaller portion of the openings 7 thereunder. This assembling arrangement is advantageous in facilitating assembly and in permitting a final inspection of the parts for alignment, etc., before studs 6 are finally tightened.

The clamping studs 6 are similar and are best illustrated in Fig. 4, where they are shown to be capped at one end by an enlarged slotted head portion and threaded at the other end for engagement with tapped openings in angle bar A. The upper body portion of the studs tapers to a neck portion of lesser diameter to facilitate the aforesaid movement of bar 1, which brings the small portion of openings 7 under the heads of the studs and into engagement with such neck portion.

Figs. 1 to 5 show similar upper and lower spacing and insulating members 2 (Fig. 7) lying flush with the outer surface of their respective terminal-retaining strips 3 and 4 at a central portion thereof between offset terminal portions 16 and 17 of terminal members 15 of the strips.

Each such member 2 is relatively narrow permitting it to lie flush against the noted central portion of its respective terminal strip (3 or 4) whereupon the pressure of the associated clamp bar (1 or A) is exerted through such member against the central portion of such terminal strip which is most desirable in view of the compressible terminal contact portions 20 extending transversely of such central portion on the other side of such terminal strip. The restricted width of each such member 2 permits the terminal portions 17 of the compressed terminal members 15 of the associated terminal strip to pass freely to the outside thereof and the thickness of such member 2 is sufficient to keep such terminal portions 17 well out of contact with the associated clamp bar when terminal members 15 are compressed thereby.

When the compression-connecting terminal apparatus is employed, as illustrated in Figs. 1 to 5, to interconnect a number of external conductors C, two similar subassemblies of terminal-retaining strips 3 and 4 and their respective associated individual spring terminal members 15, are clamped in overlapping relationship, with the upper strip 3 in the position shown in Fig. 8 and the lower strip 4 rotated 180° about its longitudinal axis. The assembled position of strips 3 and 4 brings the intermediate compressible contact portions 20 of the individual spring terminal members 15 thereof into opposed spring-engaging relationship to thereby connect related conductors C (see Fig. 3) terminating on the respective upper and lower terminal ends 16 which, as shown best in Fig. 1, extend from opposite sides of the assembly.

The similar upper and lower terminal-retaining strips 3 and 4 are relatively wide and thick sheet-like strips of suitable insulating material which serve to retain individual spring terminal members, generally designated as 15, transversely thereof in a row in the manner shown for one such terminal member in Fig. 9.

As shown in Fig. 8, generally rectangular openings 13 and 14 extend in opposed rows adjacent to opposite edges of strip 3 for receiving respective terminal members 15. Openings 14 are dimensioned to permit the respective offset conductor attachment portions 16 of terminal members 15 to pass therethrough during assembly and to receive angularly offsetting portions 19 thereof. Openings 13 are dimensioned to permit the passage of respective offset portions 17 during the assembly or removal of the terminal members and to permit the angular offsetting portions 18 thereof to freely pass therethrough when the associated terminal members 15 are compressed into final clamped assembly to thereby permit the desired spring action thereof.

Fig. 8 shows the relative position of openings 13 and 14 with respect to the opposite edges of strip 3, and the small circular openings 12 located outwardly from and to one side of such openings 14. Openings 12, as shown in Figs. 1 and 3, provide a fanning strip arrangement for external conductors passing therethrough and connected to the adjacent attachment ends 16 of terminal members 15. Openings 12 function to relieve the strain between terminal attachment ends 16 and the conductors attached thereto and to prevent acute bends of such conductors ordinarily resulting in their breakage.

The stud-receiving openings 8 and 9 in strips 3 and 4 are slightly off center to stagger such strips in final assembly to thereby bring openings 12 outwardly from the overlapping terminal retaining strip to permit access of the associated conductors thereto. See Fig. 3.

The similar individual spring terminal members 15 are punched and formed from suitable spring-sheet stock to the form illustrated in Fig. 9. Each terminal member 15 has a curved intermediate contact portion 20 and offsetting portions 18 and 19 extending therefrom terminating respectively in a short offset portion 17 and a relatively long conductor attachment portion 16. Each offsetting portion 19 is short to limit the movement of the associated assembled conductor attachment portion 16 and each portion 18 is relatively long to permit substantial movement of the associated end of the terminal member.

Terminal members 15 are assembled with their retaining strip 3 or 4 by first inserting offset conductor attachment portions 16 through respective strip openings 14 to the illustrated position of engagement with one side of the strip and by then inserting offset portions 17 through respective openings 13 which may be readily accomplished because of the resiliency of members 15. Offset portions 16 and 17 normally engaging one side of the strip cooperate with respective contact portions 20 engaging the other side of the strip to retain members 15 in position.

The individual spring terminals 15 may be assembled with retaining strips 3 or 4 by a stapling process or by forming the terminals in connected strip form in desired groups for strip handling, with the connecting portions subsequently severed after assembly with the retaining strip to provide individual terminal members.

Fig. 9 shows an individual spring terminal member 15 before it is compressed in final assembly, and Figs. 3 to 5 show two opposed terminal members 15 compressed in final assembly. It will be observed that certain of each contact portion 20 lies flush with the contact surface of its retaining strip (3 or 4) to prevent movement of the adjacent terminal portion 16 (the conductor attachment end) which lies flush with the opposite strip surface. The remainder of the curved contact portion 20 is offset from the flush portion thereof and consequently from the contact surface of the strip to permit movement to such contact surface during the compression of the terminal member. Such movement is permitted by the extending portion 18 freely passing through its opening 13 and by the narrowness

of the associated spacing member 2, which provides an unobstructed path to offset portion 17 passing to the outside thereof. The movement of the compressed terminal is effected against its spring tension which insures uniform and adequate spring contact pressure throughout a clamped assembly of compressed individual spring terminal members.

The conductor attachment offset portions 16 are formed as illustrated and are relatively long to extend beyond the associated strip to serve as an attachment point for external conductors. The offset portion 17 of each member 15 is sufficiently short to enable it to pass through openings 13 with the opposite offset portion 16 in place to permit terminal member removal and replacement, and in assembly do not extend laterally beyond the edge of their retaining strip.

The individual spring terminal members 15 are arranged in separated groups of ten along retaining strips 3 or 4 to permit the passage of the intermediate clamping studs 6, with the openings in the strips lying to either end of such terminal groups being designated by the numeral 11 and not used in the structure of the first embodiment.

The lower frame insulating member 5 is a relatively wide and thin member of suitable insulating material and serves in the assembly to insulate the overlying parts from angle bar A.

The detachable connecting feature of the compression-connecting terminal apparatus shown in Figs. 1 to 5, is of the greatest utility in that conductors C to be connected are attached to the respective terminal members 15 of terminal-retaining strips 3 and 4 (Figs. 1 to 3) before such strips are finally assembled. The detachable arrangement permits frame wires to be brought out to accessible locations where they are readily soldered to terminal portions 16 of the respective terminal members 15 and in many instances the detachable arrangement permits bench wiring. After the conductors to be connected are attached to the respective terminal members 15 of strips 3 and 4, the strips and other parts of the assembly are quickly and easily assembled.

In assembling the apparatus, clamping studs 6 are first loosely threaded into angle bar A to approximately the same distance whereupon the parts of the assembly are assembled in overlying relationship on the upper surface of the bar with studs 6 passing through openings 8 and 9 in the parts. Openings 8 and 9 have a vertical dimension corresponding to the body portion of studs 6 to limit vertical movement of assembled parts 2 to 5. A similar dimension is provided longitudinally for openings 8, one of which is located at one end of each of such parts, to limit longitudinal movement thereof. Openings 9 are elongated longitudinally to permit ease of assembly. Parts 2 to 5 are assembled with the openings 8 thereof at the same end of the assembly to provide for correct alignment of the parts.

The parts of the assembly are assembled in the following order.

The frame insulating member 5 is first assembled directly upon the upper surface of lower angle bar A. A spacing and insulating member 2 is then placed over such member 5.

The lower and upper terminal retaining strips 4 and 3, with associated terminal members 15 in place, are next assembled in that order, with strip 4 reversed with respect to strip 3 to bring the contact sides of the strips adjacent to each other, and to provide that the contact portions 20

of the respective terminal members 15 thereof are in opposed engaging relationship.

An insulating and spacing member 2 is next assembled, whereupon upper channel bar 1 is assembled thereupon, with the heads of studs 6 passing through the enlarged portions of openings 7 therein. Channel 1 is then moved longitudinally to bring the smaller portion of openings 7 under the stud heads and into engaging relationship with the neck portion of studs 6. The heads of studs 6 hold bar 1 and the underlying parts loosely in place to permit the previously noted visual inspection of the parts for alignment before studs 6 are finally tightened. The tightening of studs 6 completes the assembly with the opposed individual spring terminal members 15 compressed into spring-contacting engagement to effectively connect respective conductors attached thereto.

Second embodiment

Referring now particularly to Figs. 11 to 14, the second embodiment of the improved compression-connecting terminal apparatus will be described.

In general principle and structure, the second embodiment of the apparatus is similar to the first.

The principal difference between the structure of the first and second embodiments is that in the first embodiment two strips of opposed individual spring terminal members are compressed to detachably connect respective conductors terminating thereat, and in the second embodiment only one of such strips is employed with the individual spring terminal members thereof compressed into engaging relationship with intermediate portions of uniformly spaced bus bar multiples for effective detachable electrical connection therewith.

The modified compression-connecting terminal apparatus serves a highly useful function in detachably connecting various electrical units, relays, counters, etc., commonly mounted in overlying rows within switchboard frame structure, to bus bar multiples which are common to respective electrical units of the several rows.

The utility of the detachable connecting terminal apparatus lies in the fact that the electrical units of a row may be bench wired to respective individual terminal members of the apparatus which is readily clamped into effective detachable electrical connection with the common bus bars.

The detachable feature of the apparatus is desirable in view of the compactness of modern switchboards in that it permits ready electrical connection in limited spaces and relatively inaccessible locations.

Fig. 11 shows a top view of an end portion of the modified compression-connecting terminal apparatus employed with bus bars B. Figs. 12 and 13 show in cross section an intermediate portion of a bus bar B clamped between a compressed individual spring terminal member 15 and the two underlying insulating members 2 to retain the bar in position and to establish effective detachable electrical connection between the bar and the terminal member.

In actual use a series of relatively rigid frame channels D of the illustrated form extend horizontally across a frame structure at desired vertical locations to serve as lower clamping members for respective similar units of compression-connecting terminal apparatus clamped thereto. For convenience only a portion of one unit of

such terminal apparatus and a portion of its associated bar D is shown.

A series of similar clamping studs 36 of the form shown in Fig. 12 are secured as by riveting to the web portion of each channel bar D. The studs 36 correspond to the locations of the stud-receiving openings 7, 8, 9 in the parts of the terminal apparatus (Figs. 6 to 8) and in final assembly pass through such openings. Studs 36 are threaded at the free end to receive the hexagonal retaining nuts 37.

A flat shelf-like bracket 38 of suitable insulating material is secured by rivets 39 (Figs. 11 and 12) to the under surface of the lower leg of each channel bar D. Each member 38 extends across its associated bar D and serves to retain vertical bus bars B passing through an aligned row of openings 40 (Fig. 13) in the forwardly extending portion of the member. The forward location and lateral disposition of openings 40 maintain assembled bus bars B at a desired distance (equal to the thickness of two insulating members 2) from channel bars D and in desired vertical alignment corresponding to the individual spring terminal members 15 which are respectively compressed against the bus bars in final assembly. Two insulating members 2 are assembled between each channel bar D and bus bars B to maintain the bars sufficiently out of contact with bars D.

The terminal-retaining strip 3 and associated individual spring terminal members 15, upper insulating member 2, and channel bar 1 are similar to the corresponding parts of the first embodiment and are assembled in that order and are retained in subassembly by similar retaining clips 41.

Clips 41 are of the illustrated form (Figs. 14 and 14A) and in the noted subassembly snugly encompass channel bar 1 with the leg portions 42 passing through notches 10 of the underlying upper insulating member 2 (see Fig. 7) and through rectangular openings 11 in terminal-retaining strip 3 (see Fig. 8) where they are crimped on the under side of strip 3 to retain the parts in subassembly. Retaining clips 41 are employed at the ends of the subassembly and at intermediate points thereof between each group of ten individual spring terminal members 15. A circular opening is provided in the upper intermediate portion of each clip 41 to permit the passage of the upper portion of clamping studs 36 and the narrowed portion of hexagonal retaining nuts 37 (Fig. 12).

The various electrical units of a row are bench wired to the terminal portions 16 of the respective individual spring terminal members 15 of a subassembly of compression-connecting terminal apparatus. The row of electrical units may then be secured in final position and readily connected to respective bus wires B by means of the compression-connecting terminal apparatus wired respectively to such units.

The wired subassembly of compression-connecting terminal apparatus is readily placed in position on channel D with the clamping studs 36 passing through the previously described openings (7, 8, and 9) of the parts. Hexagon retaining nuts 37 are loosely threaded on studs 36. At this point contact portions 20 of the individual spring terminal members 15 loosely engage respective bus bars B and a visual inspection is made for alignment. The hexagon nuts 37 are finally tightened and the individual spring terminal members 15 are compressed against their respective bus bars B as in the manner previously described. The final clamping action retains the bus bars B in position and establishes effective electrical connections between the bus bars and the respective individual spring terminal members 15 and the electrical units respectively wired thereto.

We claim:

1. An electrical device for detachably connecting conductors to terminal points, said device comprising a sheet-like strip of insulating material and similar conducting spring members disposed transversely of the strip and comprising a row extending along the strip, the said strip having pairs of openings therethrough for receiving said conducting members respectively, said openings comprising two rows extending along the strip respectively adjacent to opposite edges thereof, each said conducting member having a contact portion lying on one side of the strip and extending between the two openings of its pair, each said conducting member being retained in assembled position by outwardly extending offset portions lying in engaging relationship with the other side of the strip, the offset portions of any member being connected with the contact portion thereof by angularly disposed portions positioned within the respective openings of the assigned pair, one opening of each said pair being relatively wide transversely of the strip, the length of the associated offset portion of any conducting member being less than the said width, enabling any conducting member to be sprung for insertion therein and withdrawal therefrom while the other end of such member is in assembled relationship with the strip.

2. An electrical device for detachably connecting conductors to terminal points, said device comprising a sheet-like strip of insulating material and similar conducting members disposed transversely of the strip and comprising a row extending along the strip, the said strip having pairs of openings therethrough for receiving said conducting members respectively, said openings comprising two rows extending along the strip respectively adjacent to opposite edges thereof at different distances from their respective edges, thereby providing both a short and wide margin at the edges of said strip, each said conducting member having a contact portion lying on one side of the strip and extending between the two openings of its pair, each said conducting member being retained in assembled position by outwardly extending offset portions lying in engaging relationship with the other side of the strip, the offset portions of any member being connected with the contact portion thereof by angularly disposed portions positioned within the respective openings of the assigned pair, one such offset portion extending sufficiently beyond the wide margin edge of said strip to serve as an attachment point for an external conductor, the other offset portion terminating within the short margin of the strip.

3. An electrical device for detachably connecting conductors to terminal points, said device comprising a sheet-like strip of insulating material and similar conducting members disposed transversely of the strip and comprising a row extending along the strip, the said strip having pairs of openings therethrough for receiving said conducting members respectively, said openings comprising two rows extending along the strip respectively adjacent to opposite edges thereof at different distances from their respective edges, thereby providing both a short and wide margin

at the edges of said strip, each said conducting member having a contact portion lying on one side of the strip and extending between the two openings of its pair, each said conducting member being retained in assembled position by outwardly extending offset portions lying in engaging relationship with the other side of the strip, the offset portions of any member being connected with the contact portion thereof by angularly disposed portions positioned within the respective openings of the assigned pair, one such offset portion extending sufficiently beyond the wide margin edge of said strip to serve as a connecting point for an external conductor, said strip having a third row of openings therethrough located within said wide margin for receiving external conductors connected to said points.

4. An electrical device for detachably connecting conductors to terminal points, said device comprising a sheet-like strip of insulating material and similar conducting spring members disposed transversely of the strip and comprising a row extending along the strip, the said strip having pairs of openings therethrough for receiving said conducting members respectively, said openings comprising two rows extending along the strip respectively adjacent to opposite edges thereof, each said conducting member having a contact portion lying on one side of the strip and extending between the two openings of its pair, each said conducting member being retained in assembled position by outwardly extending offset portions lying in engaging relationship with the other side of the strip, the offset portions of any member being connected with the contact portion thereof by angularly disposed portions positioned within the respective openings of the assigned pair, one said connecting portion of any conducting member being relatively short to limit movement of the associated end of the conducting member longitudinally of the opening, the other said connecting portion being relatively long to permit substantial movement of the associated end of the conducting member longitudinally of the opening, the said contact portion of any conducting member being formed to present a convex surface to the strip, and to an extent which normally maintains each of its said offset portions substantially in contact with the associated side of the strip.

5. An electrical device for detachably connecting conductors to terminal points, said device comprising a sheet-like strip of insulating material and similar conducting spring members disposed transversely of the strip and comprising a row extending along the strip, the said strip having pairs of openings therethrough for receiving said conducting members respectively, said openings comprising two rows extending along the strip respectively adjacent to opposite edges thereof, each said conducting member having a contact portion lying on one side of the strip and extending between the two openings of its pair, each said conducting member being retained in assembled position by outwardly extending offset portions lying in engaging relationship with the other side of the strip, the offset portions of any member being connected with the contact portion thereof by angularly disposed portions positioned within the respective openings of the assigned pair, one said connecting portion of any conducting member being relatively short to limit movement of the associated end of the conducting member longitudinally of the opening, the other said connecting portion being relatively long to

permit substantial movement of the associated end of the conducting member longitudinally of the opening, each conducting member having a form such that the part of the contact portion to which the longer of said angularly disposed portions is connected is held away from contact with said one side of said strip, whereby force must be applied against said contact portion to flex it to a position in which it lies flat against said strip.

6. In combination, a group of first conducting members, a rigid support bar, means including a first overlying insulating strip interposed between the bar and said first conducting members for supporting them in overlying relationship to the bar and strip, said first conducting members extending transversely of the bar and strip and forming a row extending longitudinally thereof, a second insulating strip overlying the said bar, the first strip, and the first conducting members, second conducting members individually woven into the second insulating strip in overlying relationship to the first conducting members respectively, each said second conducting member having an intermediate contact portion lying on the under surface of the strip in engaging relationship with its underlying first conductor member, the end portions of each second conducting member lying in engaging relationship with the upper surface of the said second insulating strip, one said end portion of each second conducting member being adapted to terminate an external conductor, a comparatively narrow third insulating strip overlying the second insulating strip in contact therewith between the said end portions of the second conducting members, a rigid clamp strip overlying said third insulating strip, and means, including clamp rods passing through all said insulating strips and operatively engaging said support and clamp bars, for clamping the assembly together with sufficient force to maintain the said contact portions of the second conducting members in contact with their respective underlying first conducting members.

7. In combination, a group of first conducting members, a rigid support bar, means including a first overlying insulating strip interposed between the bar and said first conducting members for supporting them in overlying relationship to the bar and strip, said first conducting members extending transversely of the bar and strip and forming a row extending longitudinally thereof, a second insulating strip overlying the said bar, the first strip, and said first conducting members, second conducting members individually woven into the second insulating strip in overlying relationship to the first conducting members respectively, each said second conducting member having an intermediate contact portion lying on the under surface of the strip in engaging relationship with its underlying first conducting member, the end portions of each second conducting member lying in engaging relationship with the upper surface of the said second insulating strip, one said end portion of each second conducting member being adapted to terminate an external conductor, each said second conducting member being of spring material and being so formed that a large part of its contact portion lies substantially out of engagement with the adjacent surface of the associated insulating strip, requiring the application of substantial force to flex it to a position in which it lies flat against its last said strip, a comparatively narrow third insulating strip overlying the second in-

sulating strip in contact therewith between the said end portions of the second conducting members, a rigid clamp strip overlying said third insulating strip, and means, including clamp rods passing through all said insulating strips and operatively engaging said support and clamp bars, for clamping the assembly together with sufficient force to maintain the said contact portions of the second conducting members substantially flat against their said strip, to apply effective spring contact force against their respective underlying first conducting members.

8. A combination as set forth in claim 7, wherein the said first insulating strip and said first conducting members are similar to the said second strip and associated conducting members.

EDWIN L. EARLE.
RICHARD P. ARTHUR.
JOHN I. BELLAMY.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,027,337	Holmes	May 21, 1912
1,514,618	Ide	Nov. 1, 1924
1,828,276	Beers	Oct. 20, 1931
2,074,958	Chirelstein	Mar. 23, 1937
2,279,824	Keefe	Apr. 14, 1942
2,284,462	Williams	May 26, 1942
2,433,358	Garberding	Dec. 30, 1947