

March 19, 1946.

G. C. THOMAS, JR

2,396,725

FLEXIBLE STRIP ELECTRICAL CONNECTOR

Filed May 16, 1944

4 Sheets-Sheet 1

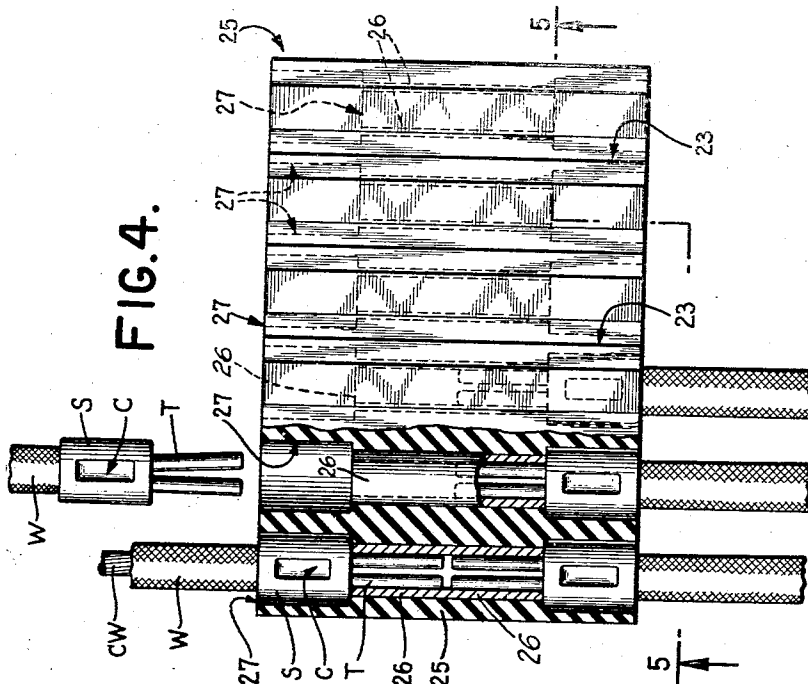


FIG. 4.

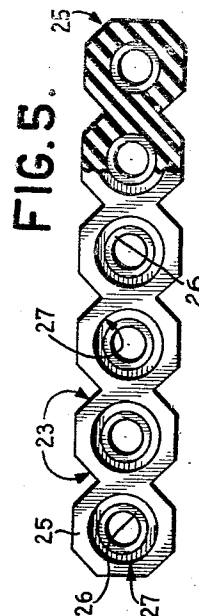


FIG. 5.

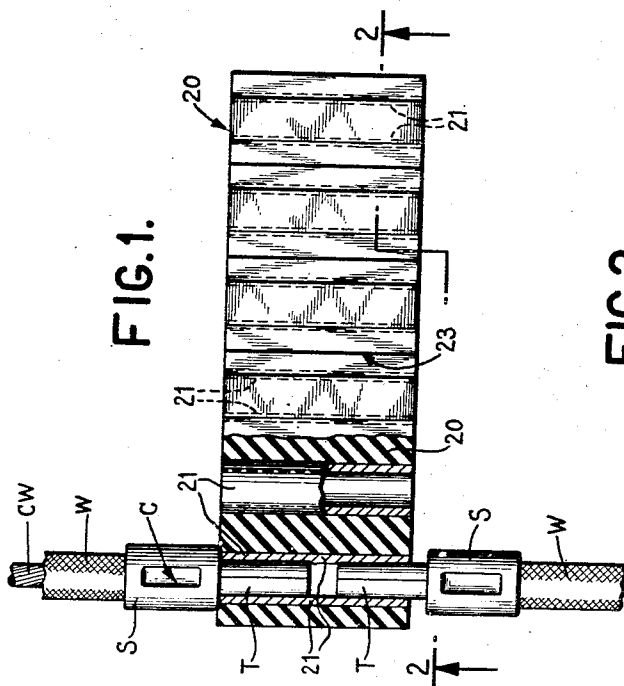


FIG. 1.

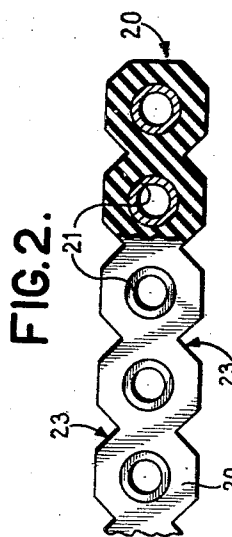


FIG. 2.

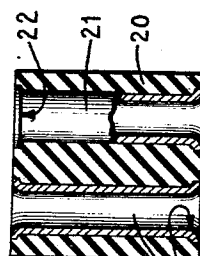


FIG. 3.

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March 19, 1946.

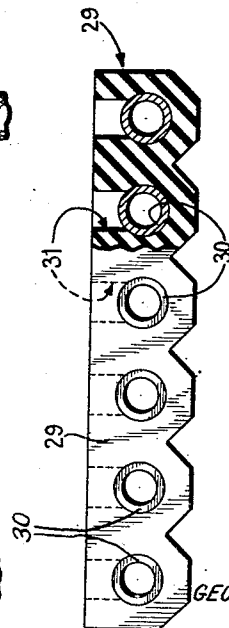
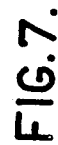
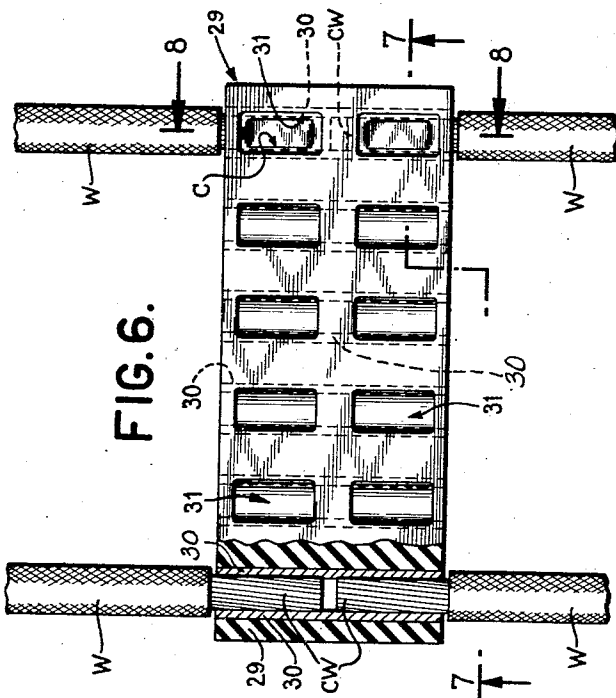
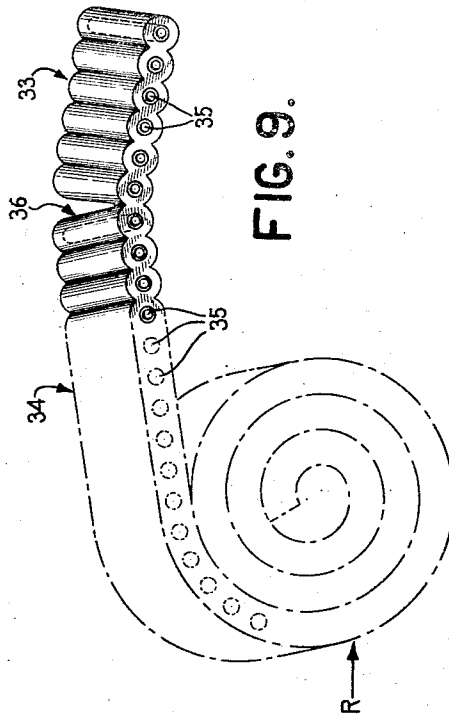
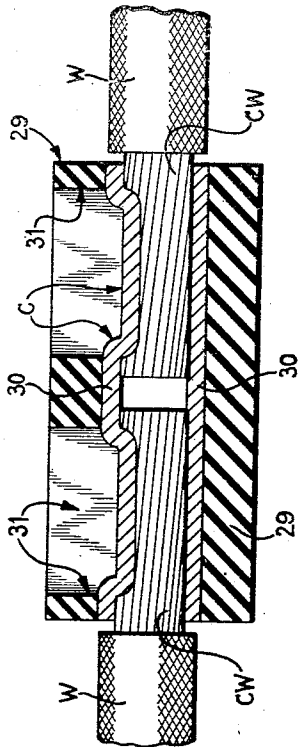
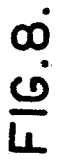
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FLEXIBLE STRIP ELECTRICAL CONNECTOR

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4 Sheets-Sheet 2



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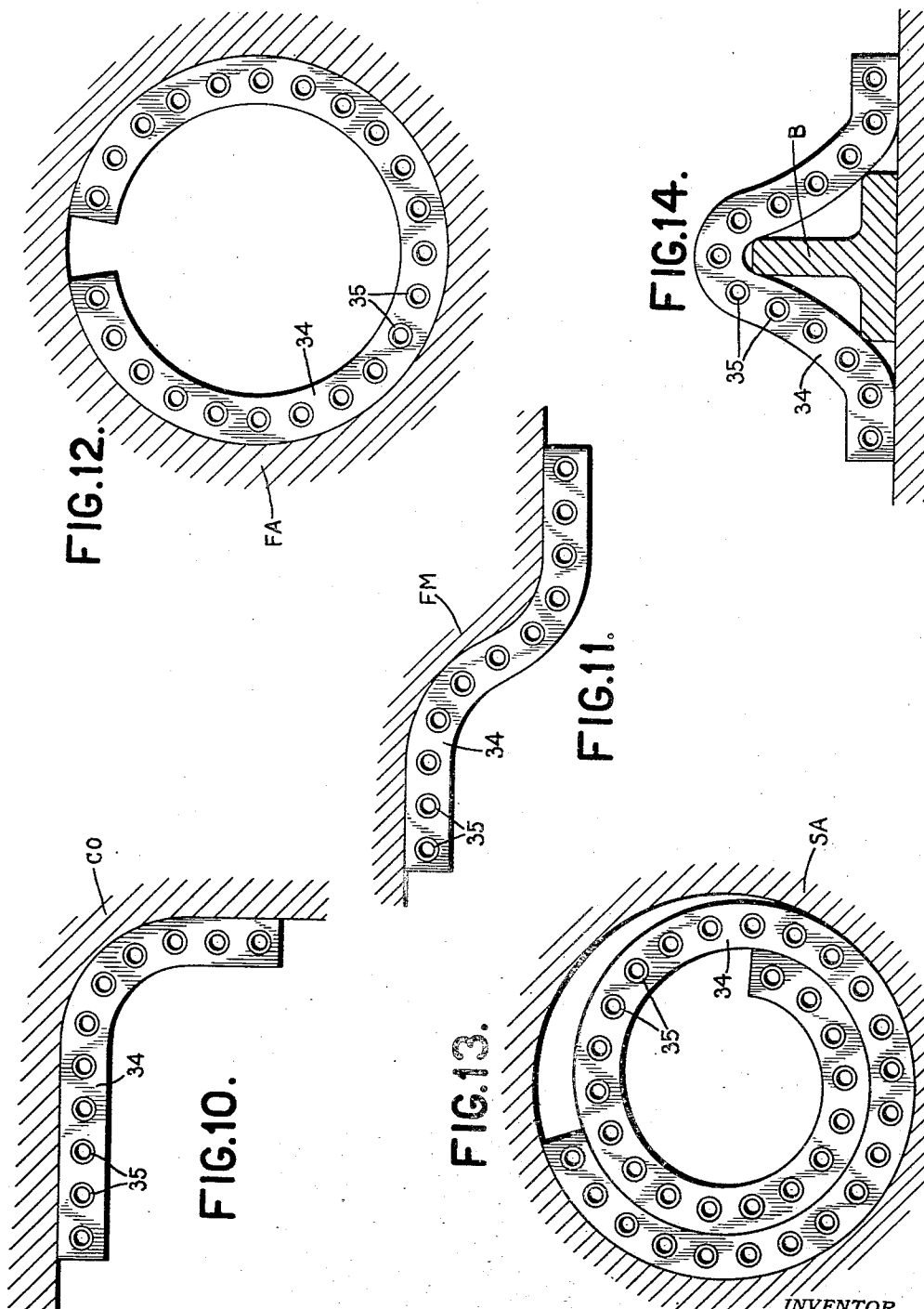
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FLEXIBLE STRIP ELECTRICAL CONNECTOR

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FLEXIBLE STRIP ELECTRICAL CONNECTOR

Filed May 16, 1944

4 Sheets-Sheet 4

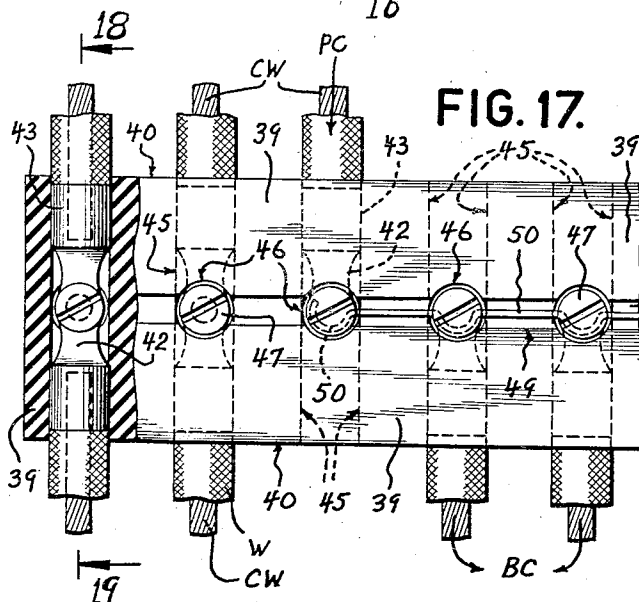
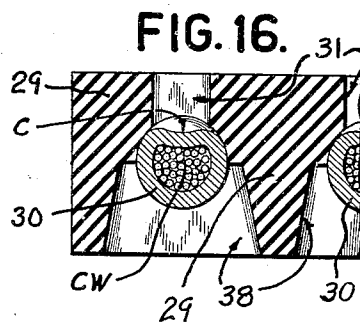
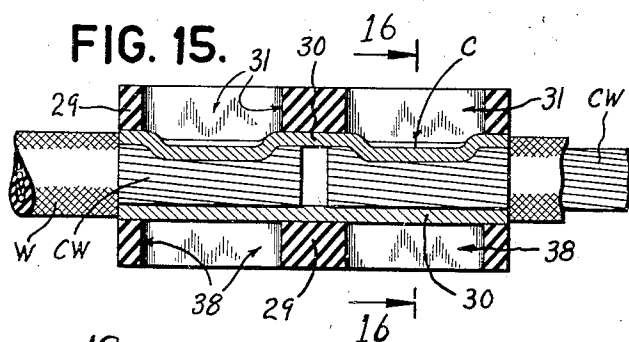


FIG. 19.

FIG. 18.

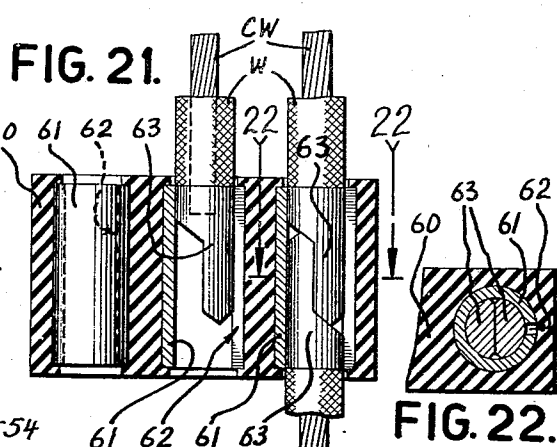
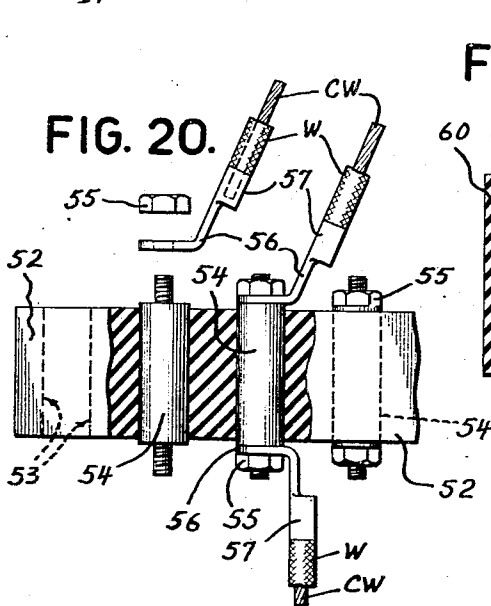
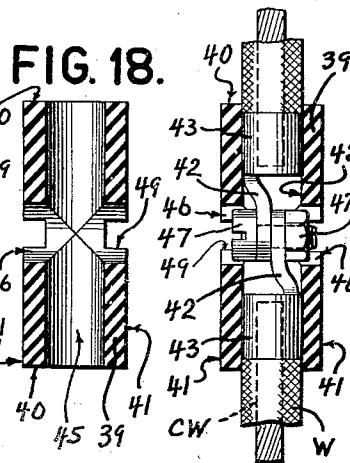


FIG. 22.

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UNITED STATES PATENT OFFICE

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FLEXIBLE STRIP ELECTRICAL CONNECTOR

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corporation of New Jersey

Application May 16, 1944, Serial No. 535,797

9 Claims. (Cl. 173—324)

This invention relates to electrical connectors for use with multiple electrical conductors or circuit wires assembled to form what is known as wiring harness largely used in connection with automotive, marine and other wiring work, especially in aircraft electrical wiring installations for instrument control, for power circuits, and the like; and the invention appertains to what is designated herein as a flexible strip electrical connector.

This application for Letters Patent is a continuation-in-part of my former application Ser. No. 449,215 filed July 1, 1942, and allowed on November 23, 1943, the issue of which is hereby waived in favor of the instant application.

In the construction of aircraft and other modes of transportation, especially large transport planes and bombers, there are a number of structural conditions which bid for improvement in electrical wiring installations along the interior of the fuselage, the wings and other parts of a craft, especially where complex wiring harness is used comprising a plurality of wires in bundle or band form. As a matter of fact, the component parts of aircraft and other machines are manufactured in separate sub-assemblies or unitary sections and thereafter the latter are assembled to complete the machine, following which it is conventional practice to then install the electrical wiring.

Aircraft sub-assembly sections have tie or joiner frame beams and other anchorage members which facilitate their rapid hook-up, and it is through or around or over such members which the electrical wiring lines must be installed. In the event one section of the aircraft or machine is damaged in service, such as a section of the fuselage or a wing sub-assembly, it then becomes important that said damaged section be readily replaced. Doing so is hampered by conventional wiring methods where the conductor lines of a complex wiring harness extend all the way through the damaged section of the craft, thus requiring that the wiring harness either be cut away or removed from even those unitary sections of the craft which are not damaged. In fact, the wiring harness may itself be intact and not injured in the damaged subassembly which is to be replaced in the aircraft.

This invention accommodates itself to a variety of conditions met with all of which cannot be enumerated, except that the basis or the principle underlying these requirements is briefly outlined herein. This new flexible strip connector lends itself to the quick removal or the disconnection of

the wiring harness so that the damaged machine section can be removed and, upon its replacement with a new section, the same wiring harness can be replaced; or if it had also previously been injured in the damaged section, a new set of wiring harness can be installed without disturbing other sets thereof not affected by the replacement of said new section.

Of primary importance is the fact that this new connector makes for rapid initial wiring harness installations in sub-assemblies of aircraft and other machines. When a sub-assembly reaches the main assembly production line at the aircraft factory the wiring harness is already installed therein. Conversely when a damaged sub-assembly is to be replaced in the field, said damaged section can be removed with its wiring harness without disturbing the wiring in the remaining undamaged portion of the machine. The new section to be installed in the machine, already having its wiring harness in place, can now have its terminals plugged into the flexible strip connector herein of the undamaged portion.

Accordingly, this connector makes it convenient to install independent wiring harness in sub-assemblies, and thereafter (either for initial production or later repair) plug the wire terminals into the flexible strip connector, instead of belatedly making the electrical installation, as in conventional practice.

According to the foregoing, an object of the invention is to produce an electrical connector in flexible strip form containing a plurality of connector members for the reception of wiring harness terminals by which to join one section of a wiring harness to another section thereof, the strip connector having its connecting members disposed in a common plane and susceptible of flexure by hand manipulation of the flexible strip connector by which to conform it to the shape of the surface of machine members on which it may be placed or mounted in service position.

A further object is to produce a flexible strip connector for electrical line work and wiring harness terminals, which connector may be installed on a flat or curved or irregular surface, or in an aperture, or astride a beam—hence a connector which may be hand formed into a circle, or into a spiral-like bundle, or any other shape to match the configuration of the structural member to which it is attached.

Another object is to produce a flexible multiple plug-in electrical connector having a plurality of connecting members, embedded crosswise in a common plane within a lengthwise body of rub-

ber-like material, the flexible strip being manufactured as stock material so that wiring mechanics may cut off a piece of the wire conductor strip containing the connecting members equal in number to the electrical wires constituting the particular wiring harness used in a specific installation. Thus, if the wiring harness at hand consists of twenty circuit wires, then a strip or piece of connector material twenty connecting members long is cut from the stock roll.

The accompanying drawings purposely present enlarged views for the sake of clarity, and illustrate several examples of construction embodying the invention, showing several typical forms of construction which the invention may take, thereby more fully explaining its principle and comprehending other forms of equivalent construction, and also showing a number of examples of use, thereby indicating the versatility of adaptations, wherein:

Fig. 1 shows a top view of the flexible strip connector with a pair of disconnect terminals plugged coaxially into a receptacle to make a continuous line circuit connection; Fig. 2 shows an edge view thereof; and Fig. 3 is a detail to show that the receptacle tube ends may be flared or swaged to hold them in the rubber strip body.

Fig. 4 shows a second form of the invention comprising a somewhat wider flexible strip connector providing rubber insulating pockets or recesses which completely cover the metallic sleeves of one type of disconnect wire terminals in conventional use; and Fig. 5 shows an edge view thereof.

Thus the foregoing views show my flexible strip connector adapted to disconnect type terminals of known form, as distinguished from permanent wiring joints suggested in the next three views.

Fig. 6 shows a third form of the invention comprising a flexible strip connector for permanently joining electrical conductors having insulation-stripped bare ends and hence do not have their ends fitted with conventional disconnect wire terminals, thereby differing from the previous views. Fig. 7 is an edge view in partial section, as on the line 7-7 of Fig. 6 showing, incidentally, that one surface of the flexible rubber body may be flat and the other corrugated. Fig. 8 is an enlarged sectional view made on the line 8-8 of Fig. 6.

Fig. 9 shows a piece of this flexible connector stock material comprising a lengthwise strip manufactured in quantity lot and rolled for convenience in storing, handling and stocking same. A short piece of the material, having six connector members, is shown severed or partially cut off from the stock roll for use by a mechanic on a job where a six-lead wiring harness is to be used.

Figs. 10 thru 14 show the manner of hand shaping and applying the device to various irregular forms and shapes of structural work where a variety of bends, corners, holes, beams, etc. are encountered, especially in aircraft wiring jobs. These views show the versatility of the flexible connector strip in its adaptation to any and all machine or structural conditions.

Fig. 10 shows the strip connector secured within the inside corner of a structural member, and it will be understood that the terminal strip similarly will fit an outside corner.

Fig. 11 shows how readily the strip connector conforms to an irregular bend encountered in a machine structural member.

Fig. 12 shows the flexible strip connector mounted in a hole in a frame member through

which circuit wiring harness must pass and occupy a minimum of space; and Fig. 13 shows a similar installation, except that a long strip of the connector has been cut off from a stock piece to accommodate wiring harness having a larger number of wire leads than in Fig. 12, thus requiring the strip connector to be spirally rolled into bundled form.

Fig. 14 shows the connector in place astride a T-beam to accommodate itself to a complex wiring problem where the leads of a wiring harness extend along each side of the beam.

Figs. 15 thru 22 show additional forms of the invention, and which constitute the subject matter in continuation of my former application as heretofore identified.

Fig. 15 shows a modification of the construction in Figs. 6, 7 and 8, by which to further adapt my flexible strip connector to the use of a crimping tool when making permanent wire joints of the solderless type. And Fig. 16 is a sectional view thereof developed on the line 16-16.

Fig. 17 shows my invention somewhat modified in respect to other forms of construction herein, devised in the form of a new flexible strip connector jacket or sheath for receiving conventional type wire terminals of the lug type; and this view also shows the simplicity with which the invention is adapted to provide any number of branch or tap circuits which may feed off from one current supply circuit. Fig. 18 is a cross section on the line 18-19 through the flexible connector sheath or jacket per se before the terminals are inserted. And Fig. 19 is a similar section along the line 18-19 after the terminals are inserted, being a side edge view of two lug terminals (the tongues thereof) placed in coaxial overlapping contact and secured together by screw means.

Fig. 20 shows the flexible strip connector fitted with screw threaded stud and nut joints also devised for adapting the invention to the use of conventional wire terminals of the lug type.

Thus, I have shown (Figs. 17 thru 20) two examples of the flexible strip connector devised for use in connection with ordinary wire terminals, and the principle thus demonstrated is susceptible to other constructions for reception of other known types of wire terminals.

Fig. 21 shows the flexible body strip connector fitted with plug-in socket receptacles devised for adapting the invention to the use of conventional wire terminals of the coaxial plug-in disconnect type; and Fig. 22 shows a cross section on the line 22-22. In this form of the invention, split tube contact receptacles are used.

The invention as shown in Figs. 1, 2 and 3

Referring further to the drawings, it will be noted that this first example of the invention comprises a rubber strip or flexible body member 20, with electrical connecting members in the form of tubular receptacle sockets 21 embedded therein. Seamless connector receptacles 21 may be used, say seamless tubing of copper or other metal best suited for efficient electrical transmission.

The body 20 is rectangular in form, having parallel sides and ends, also top and bottom parallel surfaces; and the body is made thick enough to conceal and hold the plurality of connector receptacles 21 in spaced parallel relation, as well as in-line which means that the axes of the receptacles are in a common plane. The connector members 21 are insulated from each other by

the dielectric property of the flexible material of the body member. The resiliently flexible body 20 may be manipulated, flexed, bent or rolled into any of the shapes indicated (see Figs. 10-14) and readily expands and contracts when installing it in machines as a part of an electrical wiring system.

The metallic connector receptacles 21 and the material of the body 20 surrounding them may be vulcanized or bonded together in the manufacturing process, and thus the receptacles 21 are anchored in place. However, the rubber body can be molded separately, and thereafter the receptacles 21 inserted and cemented or otherwise secured. Flaring or swedging the tubular ends at 22, as shown in Fig. 3, also secures the receptacles in the body.

It is noted that the electrical connecting members 21 are of a length about equal to the width of the flexible body strip 20, and in this way the ends of said members and side edges of the strip 20 are flush. Thus the parallel connector members 21 are buried in the elastic body and expose their open ends for the reception of the conductor terminals through the side edges of the body. As aforesaid, the axes of the parallel connector members lie in a common plane by virtue of being carried in a flat or plane insulating body, the upper and lower surfaces of which define the thickness of the body, while the side edges define its width.

The upper and lower surfaces of the strip connector may be corrugated on the top and bottom, as indicated at 23, and each body corrugation contains an electrical connector or contact receptacle 21, thereby reducing the body material to thin proportion between each receptacle. Corrugating one or both sides of the rubber strip contributes to its flexibility and lightness in weight, as well as economy in production.

In Fig. 1, an insulated wire W has its end fitted with a conventional type of connect and disconnect terminal means. For example, a plug-in prong or jack terminal T is joined to conductor wire CW by a sleeve S which in some types is pressure indented or crimped at C to make a solderless or cold-weld electrical connection between the terminal ST and the circuit wire.

The other line wire W (lower left side in Fig. 1) is shown partially plugged into the side edge of the body 20 for the purpose of illustrating how the sleeve S is adapted to abut the end of the receptacle 21 after the terminal T is pushed home. When the terminals T of the two separated wires are plugged in at each end of the receptacle tube 21, the coaxial line connection is completed; and the rubber body holds the wiring harness in place, absorbs vibration, and occupies a minimum of space.

Of importance is the fact that this multiple circuit connector in effect is fashioned by hand on the job, since the wiring mechanic may cut off at 36 a piece 33 of the strip material from a stock piece 34 (see Fig. 9) with the number of contacts 35 required, and flex it into shape and service position for fitting any structural condition, as demonstrated in Figs. 10-14. These advantages are not attained in individually manufactured connectors of the known rigid type.

A wiring harness as such is not shown herein, but it will be understood that it usually comprises a large number of insulated wires W, generally stranded wire as shown by the circuit wire CW, where the insulation is stripped off for illustration, and are bound together in the form of a roll or a bundle, or the plurality of wires is joined

together in the form of a flat band. The several terminals of a wiring harness bundle or band assembly are left free of said assembly for a few inches so that the individual wires of the assembly can be manipulated into the respective contact sockets which open through the side edges of the connector.

Figs. 4 and 5

This second form of the flexible strip connector also comprises a parallel side rubber strip or body 25 somewhat wider than heretofore described, in order that its electrical contact means, shown in the form of seamless receptacle tubes 26, may be shorter than the width of the body. By this design and arrangement, there is formed a tubular pocket recess or rubber well 27 at each open end of each tubular connector receptacle 26 and in coaxial alignment therewith.

Accordingly, the sleeve S of the wire terminal T, electrically connected with the end of the circuit wire W in a known way, is entirely concealed and insulated within the rubber hole or pocket 27. Therefore, the insulation on the wire W is the only exposed portion projecting from the two parallel side edges of the strip connector body 25.

This wide and resilient connector body 25 also may be corrugated at 23, similar to that heretofore described. However, it may be preferred to make plain or flat surface strip connector flexible bodies 20 or 25 where very small wiring receptacles 26, usually tubular in form, are employed for small circuit leads in instrument wiring work and the like. The roll of strip connector stock shown in Fig. 9 portrays both flat 34 and corrugated surfaces 33, thus affording a choice.

This form of construction (Figs. 4 and 5), employing the rubber insulating pocket 27, is particularly effective where the conductor ends of wiring harness are fitted with the metallic sleeve type terminal ST and the flexible connector is affixed to a curved surface or within a circular opening (Figs. 10-14), since under those conditions the sleeves S tend to engage each other and hence might produce short circuits in the wiring system, but for the pocket walls 27 which insulate the sleeves S from each other.

Figs. 6, 7 and 8

In this third species of flexible strip connector means embodying the invention, there is provided a multiple electrical connector for permanently joining a plurality of conductors in a wiring harness job. In the previously described examples, electrical connecting and disconnecting means are provided, by reason of the plug-in-and-out terminals T shown in Figs. 1 and 4. However, there are some wiring installations where connect and disconnect terminals are not necessary, permanent connections being made instead. And consequently, Figs. 6, 7 and 8 simply show the flexible strip connector adapted to bare end connector wires CW.

A resilient insulating body strip 29 contains wire joint means here shown in the form of seamless tubular receptacles 30. These metallic tubes 30 may be approximately equal in length to the width of the body strip and the axes of the receptacles lie in a common plane, thus providing the characteristic in-line plurality of parallel connector members 30. These permanent joint connectors 30 are cylindrical at their open ends for easy reception of the bare wire ends CW, whereupon each tube end is crimped at C in a known manner by a compression tool to permanently join the two wires CW in coaxial relation

with the strip connector and with each other by a cold-flow pressure connection.

A recess 31 or cut-out is formed in the flexible or rubber body strip 29 at the end or the ends of each connector receptacle 30. This elongated recess 31 is disposed in the connector body over the receptacle where it is determined best to compress the crimp C thereinto. The body recess 31 constitutes a guide into which the wiring mechanic on the job inserts his manually-operable crimping tool in a known way, applies pressure, and cold-flows the wire strands CW and soft metal or copper receptacle 30 together to make a permanent solderless electrical connection.

The invention relates in a number of ways to the flexible or manually deformable strip connector, by which a plurality of wire receiving electrical connectors (permanent or disconnect) are embedded or carried in a common plane in a hand shaped resilient body. And this particular example (Figs. 6, 7 and 8) is characterized by the recess 31 in or through the top or into one surface of the rubber body 29. Therefore, the particular type of tubular receptacle 30, itself subject to selection from conventional forms, is shown to explain the principle of the invention.

Any suitable cold-flow electrical connection joint 30 may be used where the strip connector is produced for solderless jobs, i. e., pressure or cold-weld connections. On the other hand, soldered wire connections may be made with this receptacle 30, or other forms thereof if preferred.

Fig. 9 article of manufacture

The several body forms of flexible strip connectors 20, 25 and 29 previously described may be produced in quantity lot as illustrated in Fig. 9, that is, in lengthwise strip or band form, and a selected length and number of the in-line receptacle contacts 21 and 26 or crimp joints 30C cut off from a stock roll for the wiring job at hand.

A flat strip of rubber-like material, corrugated as indicated at 33, or flat as diagrammatically shown at 34, affords a stock sheet simple to handle, store, pack and ship, since it can be folded or rolled as shown at R. Parallel contacts 35 of any suitable form, either for disconnectable plug-in or permanently crimped-in electrical joints disposed in a common plane, are molded in place or otherwise embedded in the rubber strip 33, 34. The connector receptacles 35 are shown in length about equal to the width of the flexible strip or body 33, 34 and hence Fig. 9 in effect shows Form 1 of the device as heretofore presented in Figs. 1, 2 and 3. Obviously, however, any of the other illustrated constructions, as well as their equivalents, may be produced in strip stock form, as demonstrated by Fig. 9.

It is important to note that each crosswise connecting member 35 is embedded in a corrugated portion extending transversely of the body strip 33 and thus forms a cleavage or shearing line 36 between each member. Accordingly, the wiring mechanic on the job may readily use his knife to cut off a piece 33 of the strip connector 34 of the required wire-number capacity, and then with his hands manipulate it into the shape required to fit the surface of the member on which it is attached. It is noted that a piece of the flexible strip connector stock, six wire connectors long, is shown partially severed or as being cut off of the stock roll R along a corrugation line 36 for use in a wiring harness job having six circuit wires.

Either seamless or split contact tubes 21, 26, 30 and 35 may be used in any one or all forms of the flexible strip connector shown. It appears obvious that whether the connector tubes be resilient (split) or be rigid (seamless) that the utility of the hand-shaped connector body remains the same as a splice connector for multiple-wire installations.

Typical examples of uses shown in Figs. 10-14

Rigid type multiple-conductor connecting devices for wiring harness are not suitable for the adaptations and uses shown in Figs. 10 thru 14, etc., of the drawings. Rigid body connectors of standardized manufacture cannot be manipulated, flexed, conformed and fitted by hand to the variety of shapes and passages encountered in air craft and other machine structures, nor can they be selected on the job for the particular wire-number capacity of a given wiring harness installation, of which there are many variations of the typical examples shown in Figs. 10-14. Such problem, however, is solved by this invention, particularly by having on hand a roll R of stock connector material.

Hence, the complex wiring systems now coming into use, due to the vastness of power and instrument circuits used in large aircraft, are far from simple to install, and are rendered more difficult where mass production is based on the completion of unitary sub-assemblies. This invention supplies the latter need and many others.

Take for example a fuselage section built complete in itself as a sub-assembly and thereafter added to the main structure of the plane. A flexible strip connector can be installed at one or both ends of the section and a wiring harness equal in length to that section may be set in place with the individual lead wires plugged into the connectors. In other words, the wiring can be installed from end to end of a tail sub-assembly or other unit, such as a wing tip, wing stub, fuselage portion, etc., with each end of a particular wire connected with its contact of the strip connector at each end of the unit.

The wiring jobs can be carried out as a step in the production of the sub-assembly, instead of waiting and wiring the aircraft as a whole after it has been completed. When, therefore, two or more sub-assemblies are joined (each of which are previously wired), it is only necessary to plug-in the wiring harness terminals from one sub-assembly to the other.

This strip connector, therefore, can be used to great advantage by making possible wiring harness sub-assemblies, so to speak, such partial or sub-wiring jobs being made co-extensive with the plane sub-structural jobs. Consequently, the wiring can be kept in step sectionally with the structural work sectionally, and when the aircraft is completed as a whole its wiring is likewise completed. Therefore, it is not a matter of wiring the craft after it is completed.

A piece of the strip connector material is cut off from the bundle or roll of stock connector material R (Fig. 9) in length by counting off the number of contact or connector members 35 equal in number to the total of the conductor leads constituting the particular wiring harness being installed.

For example, an eleven-wire harness job is contemplated in Figs 10 and 11 where in one corner CO at one end of the machine unit or sub-assembly a piece of strip connector 34, severed as at 36 from the stock roll R, is manipulated and con-

formed by hand into place, cemented down or otherwise secured in place, and at another point in the machine sub-assembly a similar strip of the stock connector material is manipulated and affixed to an irregular frame member FM.

The eleven-line wire bundle or harness is then set in place between the two machine units and their terminals plugged into these two special form connectors CO and FM fashioned by hand on the job, whereas it would be costly and impractical to manufacture these two distinct connectors of special form for these and other irregularly shaped frame members in a machine. This is all the more true when it is noted that even one or more given shapes of connectors may vary in number of contact receptacles required due to the fact that the wiring harness conductor leads vary in number.

Again, Fig. 12 demonstrates how readily a round or circular connector 34 is produced on the job for a frame aperture FA. Then in Fig. 13 the same is true where the completed wiring harness lines constitute some thirty-five independent circuits, too many for a plain circular connector and so its unusual length is readily spiraled by hand into the aperture SA of the fuselage unit. Frame apertures vary in size in aircraft structures, and it would constitute a major undertaking to manufacture special form circular connectors FA and spiral connectors SA.

Fig. 14 shows a piece of flexible connector material 34 cut from the stock roll R and flexed by hand across a beam B. This is a typical example of wiring bundle harness where its leads extend along a structural beam in an aircraft job. This special shape beam type connector is quickly made on the job from the stock roll R and applied, in each adjacent sub-assembly having the beam B, whereupon the wire leads may readily bridge through from one sub-assembly to the other, and the terminals of said wire leads may be plugged-in the beam type connectors.

It is readily seen that this new flexible strip connector, with its in-line contact means, in one or more of the flexible rubber body forms as shown at 20 or 25 or 29, may be produced as an article of manufacture and stocked in quantity as indicated at R. The variety of special hand-fashioned connectors 34 (Figs. 10-14), made by the mechanic to the required shape and wire-number capacity, that is, having any selected number of connector receptacles 35, are readily produced on the job.

These connectors may be bonded onto the duralium internal framework portions (Figs. 10-14), as a step in the production of aircraft and other machine sub-assemblies, and thus the wiring installation as such is kept in step with machine production and said wiring disappears as a separate job after the aircraft is completed.

Figs. 15 and 16

These two views are to be considered in connection with Figs. 6, 7 and 8, and show the same construction (hence like part numbers), except that a recess or cut-out 38 is molded or otherwise formed in the lower part of the flexible connector body 29. The upper and lower recesses 31 and 38 expose or lay bare the upper and lower surface portions adjacent the ends of the electrical connecting receptacle 30 carried within the flexible body, and these recesses are disposed in vertical alignment or registry with each other. This recess pair 31, 38 is provided longitudinally along or near each end of the tubular part 30 where

the crimp C is compressed thereinto for producing a cold-weld solderless electrical and mechanical joint between the conductor wire CW and the receptacle 30.

Accordingly, when a crimping or compression tool (not shown) is applied to this flexible connector 29, the jaws of such tool enter the recesses 31 and 38 for direct engagement with the exposed opposite surfaces of the receptacle 30. The lower jaw of such tool provides an arcuate nest-like support for the lower semi-circular portion of the tubular part, while the upper jaw carries a crimping rib which is the male counterpart of the crimped depression C deformed or swaged inwardly to flow the wire or strands CW and the malleable receptacle 30 into a homogeneous mass constituting a well known type of solderless electrical connection of the permanent joint type.

The lower recess 38 may be about equal in length to the upper recess 31 (see Fig. 15). However, said lower recess 38 is shown herein somewhat wider (see Fig. 16) than the upper recess 31 inasmuch as the lower jaw of a crimping tool may well require more entry-area through the body 29 to reach and support the receptacle 30 along its lower one-half side, than is required by the ribbed upper jaw of the tool to reach and engage a narrow lengthwise upper portion of the receptacle to effect the cold-weld solderless joint at the crimp C therein.

Figs. 17-19

In this form of the invention, the electrical connector is also shown as a flexible body in strip form, indicated as a whole at 39, and made of rubber-like material. The body has parallel side edges 40 which define the width of the strip, and parallel upper and lower surfaces 41 define its thickness. It is, thereof, of similar shape and form, generally, as heretofore illustrated and described—being thusly designed and constructed for side-edge multiple wiring connections and for hand shaping to fit the surface of irregular and dissimilar machine parts with which it may be used when placed in service position.

In contrast, however, to the other forms of construction herein, the strip of material 39 may be considered as taking the form of a sheath or flexible jacket. It is channeled and perforated for the reception of well known lug type conductor terminals (in pairs or twin use) which are in such general use, singly, as to make for marked advantages in now providing for their wider use in splice-connecting wiring harness in accordance with the new principles of this invention.

For example, a lug type or other like terminal of this well known form simply comprises a tongue or eye 42 carried on a sleeve 43. This type of terminal has a straight tongue or perforated eye 42 disposed coaxial with its barrel or wire receiving sleeve 43, and a conductor wire CW is electrically connected within the sleeve. The tongue 43 (in its conventional use) is attached by a screw or other means to a current transmitting part. In conventional practice, a single lug terminal 42, 43 is used for panel and instrument wiring at the terminus of a circuit, but in my new connector herein I employ a pair of these old terminals in a new way for line splicing work.

I have, therefore, devised a flexible strip connector in the form of a molded jacket or sheath 39 to accommodate conventional types of lug terminals (one type thereof being shown at 42, 43) and for converting them to multiple circuit line coupling or splicing operations in wiring harness

jobs—a somewhat new application for that type of wire terminal. With such purpose in view, the flexible strip 39 is provided with a series of parallel crosswise passages 45 molded or otherwise formed therein. These spaced passages are disposed transversely of the flexible body strip 39, and open outwardly through its parallel side edges 40, for receiving a pair of lug terminals in coaxial relation for line splicing work.

Each conductor passage 45 is perforated or provided with a hole 46 disposed at right angles therethrough centrally of the flexible body 39. This aperture 46 opens through one or both (upper and lower) surfaces 41 of the strip connector—being shown herein as passing all the way through—and the purpose of which is to receive screw means (such as a screw and nut 47) for joining two or twin wire terminal eyes 42 in a new manner for electrical connection coaxially within the flexible jacket strip 39. Thus a pair of simple type well known terminals are adapted to circuit line splicing, and each terminal pair is confined and insulated within its respective passage 45. The short screw and/or nut 47 is readily inserted into its aperture 46 and through the overlapping pair of terminal tongues 42. The screw head and nut are below the surfaces 41 of the jacket, and hence are insulated against contact with outside structural parts of the machine on which the connector is installed. The screw means 47 in the hole 46 retains the electrical splice assembly within the covering jacket 39 against relative motion.

The invention also readily lends itself to branch or tap-off wiring installations, by which several branch circuits are supplied from one power circuit. In this connection, a groove or channel 49 is formed longitudinally along the midportion in one or both surfaces 41 of the body 39. This groove may bisect the terminal receiving passages 45, and is coincident with and extends through the several screw receiving apertures 46. Thus all three openings (passage 45, aperture 46, and groove 49) communicate with each other to facilitate the wiring job in question.

A tap-off or branch conductor 50 may be placed within the channel 49 of the flexible connector for establishing electrical connection between one power supply circuit (as at PC) and any number of branch circuits (as at BC). Thus one main conductor wire PC may be attached to the connector body 39 and very readily tap-off to a plurality of branch lines BC. The tap-off conductor 50 may be a piece of wire looped under each screw head 47 (as shown) or a flexible strip of sheet metal, copper, or the like. The use of a piece of wire 50 for this purpose demonstrates the simplicity of the installation and the versatility of the jacket-like flexible strip 39 by which to adapt conventional terminals 43 (in pairs) to line splicing operations for wiring harness installations where problems are confronted as illustrated in a few of the examples shown (Figs. 10-14).

Fig. 20

This view illustrates my electrical multiple wire connector in the form of a flexible strip 52 also adapted to conventional lug terminals. But in this example, the terminal is of the angular lug type. The body or strip 52 has a series of parallel passages 53 disposed transversely that is, crosswise therein, and opening outwardly through the side edges thereof, for coaxial wire or line

splicing application of the angular lug terminal thereto.

A double-ended screw-threaded stud 54 is either molded into each passage 53 or fitted frictionally therein, with its threaded ends accessible at each side edge of the body 52, and a nut 55 is provided for each end of the stud. The stud 54 constitutes the electrical connecting member, and is shown by way of example as one form of metallic part which may be adapted to the angle-tongue lug terminal (next explained), as distinguished from the flat or coaxial-tongue terminal treated in Figs. 17-19.

These wiring terminals, long in general use, have bent or angular tongues or eyes 56 off-set from the axes of their wire receiving sleeves 57. The off-set tongues 56 are perforated and fit over the threaded ends of studs 54, one terminal at each end thereof, whereupon the nuts 55 are screwed onto the ends of the stud, and thus anchor the terminal pair with their conductor wires CW in spliced coaxial alignment.

According to the foregoing, Figs. 17 through 20 illustrate two forms of my invention purposely devised for adoption and use of conventional wiring terminals (in pairs) with my flexible connector. The flexible body sheath or jacket 39 (Figs. 17-19) does not require an intermediate connector member or part since the duplicate or twin terminals 43 are directly secured together in the midportion of the covering jacket 39. On the other hand, the flexible body 52 (Fig. 20) includes the intermediate connector member 54 in the form of a nut-and-screw fitting for coaxially splicing the conductor wires CW.

Figs. 21 and 22

The invention is here adapted to disconnect type of electrical terminals of a more recent form now coming into use for multiple circuit harness wiring installations. A rubber-like body 60 is made similar to previous forms thereof, and is adapted to coaxial splicing work through its side edges, as heretofore explained.

In this example of the invention, a contact plug-in or disconnect coupling receptacle 61 of the split tube type is employed. The tube is split longitudinally at 62 from end to end to permit expansion and contraction as will be understood in the art. These contractile receptacles 61 are carried in the flexible strip 60, in parallel spaced relation, and crosswise thereof. The receptacles open outwardly through the side edges of the body and constitute passages to receive electrical wiring coupling means, as next described by way of example.

Contact tips 63 are fitted on the conductor wires CW in the usual way, and thus provide electrical terminals. These tips terminate in pressure-wiping contact tongues 63 which (when disposed in coaxial pairs as shown) wipe each other as they slide one upon the other—thus making an effective electrical connection. The terminals 63 are identical or twin construction, and thus a pair is employed. The tips are approximately semi-cylindrical, and when two tips slide together they form a full cylindrical assembly.

The terminal pair 63 is plugged into the contact coupling receptacle 61 as shown, one terminal into each end of the receptacle. The overlapping tongues 63 have a diameter slightly more than the normal inside diameter of the disconnect coupler 61. Thus the coupler receptacle is slightly expanded when the two terminals are thrust

into position, and the overlapping tongues 63 are subjected to pressure contact.

This form of the invention has the advantage of simplicity due to the use of duplicate type terminals 63 which quickly connect and disconnect with coaxial symmetry through the opposite side edges of the flexible strip defining its width. And the upper and lower surfaces defining the thickness of this flexible connector body strip 60 may be corrugated if desired as indicated in previously illustrated examples herein.

The several forms of multiple connector construction herein proposed may be produced in long strips of stock 34 as comprehended in Fig. 9. The wiring mechanic on the job simply cuts off at 36 a piece thereof, with the required number of connector parts as at 33, and shapes the connector 33 by hand to conform to the installation shape and problem at hand, the several advantages and utility of which have been outlined in the early parts of this specification.

This invention is presented to fill the need for a useful flexible strip electrical connector. Various modifications in construction, mode of operation, use and method, may and often do occur to others, especially so after they have benefited from the teachings of an invention. Accordingly, this disclosure is exemplary of the principles and equivalents without being limited to the present showing of the invention.

What is claimed is:

1. An electrical connector for connecting a plurality of electrical conductor wires, comprising a body, which is wider than it is thick and having side edges, said body being made of rubber-like flexible insulating material which adapts said body to be manipulated by hand when conforming it to an irregular service shape, and a plurality of electrical connecting members carried parallel with each other in a common plane within the body of flexible insulating material, the axes of the electrical connecting members being disposed parallel with the surfaces defining the thickness of the body as well as crosswise of the width of said body, and said connecting members having their ends located at the side edges of the flexible body and thus adapted to electrically connect conductor wires received at said side edges defining the width of the body.
2. An electrical connector for splice connecting circuit wiring, comprising a flat body, which is wider than it is thick and having parallel side edges, made of rubber-like flexible insulating material susceptible of being manipulated and shaped by hand to conform to the irregular surface of any structural member on which the connector and its wiring may be placed in service position, and a plurality of electrical connecting receptacles embedded and insulated parallel with each other within a common plane in the flat body of flexible material, the axes of the receptacles being disposed parallel with the surfaces defining the thickness of the flat body and crosswise of the width of said body, said receptacles being open at each end thereof outwardly through the two side edges of the flat body defining its width, and the connector thereby being adapted to receive electrical conductors at both side edges and into both ends of the receptacles for electrical connection therewith, whereby each receptacle joins its respective pair of circuit wires in coaxially spliced relation.
3. An electrical connector for splice connecting circuit wiring, comprising a flat body, which

is wider than it is thick and having parallel side edges, made of rubber-like flexible insulating material susceptible of being manipulated and shaped by hand to conform to the irregular surface of any structural member on which the connector and its wiring are placed in service position, and a plurality of electrical connecting receptacles, in the form of seamless non-resilient tubes, embedded and insulated parallel with each other within a common plane in the flat body of flexible material, the axes of the receptacles being disposed parallel with the surfaces defining the thickness of the flat body and crosswise of the width of said body, the receptacles being open at each end thereof outwardly through the two side edges of the body defining its width, and the connector thereby being adapted to receive a plurality of electrical conductors at each side edge, one conductor into each end of each receptacle for electrical connection therewith, whereby each receptacle joins its respective pair of wires in coaxially spliced relation.

4. An electrical connector for splice connecting a plurality of conductor wires, comprising a body, which is wider than it is thick and having side edges, made of rubber-like flexible insulating material which adapts the connector to be manipulated by hand in conforming it to irregular service shape, and a plurality of electrical connecting receptacles embedded and insulated parallel with each other within a common plane in the flexible body, the axes of the receptacles being disposed parallel with the surfaces defining the thickness of the flexible body and crosswise of the width of said body, the receptacles being open at each end thereof outwardly through the two side edges of the flexible body defining its width, and the connector thereby being adapted to receive wires at each side edge, one wire into each end of each receptacle for electrical connection therewith, whereby each receptacle joins its respective pair of wires in coaxially spliced relation; and the electrical connecting receptacles having portions thereof exposed, adjacent their open ends, by cut-out means recessed into the body, whereby said exposed receptacle portions are accessible to and adapted to be acted upon by a crimping tool.

5. A device for splice connecting electrical conductor wires, comprising a body, which is wider than it is thick and having side edges, made of rubber-like flexible insulating material adapted for manipulation by hand for conforming it to irregular service shape, and a plurality of passages formed in parallel spaced relation within a common plane in the body of flexible material, the axes of the passages being disposed parallel with the surfaces defining the thickness of the body and crosswise of the width of said body, the passages being open at each end thereof outwardly through the two side edges of the body defining its width, the device being adapted thereby to receive electrical connecting members into the passages for connecting conductor wires in coaxially spliced relation received at both side edges of the body.

6. A device for splice connecting electrical conductor wires, comprising a body, which is wider than it is thick and having side edges, made of rubber-like flexible insulating material adapted to be hand shaped to irregular surfaces, and a plurality of passages formed in parallel spaced relation within a common plane in the body, the axes of the passages being disposed parallel with the surfaces defining the thickness of the body

and crosswise of the width of said body, the passages being open throughout their lengths and open at each end thereof outwardly through the two side edges of the body defining its width; in combination with terminal eye lugs in pairs disposed in coaxial relation with the passages, and screw means carried by the body and engaging the terminal eye lugs to electrically connect and secure them with said body.

7. A device for insulating and covering conductor wire terminal means which are connected in coaxial splicing relation, comprising a jacket-like body, which is wider than it is thick and having side edges, made of rubber-like flexible insulating material susceptible of being manipulated by hand to conform it to irregular service shape, and a plurality of passages formed in parallel spaced relation within a common plane in the flat body of flexible material adapted to receive the wire terminal means, the axes of the passages being disposed parallel with the surfaces defining the thickness of the body and crosswise of the width of said body, the passages being open throughout their lengths and open at each end thereof outwardly through the two side edges of the body defining its width, and apertures formed through the body coincident with passages.

8. A device for connecting electrical conductor wires, comprising a body, which is wider than it is thick and having side edges, made of rubber-like flexible insulating material adapted for manipulation by hand for conforming it to irregular service shape, and a plurality of passages provided in parallel spaced relation within a com-

mon plane in the flat body of flexible material, the axes of the passages being disposed parallel with the surfaces defining the thickness of the body and crosswise of the width of said body, the passages being open throughout their lengths and open at each end thereof outwardly through the two side edges of the body defining its width; in combination with conductor wire terminals, disposed in coaxial pairs within each passage, one terminal in each open end of the passage, and the two terminals having overlapping engagement with each other in the midportion of the passage.

9. A device for insulating and covering conductor wire terminal means which are connected in coaxial splicing relation, comprising a jacket-like body, which is wider than it is thick and having side edges, made of rubber-like flexible insulating material susceptible of being manipulated by hand to conform it to irregular service shape, and a plurality of passages formed in parallel spaced relation within a common plane in the flat body of flexible material adapted to receive the wire terminal means, the axes of the passages being disposed parallel with the surfaces defining the thickness of the body and crosswise of the width of said body, the passages being open throughout their lengths and open at each end thereof outwardly through the two side edges of the body defining its width; a groove being provided in one of the surfaces of the jacket-like body, extending longitudinally of said body, and in communication with the passages, adapted for the reception of a tap-off conductor.

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