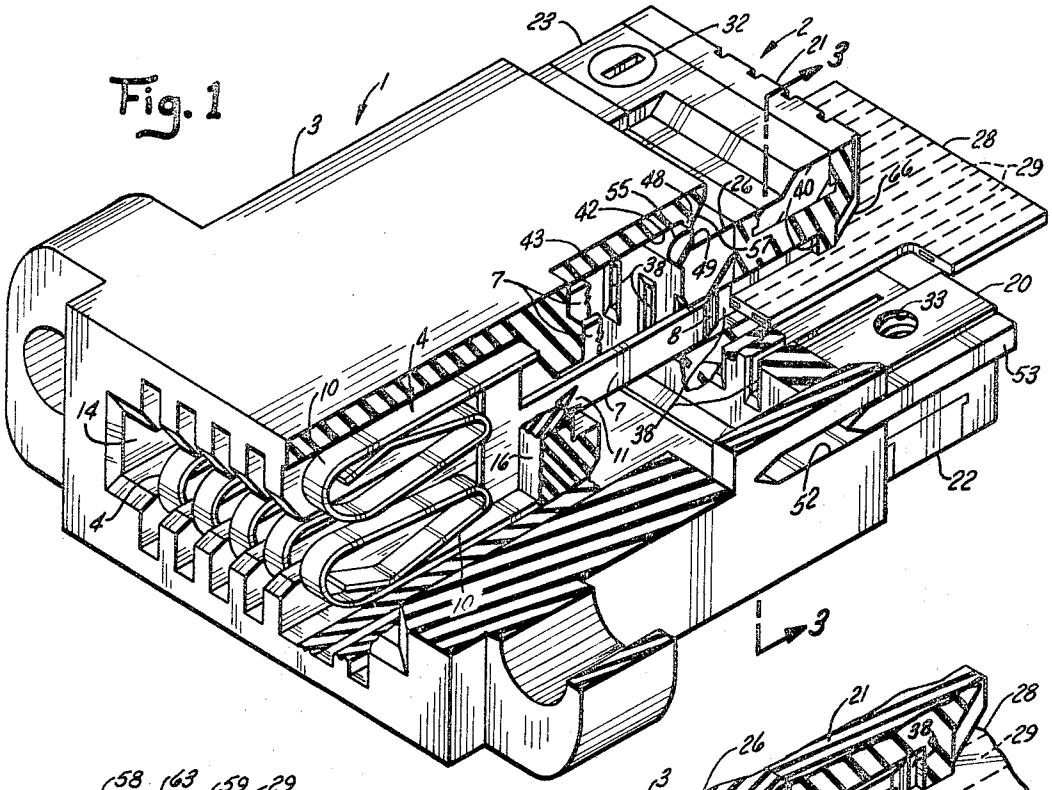
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ELECTRICAL CONNECTOR

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Fig. 1



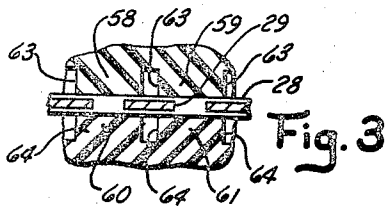


Fig. 3

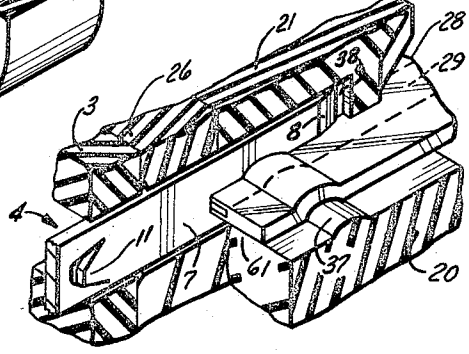


Fig. 4

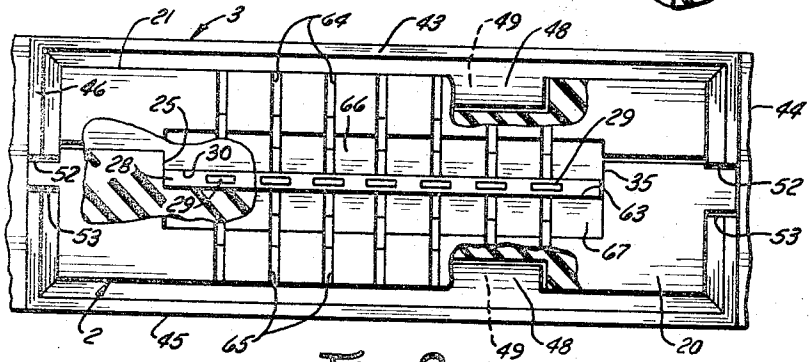


Fig. 2

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Fig. 5

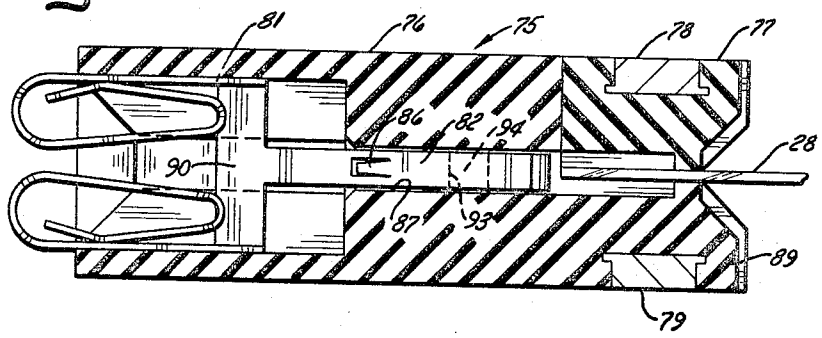


Fig. 6

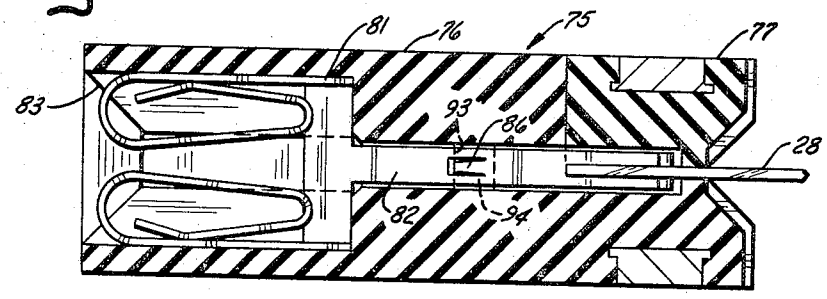
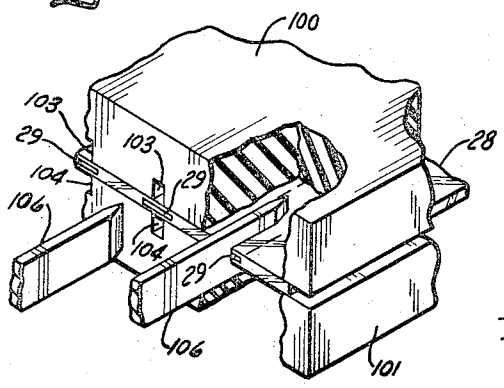


Fig. 7



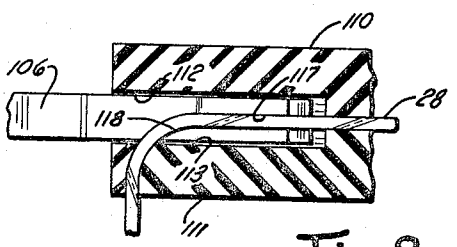


Fig. 8

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3,335,393

ELECTRICAL CONNECTOR

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Filed Dec. 16, 1964, Ser. No. 418,735
4 Claims. (Cl. 339—100)

This invention pertains to electrical connectors and is especially, though not exclusively, applicable to the making of electrical connections with the extremely thin and delicate flat electrical conductors or ribbon-like conductive strips of electrical cables known in the electrical field as tape cables.

Providing a satisfactory tape cable connector has, as it has turned out, presented a real problem to the industry over a long period of time, the solution proving to be quite illusive although in retrospect it appears to be most simple.

All of the previous efforts to make electrical connections with tape cables have required the stripping or removal of the encapsulating plastic insulation on one side of each of the conductive ribbons by mechanical scraping or by the application of heat or chemicals followed by mechanical pressure engagement of the contacts with said one sides of the ribbons, respectively, or of welding or soldering the contacts to said sides, respectively, for the electrical connections with the ribbons. Besides the complexity and expense involved, an unsatisfactory connection can easily and usually does result due to contamination of the joint by the plastic insulation in the welding method which includes going through the insulation on one side by the use of heat. Due to the wide manufacturing tolerances of the insulation and of the conductors in the direction through the side of a tape cable, the mechanical stripping of one side of such a cable, which is normally done by the use of an abrasive wheel, besides the expensive equipment and labor involved is extremely difficult and critical, requiring extreme care and accuracy to properly remove the insulation for the connection while yet not damage the extremely thin ribbon conductors, which are of only .002 of an inch thick and up some depending on the specific size to reduce the current carrying capacities thereof or even grinding entirely through the ribbons. Yet another method which involves scraping through the sides of the insulation by the contact means itself for the making of the electrical connections with the sides of the conductors, respectively, is quite complex and expensive and of questionable merit as compared to the present invention.

Until the present invention, use of the very desirable and eagerly awaited flat, tape cables has been held up or denied to the public because of the lack of a commercially satisfactory device for making connections with such cables.

It is accordingly a principal object of the invention to provide a device for the making of electrical connections with the extremely thin flat conductors of a thin flexible tape cable which device is commercially acceptable in contrast to the parade of prior unacceptable connectors for this purpose which lack of a suitable connector, in this area has actually been responsible for the desirable tape cable not being used to date. The invention is also applicable to insulated conductors or wires other than the above mentioned thin flat ones in tape cables and even to single insulated conductors or wires.

Another objective and due to marked success in this area, achievement of the invention which is most important and at least largely contributes to the truly remarkable response this connector, in one preferred form, has been receiving from the very outset throughout the country is the provision of a connector which is extremely simple in its vital operation while being most effective and completely dependable in operation. Most of the forms including the above indicated preferred form, which preferred form provides for individual insertion of blade contacts in the same manner as described in connection with the FIG. 7 form hereinafter are also most inexpensive to produce.

In the preferred general arrangements in the case of tape cables, for instance, into intersecting splitting engagement therewith the contacts are simple and effectively inserted through the uninsulated or bare ends or end surfaces of the conductors and along respectively short portions of the lengths of the conductors, respectively, while an unstripped end portion of the cable is retained or held by suitable means. Operations on single insulated conductors or wires can of course, be performed in the same manner by a single contact.

Other objects, advantages and features of the invention will appear in the course of reading in its various aspects and forms or variations and considering the following description in conjunction with the accompanying drawing in which:

FIG. 1 is an isometric view of one form of connector with a tape cable shown clamped therewithin and the connector shown in the extended condition, part of the connector and cable being shown broken away;

FIG. 2 is an end elevational view of the connector and clamped tape as seen from the right in FIG. 1 with portions being shown broken away;

FIG. 3 is a fragmentary cross sectional view taken on line 3—3 of FIG. 1 and in the direction of the arrows;

FIG. 4 is a fragmentary isometric view of a slightly modified form of the connector showing one of the contacts in engaged electrical making condition with one of the conductors of the tape cable, part of the connector and cable being shown broken away;

FIG. 5 is a longitudinal sectional view of another form of connector with a tape cable shown clamped therein and one of the contacts shown in a carried position within the body of the connector prior to the making of an electrical connection by the contact;

FIG. 6 is a view like FIG. 5 but showing the illustrated contact in the desired electrical engagement with one of the conductors (not shown) of the tape cable;

FIG. 7 is a fragmentary isometric view of a simple form of connector of the present invention broken away to show one of the contacts in the desired engagement with one of the conductors of the clamped tape cable and another contact ready to be inserted within the connector; and

FIG. 8 is a longitudinal sectional view of another form of connector of the invention showing a tape cable clamped therewithin and a contact in intersecting electrical engagement with one of the conductors (not shown) of the tape cable.

Referring to the drawing figures in detail and first to FIGS. 1 through 3 thereof, the connector therein depicted comprises a plug and a receptacle portion generally designated 1 and 2, respectively. The plug portion 1 consists of a body 3 of suitable electrically insulative plastic, for instance, and a plurality of one piece electrical contacts generally designated 4 mounted therein. Each contact 4 is provided with a forward, relatively thin blade portion 7 which is pointed at the end 8 by a bevel on each side thereof. The rear of each contact is provided with a pair of opposed, resilient loop formations 10 for resiliently receiving therebetween a printed circuit board (not shown) for electrical engagement with conductive strips thereon. Each contact 4 is locked in position by a resilient, struck out tab 11, the end thereof engaging a wall portion of the body 3 as shown in FIG. 1. The body 3 is, of course, provided with a cavity 14 of the proper forma-

tion to receive and laterally separate at the opposite sides thereof the rearward portions of the contacts, the cavity also providing for the insertion of a printed circuit board therewithin and between the portions **10** of the contacts. Each contact is prevented from moving forwardly in the body **3** by engagement with the wall portion **16** thereof, the contact passing then through a slot in this wall portion forwardly thereof.

The receptacle portion **2** of the connector comprises a main body portion **20** generally of L shape and a separate piece **21** formed to generally fill in the open corner of the L, together with the portion **20** forming the block-like receptacle **2**. Each of the parts **20** and **21**, except for imbedded metal reinforcing bars **22** and **23** extending across at the bottom and top, respectively, are made of the same insulative material as is the plug body **3**.

The body portion **20** is provided with a broad groove **25** (see FIG. 2) which extends from the rear of the body forwardly to the forward raised portion **26** thereof. The groove **25** is of such width as to relatively snugly receive a thin flat electrical cable **28** having a plurality of thin conductors **29** which cable is received within the groove **25** all the way up to the forward portion **26** of the body part **20**. The spaced, parallel conductors **29** of the cable are imbedded in severable, electrically insulative plastic, for instance, having some degree of resiliency and preferably clear in color so that the conductors can be seen therewithin. It is pointed out that the conductors are extremely thin, being of only 2 thousandths of an inch and up some in thickness while being of only 25 thousandths of an inch and up some in width deepnding on the specific size of tape cable used. The whole cable **28** is also very thin being from about 6 thousandths of an inch thick up some.

When the cable **28** is received within the groove **25** as above indicated, the body portion **21**, which is preferably loosely connected to the portion **20** by means of a pair of screws **32** (only one of which is shown) received within a pair of threaded openings **33** (only one of which is shown) passing through the portions **20** and **21**, is brought down securely against the cable **28** by the turning of the screws **32** to securely clamp the cable **28** within the receptacle portion **2** of the connector. It should be observed from FIG. 2 that the body portion **21** has a central, broad, downwardly extending portion **36** which extends from the rear of the portion **21** to its forward limits and which is relatively snugly receivable, transversely speaking, within the recess **25** in the body portion **20**, this lower extension **35** being the portion which actually engages the upper surface of the cable **28** during the clamping of the cable. The surfaces of the body portions **20** and **21** which engage the lower and upper faces of the cable **28**, respectively, may be roughened in any suitable manner to assist in retaining the cable in position during the making of electrical connections to be described below. FIG. 4 shows a variation in which an upwardly projecting ridge or formation **37** is provided in the body portion **20** extending across the recess **25** therein over which the tape cable **28** passes for anchoring the tape cable in position in lieu of or in addition to the roughening above mentioned. The upper body portion **21**, of course, has a curved recess extending thereacross for receiving the tape cable and projecting formation **37** when the cable is clamped within the receptacle portion **2** of the connector.

The forward portion **26** of the body portion **20** is provided with a plurality of parallel, longitudinally extending slots **38** one for each of the contacts **4** which slots extend from the front face of the portion **26** to the rear thereof and which slots are coextensive in height and are in horizontal alignment with each other. These slots **38** continue rearwardly through the upper body portion **21** and rearward lower part of the portion **20**, when the parts **20** and **21** are in the assembled relation shown with the tape cable **28** clamped therebetween, to a rearward location **40**. Actually, of course, there is a groove in the body portion **20** and one in the portion **21** for each of the slots **38** in the forward portion **26** of the part **20** which are in registry or alignment with each other to form a two part extension of the slot **38** in the forward portion **26**. The width of each slot **38** is approximately that of one of the thin, flat blade portions **7** of the contacts with at most very little clearance between one of said blade portions and the opposite walls of the slots receiving such blade portion when such portion is within the slot. This is the preferred arrangement although a looser arrangement may be had and still provide electrical engagement with the conductors **29**. The slots **38** are of somewhat greater height than that of the blade portions **7** of the contacts.

It is important to point out that the slots **38** are located so that the blade portions **7** of the contacts will substantially bisect the conductors **29** of the tape cable **28** over or along portions of the lengths thereof when such blade portions are moved forwardly into intersecting engagement with the conductors, respectively, as generally disclosed in FIG. 4. The slots **38** together with their received blade portions **7** are also so located relative to the clamped tape cable **28** that about as much of the blades **7** extend above such cable as extend below the same when the blades are in the electrical making engagements with the conductors represented by FIG. 4.

The sharp fronts **8** of the blade portions **7** of the contacts are caused to penetrate the bare ends of the conductors **29**, respectively, and subsequently longitudinally divide or split the end portions of the conductors into two substantially equal halves each by causing the plug and receptacle portions **3** and **2** to be brought fully together. It should be noted in this connection that the plug portion **3** is of somewhat greater height and width than the receptacle portion **2**, receiving a portion of the same within the hollow interior front portion formed by the forward projecting wall portions **43**, **44**, **45** and **46** in telescopic fashion therewithin.

The upper and lower wall portions **43** and **45** are provided with a pair of downwardly and upwardly extending portions **48**, respectively, which are engageable with a pair of surfaces **49** of the body portion **20** to prevent withdrawal of the plug and socket portions **3** and **2** from each other. In the condition of maximum separation of the plug and socket portions shown in FIG. 1, the end portions of the blades **7** are received or remain within their respective slots **38** of the socket **2** ready to be inserted within the respective conductors **29** of the tape cable **28** upon the moving of the plug and socket portions fully together without the need of the blades **7** being simultaneously inserted within the recesses **38** with certain attendant difficulties into which it will not be gone. Each of the sidewall portions **44** and **46** is provided with a longitudinally extending slot **52** from the front thereof for snug reception therewithin of a pair of longitudinally extending projecting portions **53** of the body portion **20** for guidance purposes of the plug portion **3** during movement of the portions **2** and **3** together. Guidance, of course, is further divided by the upper and lower wall portions **43** and **45** riding along the upper and lower laterally extending portions **55** (only the upper one being clearly shown).

During the initial assembly of the plug and receptacle parts **3** and **2** together, the beveled cam surfaces **57** of the wall portions **43** and **45** of the plug part **3** first, respectively, on the curved surfaces of the portions **55** to cause an outward flexure of the forwardly extending wall portions **43** and **45** by virtue of the existence of the slots **52** on the opposite sides of the plug part **3** and the resiliency of the material itself, the projections **48** subsequently springing into the interlocked relation shown in FIG. 1. When the plug and sockets portions **3** and **2** are brought fully together to bring the contact blade portions **7** into the final, intended electrical engagement with the conductors **29**, respectively, shown in FIG. 4

(forgetting the slight modification thereof), there is a resilient gripping of the opposite sides of each contact blade 7 which not only establishes and maintains intimate electrical engagement between the contact and conductor but provides sufficient gripping of the blade to prevent, especially when taken with the gripping of the other blades, movement of the plug and socket parts 3 and 2 in a direction away from each other and the blades 7 out of engagement with the conductors without the exertion of a substantial amount of separating force. A lock is not therefore, generally necessary unless a great amount of pull is expected.

FIG. 3 shows the relation of a pair of upper and a pair of lower spaced apart portions 58 and 59 and 60 and 61, respectively, of the body parts 21 and 20 respectively, which portions form the upper and lower spaces or slots 63 and 64, respectively, together forming the extending portion of one of the slots 38 which slot portions 63 and 64 are in vertical alignment with each other as can be seen. The portions 58 through 61 engage the opposite sides of the tape cable 28 and the like spaced apart portions on each side of those shown in FIG. 4 also engage the opposite sides of the tape cable 28, their total engagement providing the major portion of the clamping of said tape cable. A certain amount of clamping is also provided by the parts of the body portions 20 and 21 rearwardly of the wall portions 40 (only one being shown) defining the rear ends of the slots 38.

It can thus be seen that the end portion of the tape cable 28 is completely engaged along its entire opposite sides except where the slots 63 and 64 and like slots are present. This confinement of the tape cable in its clamped condition together with the snug or close fitting relation between the blade portions 7 of the contacts and the opposite walls of all the slots 63 and 64 build up a certain pressure within the tape cable upon the insertion of the blades 7 within their pairs of slots which is not relieved very extensively because of such close relations between the blades 7 and the sides of the slots, thus to provide a very substantial pressure on each side of each of the blades 7 by the divided halves of the engaged conductor for the establishment of the good electrical engagement desired. Should the conductor halves together with the insulation above and below the same be allowed to plastic flow freely within much larger spaces between the contact blades and the sides of the slots not as good electrical engagement will be had. It should not be inferred, however, that no generally satisfactory electrical engagements will be had with the divided halves of the conductors should the spaces be greater than those indicated in connection with FIG. 1 or even should there be no proximity with the blades on each side thereof by the clamping portions of the body parts 20 and 21.

It is also definitely preferred that the aligned slot portions 63 and 64 and the blade portions 7 received therewithin be at right angles to the central horizontal plane of the clamped end portion of the tape cable 28 inasmuch as the splitting or dividing forces on the conductors are in the direction of their widths and thus provide for more uniformity of plastic flow under the pressures encountered and more effective use of the forces than would otherwise be the case should the blades intersect the conductors at very much of an angle. However, as long as little clearance is permitted between the blade portions 7 of the contacts and the sidewalls of the slots, quite good electrical engagements will be had even though the blade portions 7 intersect the conductors at substantial angles because of the establishment of relatively high pressures which cannot be very greatly relieved by plastic flow into the restricted space available.

It is also most important to point out that the blades 7 of the contacts not only pass through the bare ends of the conductors 29 of the tape cable 28 rather than through the sides of the cable with the accompanying drawing in of insulation between the contacts and conductors but

the blades 7 also move through the conductors to the extents of their penetrations thereof in the directions of or parallel to the lengths of the conductors completely free and clean of any interposed insulation which would reduce the effectiveness of the electrical engagements or even render them unsatisfactory or nonexistent. This movement along or, more precisely, longitudinally through the conductors from the bare uninsulated end of the unstripped tape cable without the involvement of any insulation whatsoever between the engaging metal parts forming the electrical connections constitutes one of the principle features or aspects of this invention. In the case of the FIG. 1 form, the entire engagements between the blades 7 and the respective conductors are along or longitudinally through the respective conductors. In the case of the FIG. 4 form there is movement of each contact blade longitudinal through the end part 60 of the engaged conductor 29 and as well longitudinally through a rearward portion 61 of such conductor for good electrical engagement with such portions.

It can also be appreciated and it is likewise important to point out that the splitting or intersecting engagements of the blades 7 with the end portions of the conductors, respectively, continuous engagements along both sides of the blade portions 7 to the full extents of the penetrations of the conductors by the blades 7 to exactly double the amount of electrical engagement with the conductors that would otherwise be possible without such engagement thus to markedly increase the efficiency of the electrical connection with the conductors. This engagement, of course, can reduce in half the amount of movement or penetration of the contact blades 7 within the ends of the conductors to greatly reduce the size of the connectors.

Should it be desired to remove the connector from the tape cable 28 for any reason as to apply the connector to another tape cable elsewhere or perhaps to the same cable shortened by cutting off a portion thereof, the plug portion 3 of the connector is merely pulled to the left as seen in FIG. 1 as far as it will go relative to the receptacle part 2, that is, until the inwardly projecting portions 48 of the plug part engage the wall portions 49 of the receptacle part, and the entire connector merely slipped out from the end of the tape cable after loosening the pair of screws 32 to some extent. The connector parts 2 and 3 are merely brought together again upon the insertion of the same or a different tape cable within the slot 63, formed by or existent between the portions 20 and 21 of the receptacle part 2, as far as the cable will go and after tightening the screws 32 to establish electrical engagement with the conductors of the tape cable in the manner above covered.

It should, of course, be appreciated that the inwardly extending portions 48 of the upper and lower wall portions 43 and 45 may be eliminated in which case the plug and receptacle parts 3 and 2 would not be an assembled unit both when in and out of the electrical connection making condition thereof but these parts would remain two separate pieces which would be brought together from remote or relatively far removed locations into the condition indicated in FIG. 4 after a person first causing the ends of the blades 7 of the contacts to enter the open ends of the respective slots 38 with the help of the chamfered outer limits of the slots, the pointed nature of the ends 8 of the blades 7 and alignment or guidance provided by the projecting portions 53 riding within the slots 52 and the extending wall portions 43 through 46 which snugly receive the outer side surfaces of the receptacle 2. This manner of operation is also actually present in the FIG. 1 form when the plug portion 3 is initially moved forwardly on the receptacle part 2, with the tape cable 28 in its clamped position within the latter, as far as it will go even after the interlocking between the extending portions 48 and 55 occurs.

Vertically extending, parallel pairs of vertically aligned notches **64** and **65** are also provided in the rear faces of the body portions **20** and **21** to help a person laterally position the tape cable within the slot **63** where or should there be substantial lateral looseness of the cable within said slot so as to assure himself that the blade portions **7** of the contacts will move through the approximate centers of the conductors **29** during the bringing together of the connector parts **2** and **3** inasmuch as the pairs of notches **64** and **65** are equal in number to and in longitudinal alignment with the slots **28**, respectively. The chamfers or bevels **66** and **67** in the back faces of the portions **20** and **21** assist the introduction of the tape cable **28** within the slot **63**. The pairs of notches **64** and **65** are, of course, very important where there is substantial side play or lateral looseness between the slot **63** and tape cable **28** or in tape cable constructions in which the width of the slot is not close to that of the tape cable although in the FIGS. 1 through 3 form it is sought to automatically establish a predetermined position of the tape cable **28** within the receptacle part **2** by mere insertion of the cable within the slot **63** all the way and tightening of the screws **32** for the subsequent proper engagement of the blades **7** with the conductors by virtue of a snug lateral reception of the tape cable within the slot **63** as well as the cable being within the slot to its full longitudinal extent.

FIGS. 5 and 6 disclose another form of connector within the purview of the invention in which there is no plug and socket portion such as **2** and **3** of the first form but a single two-piece body member **75** receiving and housing the contacts **81**. The member **75** comprises two parts **76** and **77** constructed of the same kind of insulative material as indicated in connection with the first form except for the metal reinforcing elements **78** and **79** which are similar to **22** and **23** of the previous form. The parts **76** and **77** fit together to form a block-like member which is essentially the same as the receptacle part **2** of the previous form except that the part **76** extends forwardly to house substantially all of each of the contacts **81** (only one of which is shown) which contacts are substantially the same as the contacts **4** of the first form except for the lengths of the blade parts **82**. In the electrical engaging condition of the connector, shown in FIG. 6, the contacts are, of course, entirely received within the body member **75** ready for insertion of a printed circuit board within the cavity **83**, which is comparable to the cavity **14** of the first form, and between the opposite resilient loop portions of the contact as previously covered in connection with the first form. The present form of connector can be shipped and/or stored with the body member **75** and the contacts completely separate or the contacts may be placed in the position shown in FIG. 5 for shipping and/or when in storage. The outwardly struck resilient tabs **86** of the contacts create a certain amount of resistance against sidewall portions of the slots **87**, respectively, which slots are comparable to the slots **38** in the first form, to more or less retain the contacts in the position shown in FIG. 5 even during shipment or storage.

When it is desired to make the electrical connections with the tape cable **28**, the cable is placed fully within the slot between the lower part **89** of the portion **76** and the upper portion **77**, which slot is identical to the slot **63** of the first form, and the portions **77** and **89** are clamped together by use of a pair of screws (not shown). The contacts **81** are thereupon caused to be moved forwardly one at a time or individually by inserting a proper tool between the loop portions of the rear part of each contact applying forward pressure against the cross portion **90** of the contact until the blade portion **82** of the contact intersects the flat conductors (not shown) that it is intended to engage of the tape cable **28** exactly in the same manner as indicated in connection with the first form and as represented in FIG. 6. In this conductor engaging condition, the spring tab **86** has sprung behind a vertical, laterally extending wall portion **93** of a recess **94** in the side of the slot **87** to lock the contact in the position shown in FIG. 6. If desired, all of the contacts **81** may be moved into electrical engagement with the conductors of the tape cable simultaneously by the insertion of the printed circuit board to which electrical connection is also being made. However, the force necessary for the insertion of the contacts can be very greatly reduced by pushing the same forwardly one at a time for their cutting and bisecting of the individual conductor.

FIG. 7 illustrates a still simpler form of the invention in which an upper and a lower block portion **100** and **101**, respectively, of suitable electrically insulative material and reinforced with metal bars (not shown) if desired, are brought together into clamping relation with a tape cable **28**, which has been inserted therebetween so that the end surface thereof is approximately flush with the front faces of the blocks, as by means of a pair of screws (not shown). The blocks **100** and **101** are provided with vertically aligned grooves **103**, **104**, which are equivalent to the rearward extensions of the slots **38** of the first form, which grooves may extend all the way through the blocks or only sufficiently for the desired amount of insertion of the contact blade portions **106** which bear the same relation with the slots or, more correctly, with the wall portions thereof, as indicated in connection with the first form. The movement of the blade portions **106** within the slots and along or longitudinally through the conductors into the desired final electrical engagement with the same and the relation between the blades and the sides of the slots is exactly the same as indicated in connection with the first form.

Although no slot such as **63** of the first form is provided in this form for the placement of the tape cable **28** between the blocks, the cable may be visually placed in a predetermined position, laterally as well as longitudinally, between the blocks **100** and **101** by observing that the pairs of aligned slots **103** and **104** fall in the mid parts, laterally speaking, of the respective conductors **29** by viewing the front faces of the blocks and interposed tape cable and also seeing that the longitudinal edges of the cable are normal to the front faces of said blocks. The tape cable **28** may also, if desired, be placed between the blocks so as to extend at least a certain amount forwardly thereof for assistance in lining up the conductors **29** with the pairs of slots **103** and **104** prior to clamping the tape cable between said blocks. The blocks **100** and **101** may also be constructed of transparent material for assisting in the proper placement of the tape cable therebetween.

Although it is definitely desired that the contact blades go through the bare ends of the conductors **29**, as previously described and as illustrated, should the tape cable **28** be turned under at the end or brought back a certain distance from the end to produce a doubled back or double thickness end portion, rather than having bare conductors at the end of the tape cable, and the same be clamped within the receptacle **2** of the first form or the body **75** of the FIG. 5 form respectively or between the blocks **100** and **101** of the FIG. 7 form, the contact blades will still cut into the conductors, respectively, in the same manner as previously indicated except that the blades will first go through a few thousandths of an inch of insulation where the cable has been bent around and back and also cut through or intersect conductor portions around the bend.

Although a certain interposition of insulative material may occur at the very front of each blade intersection of its conductor, the movement of such contact blade longitudinally through the conductor therebehind with no involvement of any more insulation will allow the opposite sides of the contact blades to engage cleanly with the conductor completely free of any interposed insulation back from said front of the blade intersection of the conductors. It is therefore intended, so as not to permit circumvention of certain of the claims at least of this patent,

that any recitation in the claims of "an end portion of an insulated conductor" or "wire" is intended to include such doubled back end as well as a single end as earlier disclosed, the fundamental feature of the invention in its preferred forms being, where such doubled end is brought into the picture, contact movement substantially or approximately along or longitudinally through the conductors over a substantial distance thereof. Such recitation in any of the claims as "the end of the end portion of the insulated conductor" or "wire," but not recitation of the "end surface of the conductor" or "wire" is intended to refer to a cut off end of the insulated conductor or wire in the case of a single end thereof and to the place of bending back of the insulated conductor or wire in the case of the bent or doubled back end thereof.

It is not desired to limit the appended claims necessarily to strict or nearly strict movement of a contact along or longitudinally through a conductor inasmuch as a certain leeway or tolerance is desired to also prevent circumvention of at least certain of the claims. Also, certain connector constructions could be had in which a certain slicing action or an upward or downward component, as viewed in the drawing figures rather than in an absolute sense, of the movement of the particular contact or contact means may be employed to assist in cutting into an insulated conductor or cable especially where the insulation if not the conductor also is very rough and difficult to part and as long as the upward or downward component is not too extreme, at least a fair electrical engagement may still be had with the conductor or conductors or the like.

Although movement of the contact blades through the ends of the conductors or wires, whether single as disclosed in FIGS. 1 through 7 or through a doubled back end portion, as above mentioned has been described up to this point, it is not desired to necessarily restrict the invention to such movement through the ends inasmuch as contact engagement may also be had with conductors or wires at points remote or removed from the ends thereof so long as, in the preferred arrangements, there is movement of the contact blades or means along or longitudinally through the conductors a substantial or a good distance therealong to provide for the clearing or running out of any insulation that might become interposed between the contact blades and opposite halves of the split conductor parts for a good electrical engagement with the latter.

Such an example is shown in FIG. 8 wherein an upper and lower body portion **110** and **111**, respectively, of the same insulative material as that of parts **1** and **2** of the first form, for example, and between which the tape cable **28** is placed in the same general manner as it was in the case of the FIG. 7 form, that is with the longitudinal center lines of the conductors lined up with the laterally spaced parallel pairs of vertically aligned slots **112** and **113**, respectively, but with the tape cable curving with the curved portions of the parting surfaces **117** and **118** of the portions **110** and **111** near the front thereof down and out of the connector at the bottom thereof rather than being cut off, securely clamp the tape cable therebetween by means of a pair of screws (not shown). It can, of course, be seen that the parting surfaces of the portions **110** and **111** clamp the cable **28** flat behind the curved forward portions thereof for movement of the contact blades **106** longitudinally through such flat portions and into good electrical engagement with at least most of the length of such portions. Similar to the case where the end of the tape cable was doubled back, mentioned earlier in this specification, clearing or running out of any interposed insulation will occur at the front part of the flat part of the clamped cable to in no way interfere with the electrical engagement therebehind. The same closeness preferable, though not necessarily, exists between the contact blades **106** and side walls of the slots **112** and **113** as it does in the case of the FIG. 1–3 form, for example, as previously covered.

In constructions where the the conductors or wires are engaged at removed or remote locations from the ends thereof, it is also not desired to necessarily limit the invention and at least certain of the claims thereof to movement of the contact means to exactly or nearly exactly longitudinally through the straight portions or wires inasmuch as this movement may be off somewhat, having some upward or downward component (as viewed in the drawing, not absolutely). In fact, a certain sliving effect might be desired in some circumstances to assist the contact means to move into engagement with the conductors so long as there is very substantial movement of the contacts longitudinally through the conductors and the contact means themselves preferably do not move at too much of an angle relative to the conductor wires so as to establish at least relatively satisfactory electrical engagement with the same.

Although the electrical connections have been described as being made with very thin, flat electrical conductors or wires arranged in a flat tape cable, it is desired not to necessarily limit the application of the invention to such cables or insulated conductors. For instance, round wires or perhaps elongated or oval shaped wires may be imbedded in insulation to form at least a generally flat cable with the opposite sides thereof being either flat and parallel or even wavy or of a generally sign curve formation, in the latter instance the cable being thinner between the conductors. The latter wavy form of cable could just as well be clamped between similarly shaped clamping surfaces and electrical engagement be made with the conductors or wires through the ends thereof by the thin contact blades, if this arrangement should be desired. Also, of course, engagement need not necessarily be made with the conductors or wires of a flat or generally flat cable but a single contact blade or means may be inserted through the end or mid-part, for instance, of a single insulated conductor or wire with a flat conductor or wire or one that is of another shape including even round, if desired.

As previously indicated, use of the expression "the end of the end portion of the insulated wire" or "conductor" in any of the appended claims is intended to refer to the end limit of the clamped or held end portion of the insulated wire or conductor whether in the single form, shown in FIGS. 1–7 of the drawing, or in the double back form, previously mentioned, rather than to the actual bare end of the wire or conductor which is no longer at the end of the clamped or held end portion but removed therefrom and not serving as an end of the end portion of the wire or conductor to be entered by a contact blade or means.

While certain illustrative forms of the invention have been depicted in the drawing figures and described above, it is not desired to limit the invention to these forms inasmuch as yet other variations and forms can be had and are in fact had in mind within the purview of the invention. The appended claims, therefore, should be limited only by their own terms construed in the broad overall light of the invention in its various concepts and aspects.

What is claimed is:

1. An electrical connector comprising an insulating body portion having contact-receiving openings at one end, contacts seated within said openings in fastened assembly with said insulating block, each of said contacts providing a terminal element having a cutting free end, a cable holding portion at the opposite end of said connector, said holding portion being formed of insulating material and having openings in the form of extensions of said contact-receiving openings, said holding portion having a slot for receiving an edge portion of a strip of conductor cable, each of said extensions of said contact receiving openings intersecting said slot, a flat conductor cable having an edge portion disposed within said

slot, said cable comprising thin flat metal conductors imbedded in a ribbon of insulating material, said conductors extending longitudinally of said cable and being separated from each other by said ribbon of insulating material, said contact-receiving openings and said extensions thereof being disposed in a direction generally parallel to the longitudinal axis of said conductor cable, said terminals of said contacts extending into said slot and having their major dimensions perpendicular to said edge portion of said conductor cable and said cutting free ends thereof being in cutting engagement with said metal conductors of said cable longitudinally of said cable and through the insulating material thereof so as to engage electrically said conductors.

2. The connector of claim 1 in which said holding portion has elements clamping opposed flat surfaces of said cable during cutting engagement of said terminals with said cable conductors.

3. The connector of claim 1 in which said holding portion and said body portion have elements in interengagement for securing said portions in assembly.

4. The connector of claim 1 in which said conductor cable is disposed within said slot a relative distance with respect to the dimensions of said contact-receiving openings and said contacts to permit said cutting ends of said terminals of said contacts enter cutting engagement with said metal conductors of said cable prior to final fastened seating of said contacts in said contact-receiving openings.

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