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J. H. HUBER ET AL
ELECTRICAL CONNECTOR

3,201,743

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2 Sheets-Sheet 1

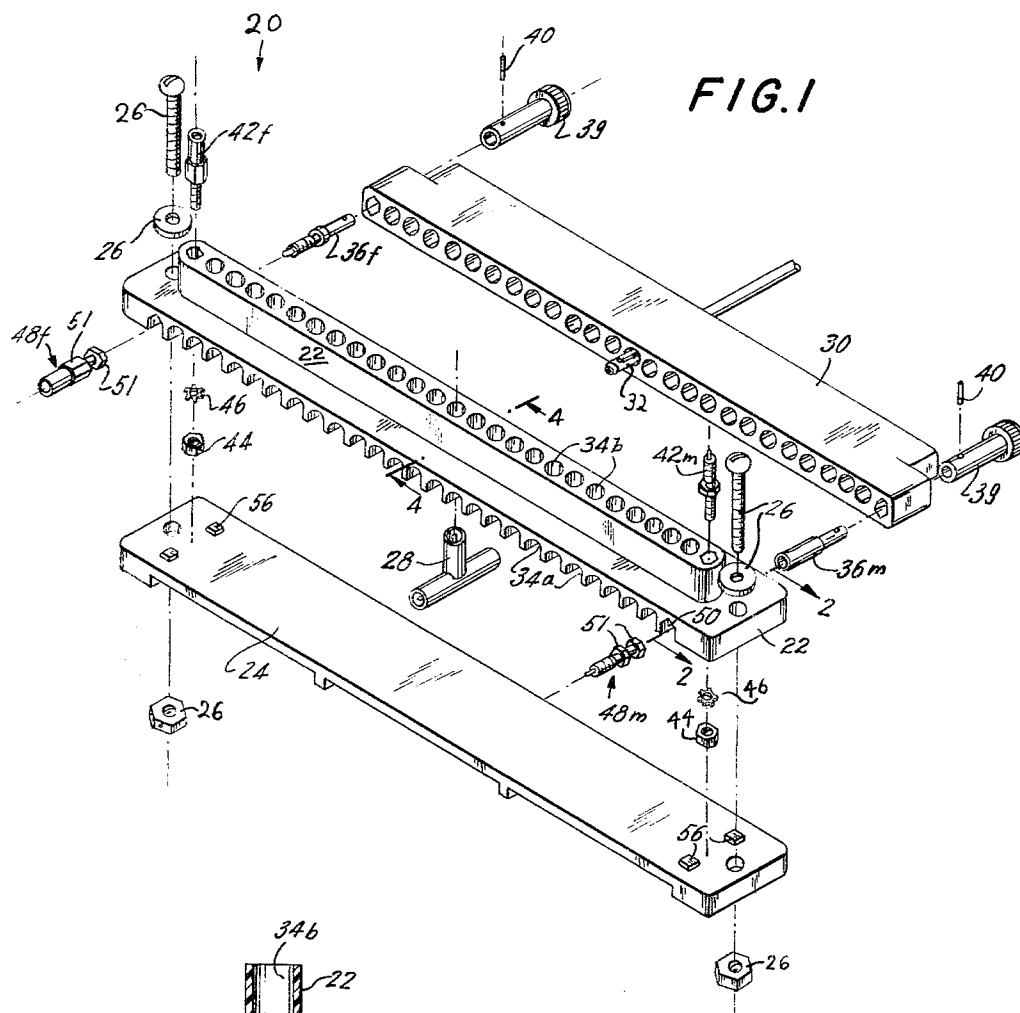


FIG. 1

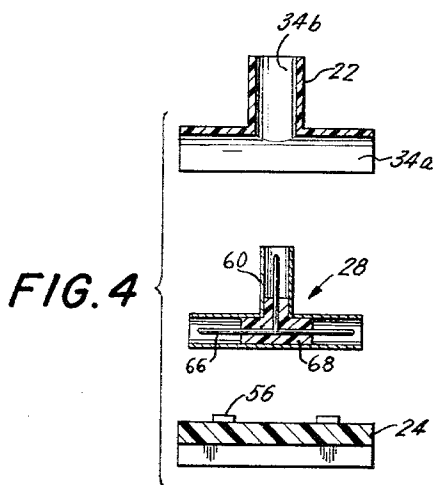


FIG. 4

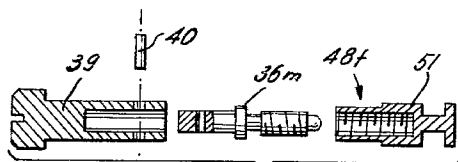


FIG. 3

INVENTORS
JOHN H. HUBER
WILLIAM L. SCHUMACHER
BY
Curtis, Morris & Safford
ATTORNEYS

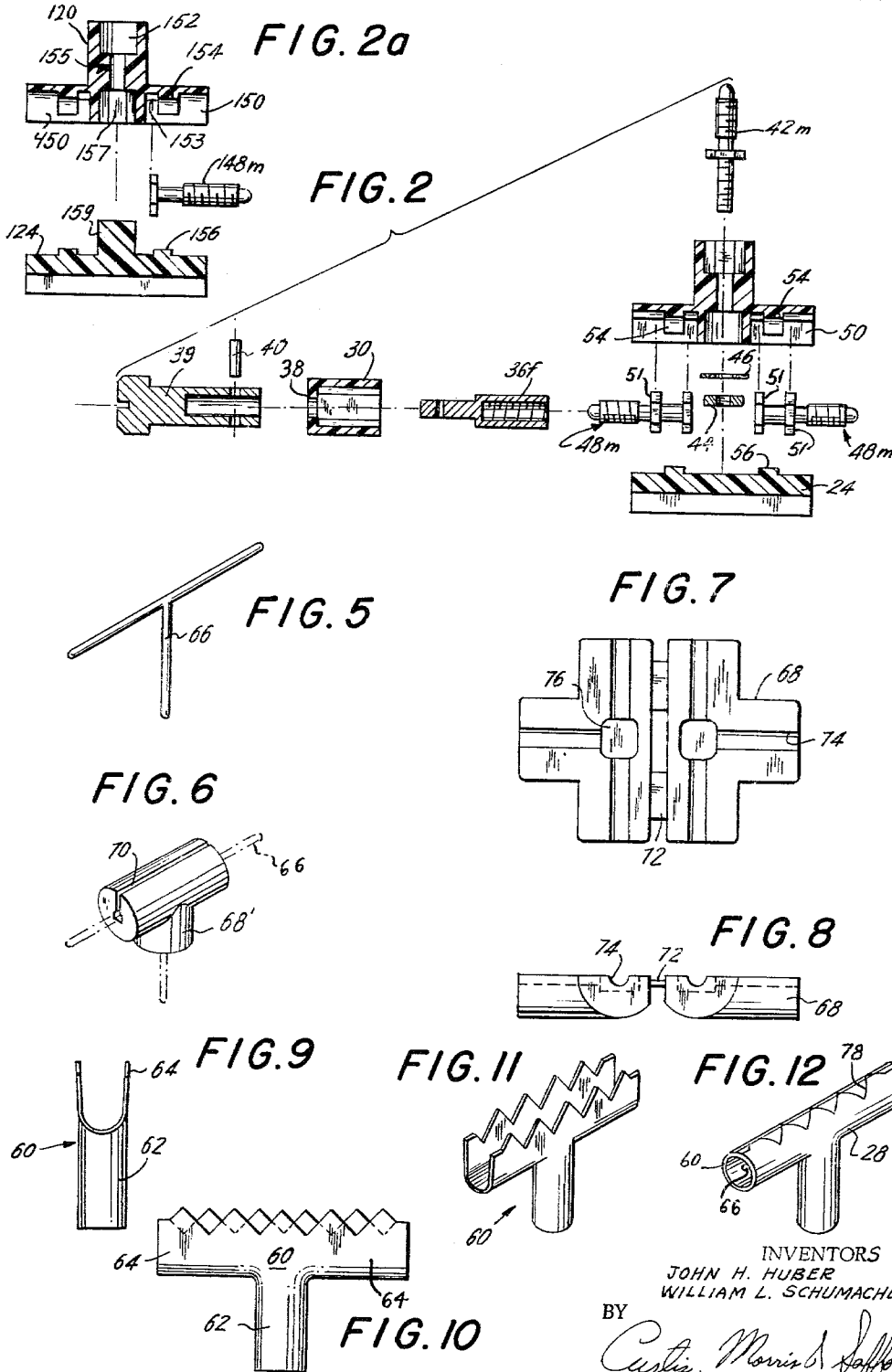
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WILLIAM L. SCHUMACHER
BY
Curtis, Morris & Safford
ATTORNEYS

1

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ELECTRICAL CONNECTOR

John H. Huber, Harrisburg, and William L. Schumacher, Camp Hill, Pa., assignors to AMP Incorporated, Harrisburg, Pa.

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The present invention relates to an electrical connector means. More particularly, it pertains to a "tap-off" coaxial connector block, means for coupling such blocks with at least one mating coaxial connector block, and a coaxial T-connector, and method for making same, for use with said block.

Forming coaxial "tap-off" connectors has always been a difficult and time consuming, and therefore expensive, procedure. A major problem arises because a T-shaped conductor pin must somehow be inserted into a completely enclosed T-shaped outer shell. The prior art generally employed some variation of the following method in making coaxial T-connectors. A piece of shielding material in cylindrical form would have a hole cut into one side and a matching piece of cylindrical tubing would be cut and placed perpendicularly over this hole and brazed to the first piece. Next a length of conductor wire would be cut to form a pin about the length of the first cylindrical piece. Then a branch piece of conductor wire would be cut and inserted through the branch portion of the shell and somehow joined inside the shell to the first main conductor pin. The real problem was how to join these two pins within the T-shaped coaxial shell. The problem of working in such a confined space became more and more acute as first miniature, and then sub-miniature, coaxial cable was introduced.

One method of forming the T-pin was to braze the branch pin to the main pin through the opening in the main cylinder before the branch cylinder was joined to the latter. As will be appreciated, it is very difficult to handle such small parts in these confined spaces, especially without damaging them during brazing, and consequently is a time consuming hand operation.

Another method of forming the T-pin was to have the main conductor pin fitted with a threaded receptacle into which the branch pin, with its end threaded, could be inserted. However, such specially machined parts are expensive, and being small remain difficult to assemble.

Somewhat similar problems are encountered in the coupling of T-connector blocks to three mating connector blocks (or a combination thereof). It is common practice to couple one connector block to another by having a jack screw mounted at either end of one block positioned to join to mating pack screws correspondingly mounted on the other block. One method of coupling T-connector blocks had been to make a double ended jack screw out of bar stock, and then drill a threaded hole transversely through the center of this double jack screw and screw a single jack screw (having a correspondingly threaded head) perpendicularly into the double jack screw, thereby forming a T-shaped triple jack screw. The expense of this and other coupling means for T-connector blocks have been an economic hindrance to wide commercial acceptance of T-connector blocks.

It is an object of this invention to overcome the many problems encountered by the prior art, by creating a "tap-off" coaxial connector, where not only the T-shaped conductor pin, but also the insulation therefor, may be performed outside of the shielding shell and thereafter inserted in such shell to give a superior coaxial T-connector more quickly and less expensively than had heretofore been

2

thought possible. It is a similar object to produce jack screw means as a coupling for T-connector blocks which are readily assembled into the T-connector blocks and are quickly and inexpensively made.

Other objects and attainments of the present invention will become apparent to those skilled in the art upon a reading of the following detailed description when taken in conjunction with the drawings in which there is shown and described preferred embodiments of the invention; it is to be understood, however, that these embodiments are not intended to be exhaustive nor limiting of the invention, but are given for purposes of illustration in order that others skilled in the art may more fully understand the invention and the principles thereof and the manner of applying it in practical use so that they may modify it in various forms, each as may be best suited to the conditions of a particular use.

In the drawings:

FIGURE 1 is an isometric exploded view of the preferred embodiment of our "tap-off" coaxial connector block, the coupling means for said block, and a mating plug connector block showing only one individual connector and one mating plug;

FIGURE 2 is an exploded transverse section, taken along line 2-2 in FIGURE 1, through the righthand jack screw housing of the connector block shown in FIGURE 1;

FIGURE 2A is a section similar to FIGURE 2 illustrating an alternative embodiment;

FIGURE 3 is a section of a female jack screw assembly which may be substituted for the male jack screws illustrated in FIGURE 2;

FIGURE 4 is an exploded transverse section, taken along line 4-4 in FIGURE 1, through a coaxial T-connector as oriented in its connector block;

FIGURE 5 is a perspective view of the assembled T-conductor pin for the T-shaped coaxial connector;

FIGURE 6 is an alternative embodiment of the dielectric spacer for said connector, illustrating in dotted outline how the T-shaped pin fits therein;

FIGURE 7 is a plan view of the preferred embodiment of the dielectric spacer for said connector shown prior to assembly;

FIGURE 8 is a side elevation of the spacer illustrated in FIGURE 7;

FIGURE 9 is an end elevation of the shielding shell of said connector prior to assembly.

FIGURE 10 is a side elevation of the shell illustrated in FIGURE 9;

FIGURE 11 is a perspective view of the shell illustrated in FIGURE 9; and,

FIGURE 12 is a perspective view of the completely assembled preferred embodiment of the coaxial T-connector.

The complete preferred embodiment of the present invention is illustrated in FIGURE 1. The T-shaped coaxial connector 20 is composed of the upper block housing 22 and the block base 24, which are joined by nuts, bolts, and washers 26. Block 20 is adapted to hold, in a regularly spaced relation, a plurality of "tap-off" (otherwise referred to as T) coaxial connectors 28, so that a mating coaxial connector block 30 having a similar number of correspondingly spaced plug coaxial connectors 32 may be coupled to block 20 to affect a simplified one-step multiple connection. As illustrated in FIGURE 1, there are twenty-five sets of T-shaped passages 34. Each is composed of a transverse passage 34a opening in from the bottom of said block housing 22 and of a vertical passage 34b which opens perpendicularly

from said transverse passage 34a up out through the top of block housing 22. Each of these passages 34 contain, slightly recessed therein, a coaxial T-connector 28 which is secured in place by block base 24.

The mating coaxial plug connector block 30 is coupled to the coaxial T-connector block 20 in part by two turnable jack screws 36 at either end of said block 30. As can thus be seen to the left of FIGURE 2 the female turnable jack screw 36f (or alternatively male turnable jack screw 36m, see FIGURE 3) is retained in block 30 by lip 38 which rides between the base portion of turnable jack screw 36 and the detachable head portion 38. The detachable head 39 is shown connected to the base of 36 by wedge pin 40.

FIGURE 2, together with FIGURE 3, best illustrates the preferred embodiment of our improved jack screw coupling means for connector blocks. A fixed jack screw 42m, with a hexagonal shaped ring and headed by a narrowed, threaded portion, is used for the vertical coupling of T-block 20 with a side block 30 and is secured into block housing 22 by nut 44 and lock washer 46. Improved fixed jack screw 48 is headed by two spaced polygonal rings 51, which also are shown in the preferred hexagonal shape. These improved jack screws 48 are cooperatively fixed in place by a respective jack screw housing 50 which opens in from the bottom of the block housing 22. This housing 50 grips its respective jack screw 48 by having at least two walls which flushly engage two respective polygonal sides of the jack screw rings 51. In the preferred embodiment shown in FIGURES 1 and 2 housing 50 has two vertical walls and two peak walls which are at an angle of 120° to each other thereby engaging four sides of the hexagonal rings 51. When the block base 24 is secured in position, jack screws 48 are permanently seated in their housings 50, thereby ensuring full flush engagement of the walls of the housing with the rings 51. Housing 50 further has a retaining ridge 54 for catching between the hexagonal rings 51 and securing the jack screw 48 against longitudinal movement of the screw 48 within housing 50. A supplementary ridge 56 is advantageously formed on the block base 24 to fit between the rings 51 of the jack screw 48 when the jack screw is in position and the base is mounted on the block housing 22.

This improved jack screw assembly has the great advantage of being very easily assembled and therefore labor saving. For example, jack screw 48 need only be dropped into housing 50 and the cover 24 secured in place to complete the assembly. Furthermore, jack screw 48 will always be well oriented with the housing 50 because the spaced relation of the rings 51 support the jack screw centered within the housing 50. Another decided advantage over the prior art which was made from bar stock, is that these improved jack screws 48 can be turned from readily available, inexpensive, hex stock with a minimum of special processing.

An alternative improved jack screw assembly is shown in FIGURE 2A, wherein similar elements are given the same reference numbers preceded by a one (1). This alternative embodiment has the advantage that the improved male jack screw 143m may be used in all three positions in the T-connector block 120. In this embodiment only slot 153 of jack screw housing 152 need have a partial hexagonal shape, or the like. The retaining ridge 154 may be slightly broadened in order to help center the jack screw 148m which no longer has the second ring 51 to serve that function. Vertical retaining ridge 155 must leave a large enough opening to permit passage of the shank of jack screw 148m. The vertical equivalent of slot 153 is the vertical polygonal, or here hexagonal, hole 157. Vertical positioning post 159 on base 124 fits up into hole 157 to seat jack screw 148m securely within its housing 152, with its hex head 151 held flat against the retaining ridge 155.

It should be noted that polarization of connector block with respect to the mating connector blocks 30 can be

achieved in several ways. For example, where two pairs of jack screws are used to join blocks 30 with a T-block 20, then polarization can be achieved by the use of all three combinations of male and female jack screws (i.e. by using two of one, two of the other, and one of each). Polarization can also be achieved by irregular spacing of the connectors themselves along the blocks, or by other well known means.

The coaxial T-connector shown in FIGURES 5 through 12 is particularly useful for making tap-offs (and right angle turns) for miniature and sub-miniature coaxial cables, particularly where crimping, threading, and other prior practices in forming the center pin for such a coaxial T-connector would be impractical. As will become readily apparent, the coaxial T-connector embodying this invention can be manufactured at a strikingly low cost over prior competitive connectors and with an extreme ease of assembly, which also contributes to its low cost.

The particular coaxial T-connector shown in FIGURES 5 to 12 provides a shielded jack connection adapted to receive plug coaxial connectors; for example, connector 32 shown in FIGURE 1. The shielding shell 60 of this connector 28 (see especially FIGURES 9, 10 and 11) is advantageously made in one piece, drawn from flat brass stock. The branch portion 62 of shell 60 may be drawn from the flat stock and then the main portion 64 is U'd up to the form shown in FIGURES 9, 10 and 11. The conductor pin 66 for this connector 28 is preformed in a T-shape by brazing together two pieces of wire; which is preferably half hard brass, very thinly plated with nickel and then with gold in order to insure excellent contact properties.

This pre-assembled T-connector pin 66 is then placed in a dielectric spacer 68', e.g. as indicated in FIGURE 6. This spacer 68' can advantageously be made of natural polypropylene, or if the conditions of use so require, may rather be made from more expensive temperature-resistant, Teflon (polytetrafluoroethylene). The spacer 68' shown in FIGURE 6 has a longitudinal slot along the main portion of the spacer, through to the central bore, thereby enabling the pin 66 to be inserted into the spacer 68'. This slot 70 is advantageously slightly smaller than the pin 66, thereby causing a snapping and closing action to retain the pin in said spacer. In the preferred embodiment (shown in FIGURES 7 and 8) spacer 68 is symmetrically divided into two T-shaped halves, between which the T-shaped connector pin is positioned prior to insertion into the shielding shell 60. This preferred embodiment has the advantage of completely surrounding the T-pin 66 by dielectric and not having an air slot 70. As can be seen, in the preferred embodiment the two halves are joined by hinges 72 to facilitate handling of this spacer 68. To accommodate these hinges 72, the top of the spacer 68 is slightly flattened from its cylindrical form. Also where the central bore 74 (which accommodates T-pin 66) joins in the center of the spacer 68, a rectangular cutout 76 serves to accommodate any additional bulk of the T-pin 66 which may result from the joiner of its two parts. The completed coaxial T-connector 28, shown in FIGURE 12, is finally formed by placing the T-pin of FIGURE 5 into the spacer 68, see FIGURE 7, closing the two halves of the spacer together, inserting it into the shell 60, see FIGURE 11, and forming the main portion 64 of the shell 60 over the spacer 68 to a cylindrical shape thereby drawing together the two longitudinal edges of the shell 60 into a seam 78. A tool with two co-acting semi-cylindrical dies can conveniently be employed to complete the assembly of the connector 28.

It can now be seen that having the shell 60 open along the top edge obviates the need of assembling the T-pin within the T-shell, a particularly tough job with miniature coaxial T-connectors. In an example of the relative size in which these connectors 28 can commonly be made, the main portion 64 of shell 60 is about one inch

5

long, pin 66 has about an 0.04 inch diameter, and branch 62 and main portion 64 of shell 60 have an inside diameter of about 0.175 inch.

This seam 78 is sawtooth, or undulating in order to minimize any radio frequency leakage from the seam. Advantageously the T-pin 66 terminates recessed within the shielding shell 60, thereby enabling the tapered nose of the coaxial plug connector 32 to enter properly within the shell 60 and become centered therein before engaging the T-pin, thereby avoiding damage to said pin.

Connector 28 might alternatively within the scope of this invention be made a plug rather than a jack coaxial T-connector.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective against the prior art.

We claim:

1. A "tap-off" coaxial connector block for gang coupling with three mating coaxial plug connector blocks, or any combination thereof, comprising a block housing having a plurality of spaced transverse passages opening in from the bottom of said block housing and corresponding vertical passages passing from said transverse passages up out through the top, a coaxial T-connector closely fitted within each set of passages, at least one additional vertical passage having a concentrically bored ridge therein, a jack screw seated in the additional vertical passage and secured therein to said ridge, at least one pair of jack screws headed by spaced hexagonal rings, at least one pair of transversely disposed jack screw housings opening in from the bottom of said block housing on either side of the additional vertical passage and shaped with two vertical walls and two peak walls, each of these four jack screw housing walls flushly engaging one respective side of the hexagonal rings of the jack screws seated therein and further having a retaining ridge fixed between said hexagonal rings, a block base mounted on the bottom of said block housing to secure said T-connectors in their spaced relation and said pair of jack screws within said block housing, said coaxial T-connectors each comprising a T-shaped conductor pin, a dielectric spacer insulatingly supporting and centering said pin while leaving the three pin ends exposed, a one-piece shielding shell having a cylindrical main portion with a cylindrical branch portion opening perpendicularly off the base of the main portion, said main shell portion having a closed seam longitudinally along the side opposite the branch portion through which said T-pin was introduced into said shell.

2. A coaxial connector comprising the combination of a one-piece shielding shell having a main tubular portion open along one side to give a substantially U-shape in cross-section and further having a branch portion of a closed tubular shape opening off from the base of the U-shaped main portion, a conductor having a branch portion joined thereto at the same angle that the branch portion of the shell makes with its main portion, a dielectric spacer adapted to receive said conductor and insulatingly support it centered within said shell, said shell being adapted to have the U-shaped main tubular portion formed over said spacer to a closed tubular shape after said conductor has been seated within the shell.

3. A coaxial "tap-off" connector comprising the combination of a one-piece shielding shell having a substantially semicylindrical main portion with a substantially U-shaped cross-section and further having a cylindrical branch portion opening perpendicularly off the base of the main portion, a T-shaped conductor pin, a dielectric spacer adapted to receive said conductor pin and

6

insulatingly support the pin centered within said shell and further recessed in said shell sufficiently to leave the three ends of the conductor pin exposed for contact with mating coaxial plug connectors, said shell being adapted to have the U-shaped main portion formed over said spacer after the latter has been seated within the shell to a cylindrical shape having substantially the radius of the branch portion.

4. A connector as described in claim 3 wherein the side edges of the U-shaped main portion of said shell form complementary saw-tooth edges which are adapted to mate and form a zig-zag seam when the main portion of said shell is formed over into a cylinder.

5. A connector as described in claim 3 wherein the side edges of the U-shaped main portion of said shell form complementary undulating edges which are adapted to mate and form an undulating seam when the main portion of said cylinder is formed over into a cylinder.

6. A connector as described in claim 4 wherein said spacer is formed of two symmetrical T-shaped halves thereby enabling the T-shaped conductor pin to be positioned therein prior to insertion of this subassembly into said shielding shell.

7. A connector as described in claim 6 wherein the halves of said spacer are hinged together and the ends of the T-pin terminate recessed within said shell whereby a mating tapered coaxial plug connector will be properly centered before engaging one end of the T-pin thereby avoiding damage to said pin.

8. A connector as described in claim 4 wherein said spacer has a T-shaped central bore for accommodating said conductor pin and further has a longitudinal slot along the main bore and opposite the branch bore to enable the T-pin to pass through this slot and be snapped into position within said spacer.

9. A conductor as described in claim 2 wherein said elements are assembled and said shell has been formed closed over said spacer.

10. A conductor as described in claim 3 wherein said elements are assembled and said shell has been formed closed over said spacer.

11. A conductor as described in claim 7 wherein said elements are assembled and said shell has been formed closed over said spacer.

12. The method of forming a coaxial "tap-off" connector comprising joining the branch conductor to the main conductor, forming a shielding shell with the main portion longitudinally open, introducing the joined conductor into said shell through said longitudinal-opening, centering said conductor within said shell and insulating it therefrom leaving the ends of said conductor unencumbered, and forming the longitudinal-opening closed, thereby effectively completing the shielding of the conductor.

13. In a T-connector block for gang coupling with three mating connector blocks, or any combination thereof, the coupling improvement which comprises three male jack screws, each having a polygonal shaped head, a vertical jack screw housing having a retaining and centering ridge with a concentric bore adapted to pass the shank of said jack screw therethrough and shaped flushly to engage at least two sides of the jack screw head when in position against the underside of said ridge, a pair of transversely disposed jack screw housings opening in from the bottom of said block on either side of said vertical housing shaped flushly to engage at least two sides of the jack screw head and further having a retaining ridge to center the jack screw and to secure its head against the end wall of said transverse housings, and a block base mounted on the bottom of said block housing and shaped to secure said jack screws up within their respective housings.

14. A coaxial connector comprising the combination of a one-piece shielding shell having a main portion adapted to be formed into a tube having a seam along

one side of the resulting tube and further having a branch portion of a closed tubular shape opening off from said main portion, a conductor having a branch portion joined thereto at the same angle that the branch portion of the shell makes with its main portion, a dielectric spacer adapted to receive said conductor and insulatingly support it centered within said shell, whereby said main tubular portion of said shell can be formed over said spacer to a closed tubular shape after said conductor, together with said spacer, has been properly seated within the shell.

5

10

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JOSEPH D. SEERS, *Primary Examiner.*