July 6, 1965 C. W. DANIELS 3,193,636

ROTATABLE MULTIPLE-LEAD ELECTRICAL CONNECTOR

Filed Nov. 7, 1962 3 Sheets-Sheet 1

FIG. 1

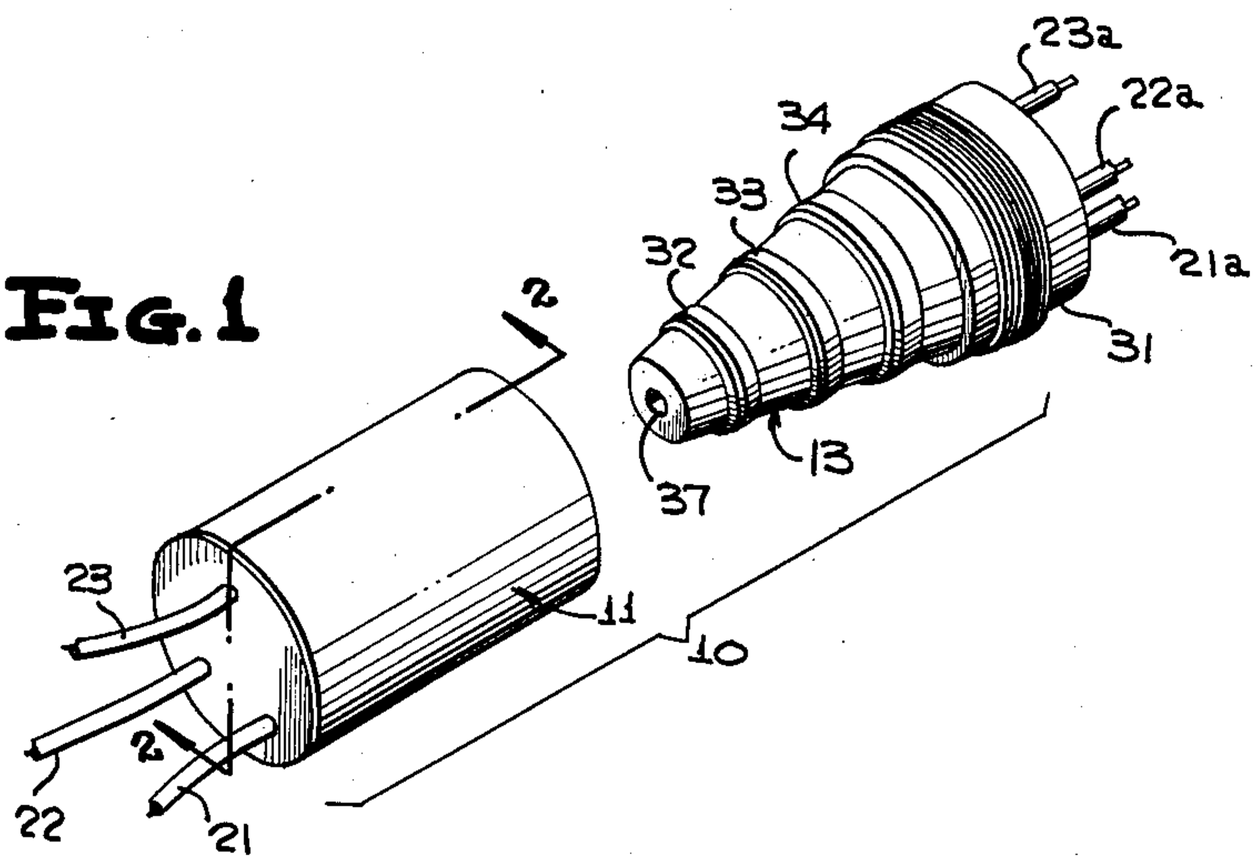


FIG. 2

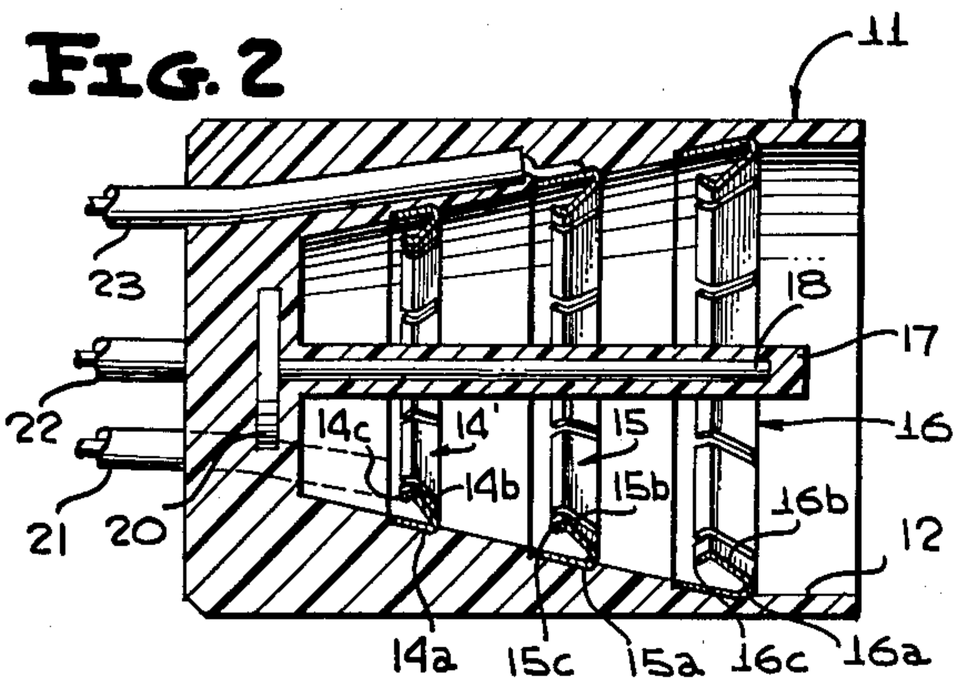
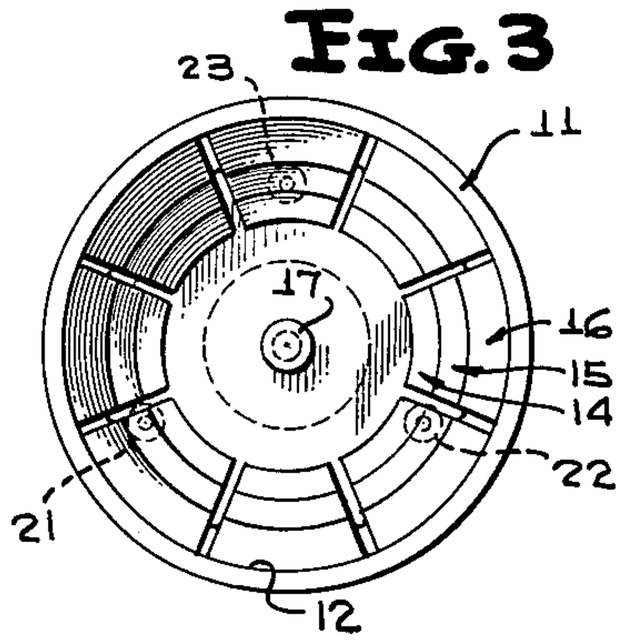


FIG. 3



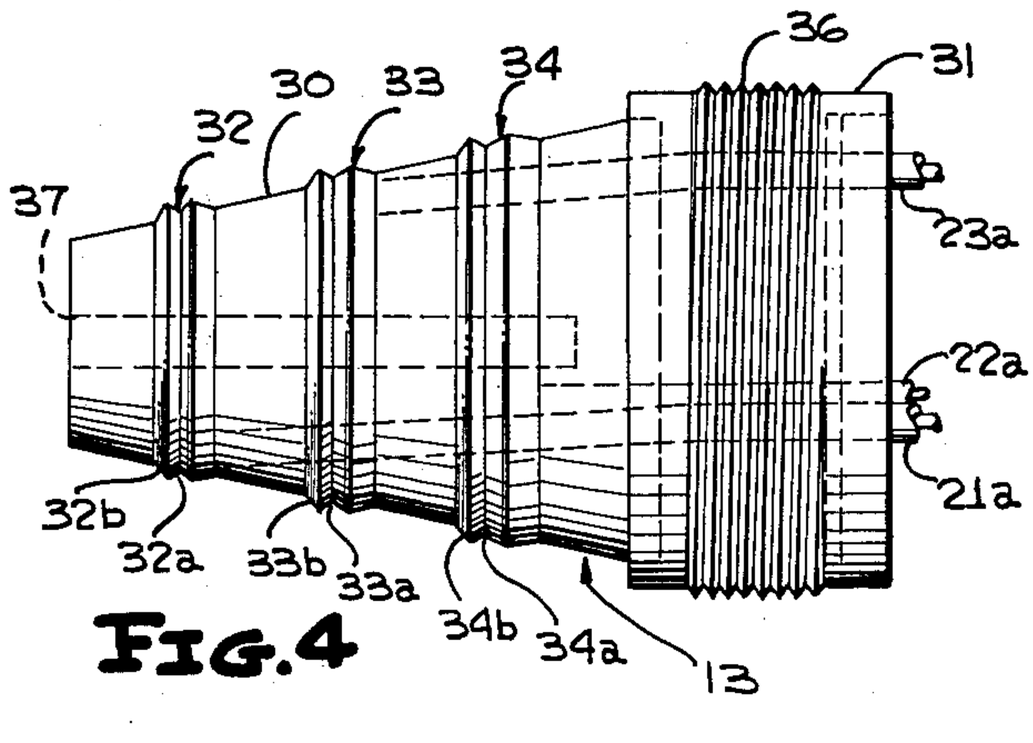


FIG. 4

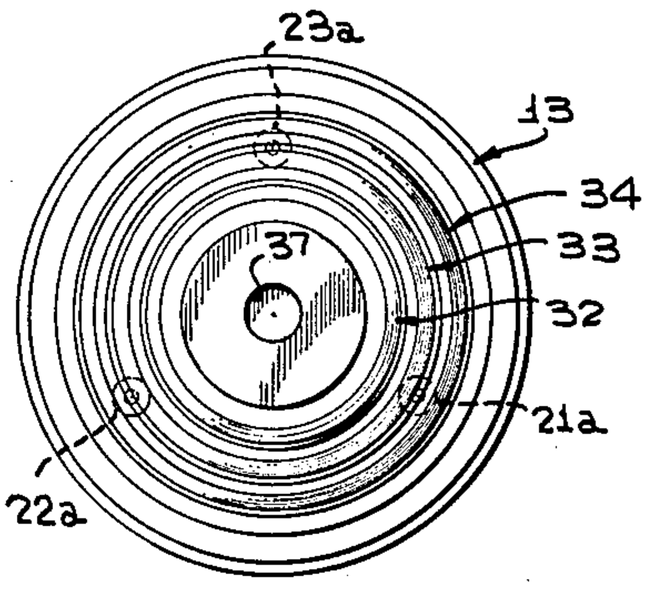


FIG. 5

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ROTATABLE MULTIPLE-LEAD ELECTRICAL CONNECTOR

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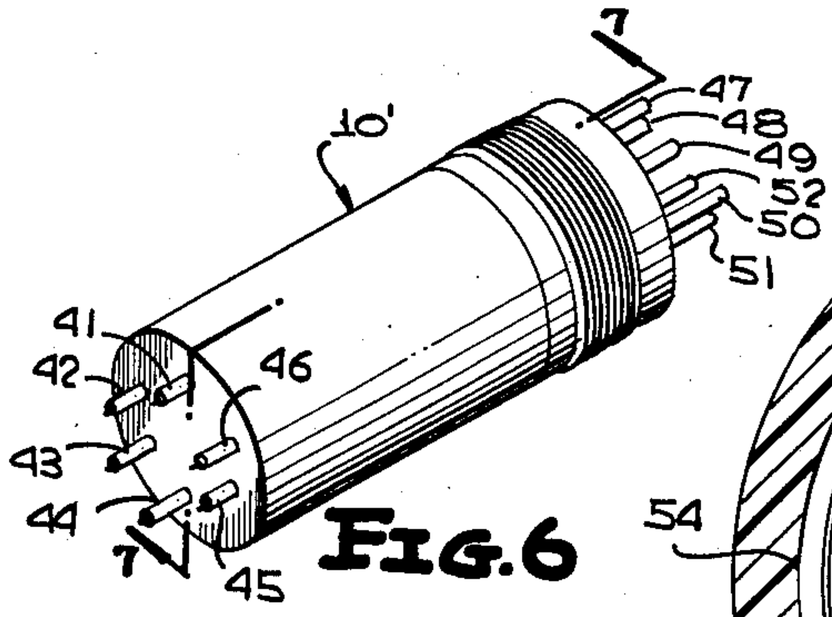

FIG. 6

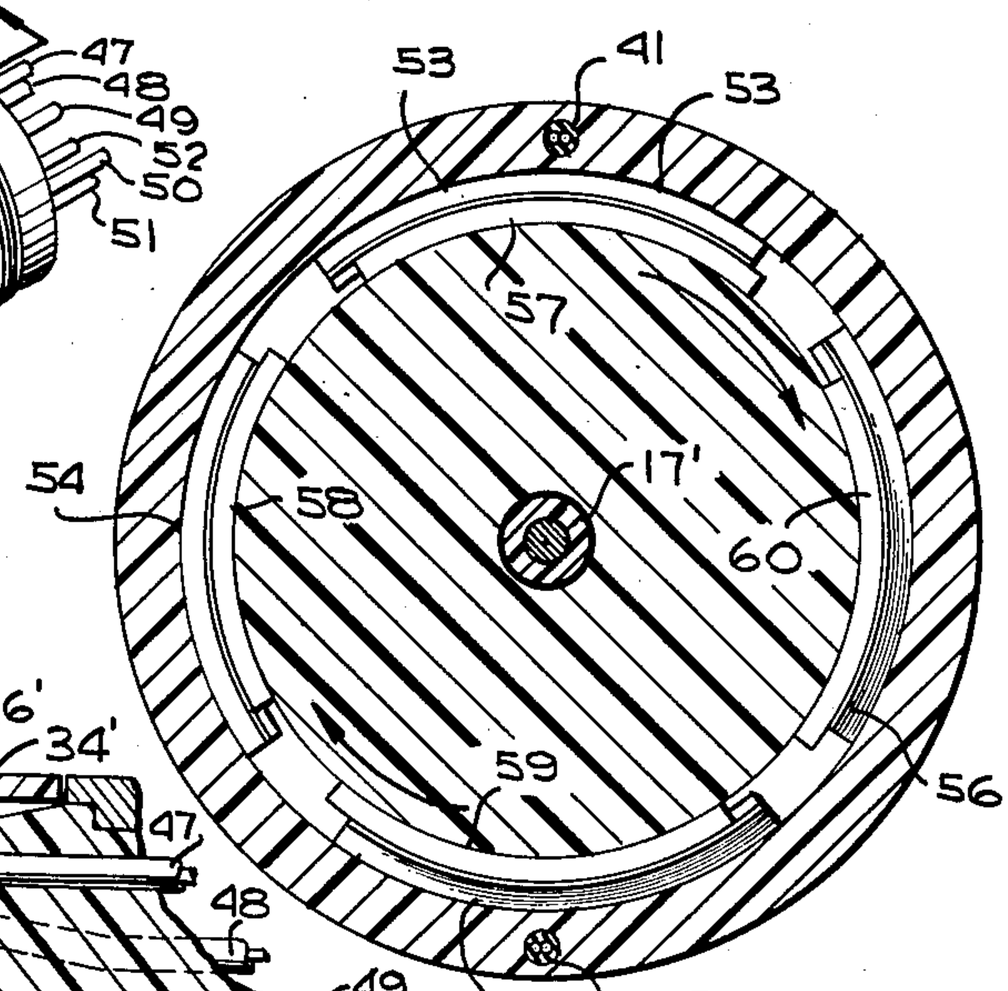

FIG. 8

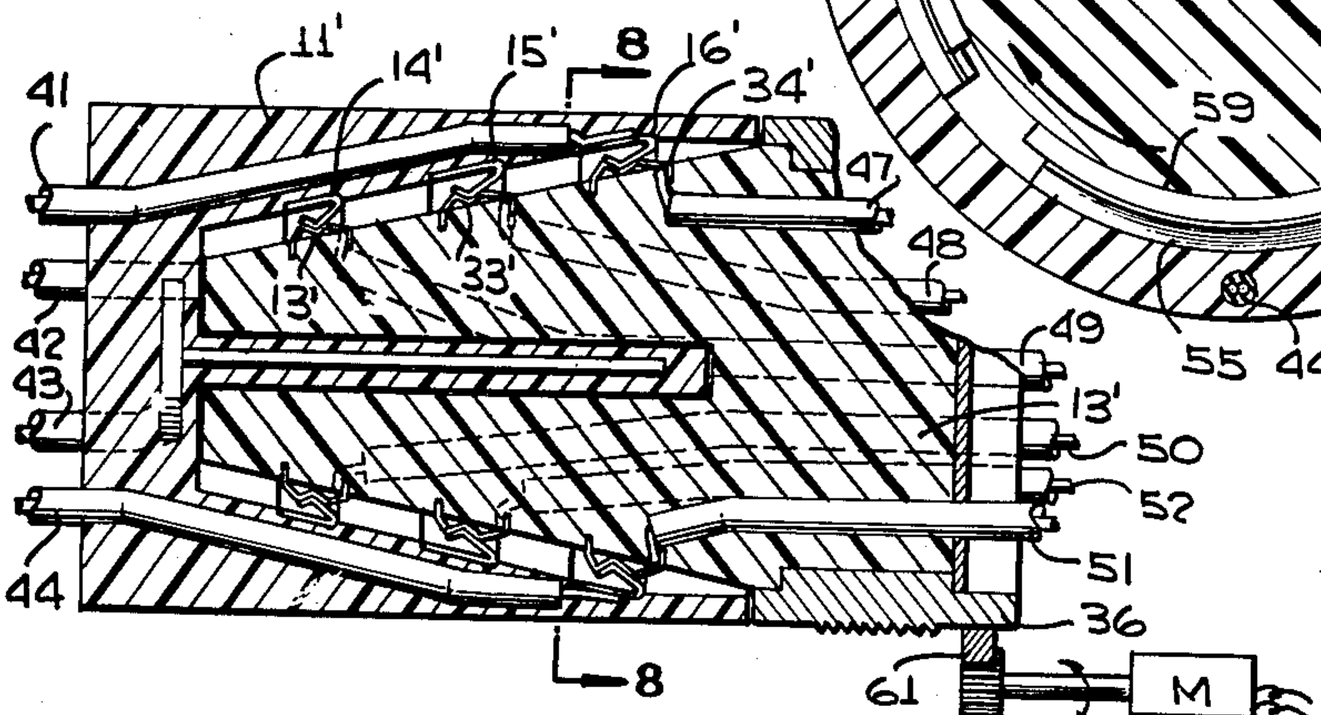

FIG. 7

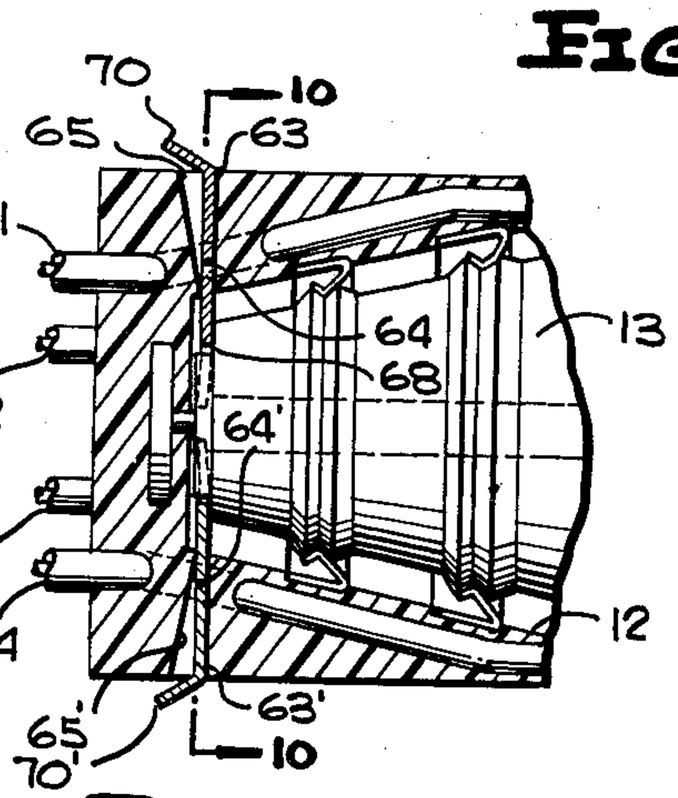

FIG. 9

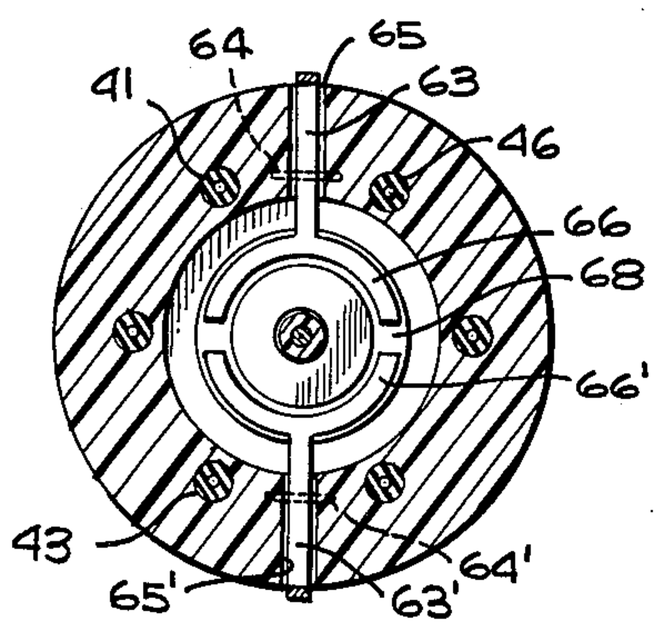

FIG. 10

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ROTATABLE MULTIPLE-LEAD ELECTRICAL CONNECTOR

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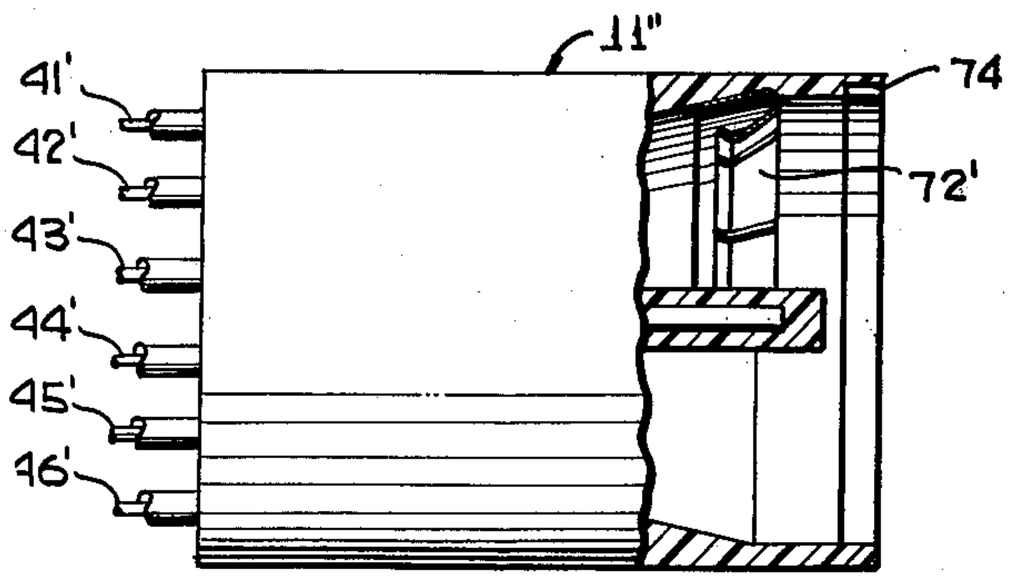

FIG. 11

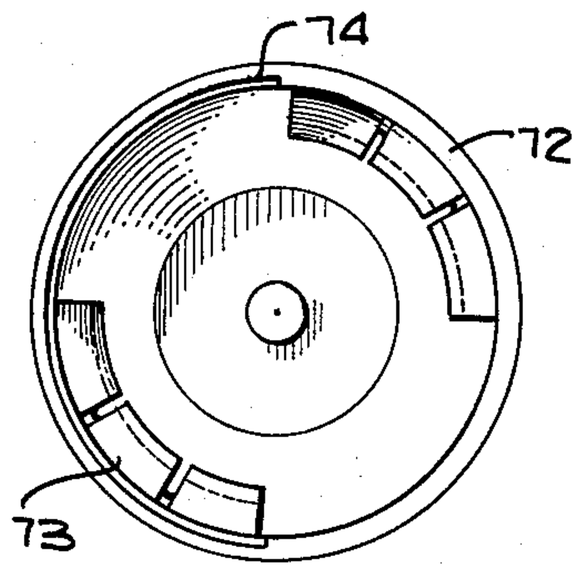

FIG. 12

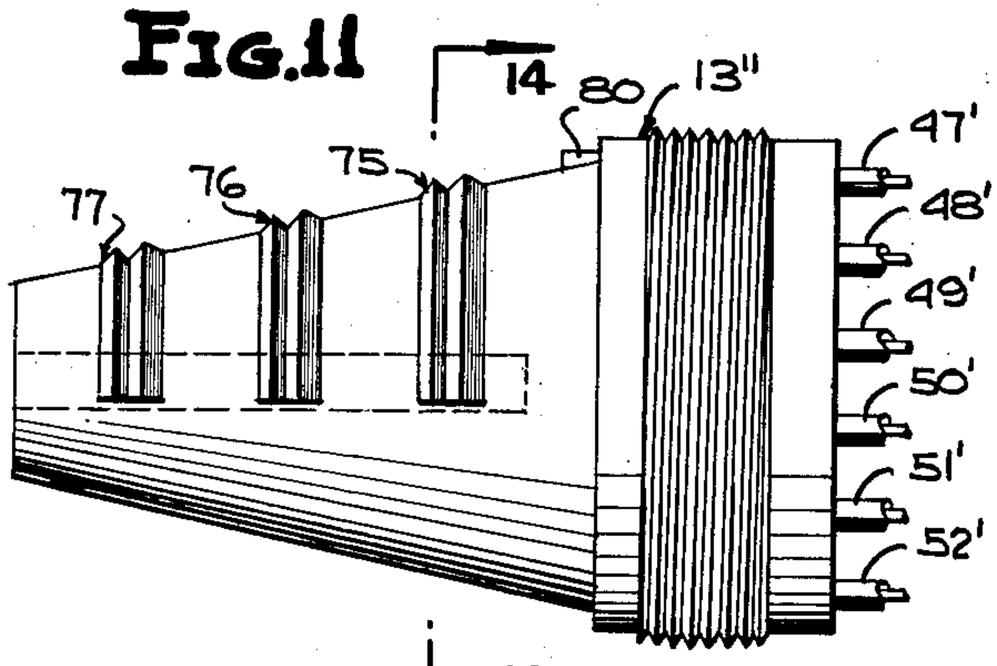

FIG. 13

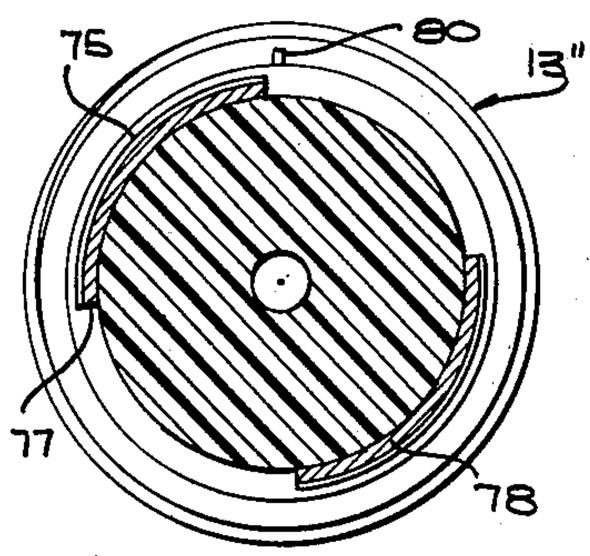

FIG. 14

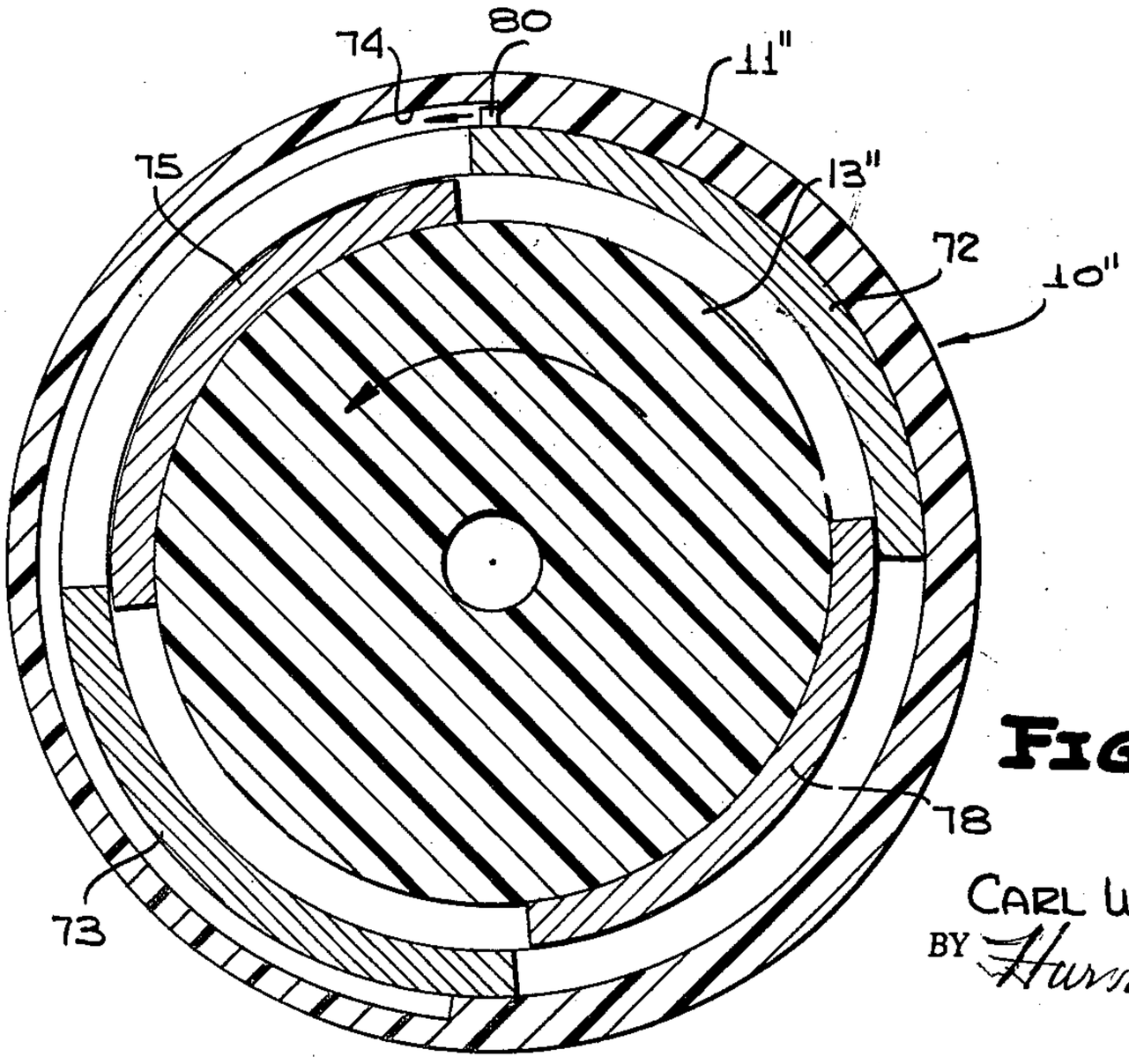

FIG. 15

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United States Patent Office

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3,193,636
ROTATABLE MULTIPLE-LEAD ELECTRICAL CONNECTOR

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Filed Nov. 7, 1962, Ser. No. 236,104
6 Claims. (Cl. 200—51.12)

The present invention relates generally to multiple-lead electrical connectors of the swivel type, and more particularly to a self-interlocking demountable swivel-type connector in which the internal contacts provide self-interlock features for the connector.

Swivel connectors which are designed to connect the ends of a pair of cables together generally comprise a female receptacle for housing the lead ends of one set of conductors of one cable, and a plug insertable into the receptacle for housing the lead ends of the set of conductors of the other cable. Conventional connectors are designed so that lead ends in the plug are soldered or otherwise attached to annular contact rings provided on the outer surface of the plug, and the lead ends of conductors in the receptacle are connected to internal contact rings secured to the receptacle. The contact rings mate when the plug is inserted into the receptacle thereby effecting an electrical connection between the ends of the cables.

After the plug is inserted into the receptacle, the problem arises of preventing an unintentional breakage of the electrical contact by forces applied to the cables or to the connector directly. The prior art has sought to overcome this problem by providing the connector with a locking device that permits limited rotative movement between the plug and the receptacle and yet limits or prevents electrical contact-breaking axial movement between these two parts. Conventional locking devices may, for example, take the form of a cap for the plug which incapsulates the plug and threadedly connects the plug to the receptacle; or the locking device may take the form of a bolt that extends axially through the plug and receptacle and is threadedly connected to the receptacle so that the head of the bolt can limit contact-breaking movement between the plug and the receptacle.

Electrical assemblies may incorporate a considerable number of swivel-type multi-conductor connectors, and therefore it would be advantageous to eliminate the use of a locking device as well as the accompanying step of fastening the locking device to the receptacle after the plug has been seated in the receptacle. In prior-art connectors that incorporate locking devices of the general type described briefly hereinabove, if the particular locking device were not employed, only frictional engagement between the mating contacts would serve to hold the plug within the receptacle. By increasing the frictional contact between the mating contacts, the force which must be applied to effect contact-breaking separation also increases. Unfortunately, the increase in frictional engagement between the contacts also gives rise to the need for applying a correspondingly increased force to effect proper insertion of the plug into the receptacle.

Another disadvantage of known swivel-type connectors is the lack of a relatively simple mechanism for pushing the plug outwardly from the receptacle so that the lengths of the cables extending from the plug and the receptacle do not have to be grasped and pulled apart to effect separation between the plug and receptacle. Particularly if the junction formed by the internal contacts of the plug and the receptacle is relatively tight, pulling on the cable instead of the connector may cause breakage of the connection existing between the lead ends of the cables and their contacts in the plug and receptacle

of the cables and their contacts in the plug and receptacle of the connector.

The present invention is primarily directed to overcoming the aforementioned disadvantages of known swivel-type multiconductor connectors, and provides among other features, interlocking contact elements which mechanically interlock such that the force that must be applied to break contact between the elements must be considerably larger than the force initially required to seat the plug in the receptacle. An additional feature of the invention is the provision of a relatively simple mechanism which can be actuated to push the plug outwardly from the receptacle a distance sufficient to break the interlock existing between the internal contacts thereby facilitating the removal of the plug from the receptacle.

Broadly, therefore, it is an object of this invention to provide a multiple-lead electrical connector of the swivel type wherein the internal electrical contacts self-interlock.

More specifically, it is an object of this invention to provide a multiple-lead connector of the swivel type including a plug and a receptacle for receiving the plug, wherein mating contacts affixed to the plug and receptacle respectively, permit relatively easy insertion of the plug into the receptacle but offer a considerably increased resistance to removal of the plug from the receptacle.

Another object of this invention is to proivde a swivel-type electrical connector having interlocked internal contacts, the connector including a mechanism operable to break the interlock existing between the internal contacts.

Still another object of this invention is to provide a self-interlocking multiple lead electrical connector including a plug and a receptacle having mating contact sections affixed thereto, the plug and receptacle being rotatable relative to each other so that a lead connected to one contact section on the plug may be selectively connected to a lead connected to another and initially non-mating contact section on the receptacle.

Yet another object of this invention is to provide a self-interlocking multiple-lead connector including a receptacle and a plug seated in the receptacle and having mating internal contacts, the receptacle including a device for orienting the plug during insertion thereof into the receptacle so that proper electrical contact is effected between the internal contacts.

The above and still further objects, features and advantages of the present invention will become apparent upon consideration of the following detailed description of one specific embodiment thereof, especially when taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a perspective view of a disconnected swivel-type multiple-lead connector in accordance with this invention;

FIGURE 2 is a sectional side view of the receptacle of the connector taken on line **2—2** of FIGURE 1;

FIGURE 3 is an end view of the receptacle shown in FIGURE 1;

FIGURE 4 is a side view of the plug of the connector shown in FIGURE 1;

FIGURE 5 is an end view of the plug shown in FIGURE 4;

FIGURE 6 illustrates another embodiment of the connector in accordance with this invention;

FIGURE 7 is a partial sectional side view of FIGURE 6 taken on line **7—7** of that figure;

FIGURE 8 is a full sectional end view of the embodiment shown in FIGURE 6 taken on line **8—8** of FIGURE 7;

FIGURE 9 is a partial sectional side view of the receptacle and the plug seated in the receptacle, and additionally illustrates a mechanism for forcing the contacts on the plug from interlocking relationship with mating contacts in the receptacle;

FIGURE 10 is a full sectional end view of the connector shown in FIGURE 9 taken on line 10—10 of that figure;

FIGURE 11 is a partially sectioned perspective view of another embodiment of a receptacle constructed in accordance with this invention;

FIGURE 12 is an end view of FIGURE 11;

FIGURE 13 is a side view of another embodiment of a plug for use with the receptacle shown in FIGURE 11;

FIGURE 14 is a section view of FIGURE 13 taken on section line 14—14 of that figure; and

FIGURE 15 illustrates a cross-section of an assembled connector embodying the plug and receptacle illustrated in FIGURES 11–14, inclusive, the cross-section being taken through section 14—14 of the plug.

Referring now to FIGURES 1 and 2 of the accompanying drawings for a more complete understanding of the present invention, the cylindrical connector 10 comprises a cylindrical receptacle 11 formed of an electrical insulating material, as for example, hard rubber. A conical bore 12 is formed in the receptacle 11 into which an essentially frusto-conical shaped plug 13 can be inserted and seated. Extending into the bore 12 are one or more finger-type contact elements, three of these elements being shown and designated by the numerals 14, 15 and 16, respectively. The contact elements 14, 15 and 16 are formed with ring-like bases 14*a*, 15*a* and 16*a*, respectively, which may be molded into, or otherwise secured to the conical wall forming the bore 12, the bases 14*a*, 15*a* and 16*a* respectively increasing in diameter an amount corresponding to the increase in diameter of the bore 12. The contact elements 14, 15 and 16 are segmented in order to provide a plurality of contact arms, one arm of each contact element 14, 15 and 16 being designated by the numeral 14*b*, 15*b* and 16*b*, respectively. The contact arms 14*b*, 15*b* and 16*b* cantilever from the bases 14*a*, 15*a* and 16*a*, respectively, and are inclined with respect to the walls forming the bore 12 in the direction of plug insertion. The number of contact arms formed in each contact element may vary as a matter of design, and therefore the description with respect thereto will be limited to the single set of arms 14*b*, 15*b* and 16*b*. The extremity of each arm 14*b*, 15*b* and 16*b* is formed with an angled dependent tip 14*c*, 15*c* and 16*c*, respectively, and the purpose of this specific design of the contact arms and the tips will be discussed in detail subsequently.

A cylindrical plug 17 of insulating material is formed preferably with the longitudinal axis thereof concentric with the axis of the conical bore 12. A metal pin 18 having the head 20 thereof molded in the base of the receptacle 11 may be embodied in the plug 17 to decrease the flexibility of the plug 17, if necessary. A plurality of conductors or leads referred to generally by the numerals 21, 22 and 23 have the ends thereof soldered or otherwise attached to the contact bases 14*a*, 16*a* and 15*a*, respectively, the three conductors extending from both ends of the connector 10 being usually bundled and wrapped together so as to form cables.

With reference to FIGURES 1 and 4 of the drawings, the frusto-conical plug 13 is composed of a suitable electrical insulating material which may be the same composition as the receptacle 11, and a plurality of contact rings referred to by the numerals 32, 33 and 34 are embedded in the tapered periphery of the plug 13 and are positioned so as to mate with and make electrical contact with the contact elements 14, 15 and 16, respectively, of the receptacle 11 when the plug 13 is seated in the receptacle 11. Conductors or leads 21*a*, 22*a* and 23*a* which are to be electrically connected to the conductors 21, 22 and 23, respectively, extend from the cylindrical base end 31 of the plug 13 and terminate in leads that are soldered or otherwise connected to the contacts 32, 34 and 33, respectively. The base 31 is preferably molded to the plug 13 and includes a threaded portion 36 which may be screwed into a fixture or into an electrical installation for the purpose of securing the connector 10 to that fixture or installation.

As shown in FIGURES 2, 4 and 7 of the accompanying drawings, the ring contacts 32, 33 and 34 are essentially of an inverted W shape, the V-shaped peripheral raceways or grooves 32*a*, 33*a*, and 34*a*, respectively, formed intermediate the embedded ends of the contacts to receive the tips 14*c*, 15*c* and 16*c*, respectively, as well as a relatively short section of the adjoining contact arms 14*b*, 15*b* and 16*b*, respectively. The angle formed by the tips 14*c*, 15*c* and 16*c* and the adjoining short sections of the contact arms 14*b*, 15*b* and 16*b*, respectively, is essentially the same angle formed by the opposite inclined sides of the V-shaped grooves 32*a*, 33*a* and 34*a*, respectively, so that the tips 14*c*, 15*c* and 16*c* and the adjoining relatively short sections of the contact arms 14*b*, 15*b* and 16*b*, respectively, contact opposite sides of V-shaped grooves, FIGURES 7 and 9, when the plug 13 is seated in the receptacle 11. The outermost radii of the contact rings 32 and 33 are preferably made less than the innermost radius of the contact element 16, and the outermost radii of the ring 32 is also preferably made less than the innermost radius of the contact ring 33 in order to eliminate any additional resistance to the insertion of the plug into the receptacle beyond that required to actually effect the interlock between mating contact elements.

As will be evident during insertion of the plug 13 into the bore 12 of the receptacle 11, the arms 14*b*, 15*b* and 16*b* are forced inwardly towards the wall of the bore 12 until the tips 14*c*, 15*c* and 16*c* of each contact arm of the ring 14, 15 and 16 snap into the grooves 32*a*, 33*a* and 34*a*, respectively. Since the arms 14*b*, 15*b* and 16*b* are inclined in the direction of plug insertion, and the inverted W-shape of the contacts 32, 33 and 34 provide leading inclined surfaces 32*b*, 33*b* and 34*b*, respectively, which initially engage only the inclined arms 14*b*, 15*b* and 16*b*, comparatively little force need be applied against the base 31 of the plug 13 in order to seat the plug 13 in the receptacle 11. A bore 37 is formed concentrically in the plug 13 and the plug 17 can be inserted into the bore 37 to guide and concentrically position the plug 13 in the bore 12.

With the plug 13 seated in the receptacle 11, the tips 14*c*, 15*c* and 16*c* engage the sides of the V-shaped raceways or grooves 32*a*, 33*a* and 34*a* adjoining the surfaces 32*b*, 33*b* and 34*b*, respectively, and the relatively short adjoining sections of the arms 14*b*, 15*b* and 16*b* contact the opposite sides of the V-shaped grooves to effectuate an interlock between the mating contact elements. The contact arms 14*b*, 15*b* nad 16*b* are flexed inwardly towards the wall forming the bore 12 and since the plug 13 can only be withdrawn axially from the receptacle 11 the relatively short and inflexible arms 14*b*, 15*b* and 16*b* abutting the sides of the grooves 32*a*, 33*a* and 34*a* adjoining the surfaces 32*b*, 33*b* and 34*b*, respectively through the tips 14*c*, 15*c* and 16*c*, respectively, offer a greater resistance to the removal of the plug from the receptacle than that offered by the contact arms during seating of the plug in the receptacle. Consequently the force required to disconnect the connector 10 is considerably greater than the force initially required to effect the connection. Although an axial mechanical interlock exists between the contact elements, the receptacle 11 and the plug 13 can be swiveled relative to each other without breaking the electrical contacts.

While mating contact elements and conductors for a three-wire system are shown in the accompanying drawings, the number of mating contacts and the number of conductors embodied in the connector 10 will ordinarily be merely a matter of connector design, and a plurality of conductors may be connected to any single contact ring if so desired.

FIGURE 6 illustrates a modification of the connector 10, wherein like elements are referred to by like numerals

in the accompanying drawings. For purposes of illustration only, the cylindrical connector **10'** is shown having six leads **41, 42, 43, 44, 45** and **46,** extending from one end thereof, and having six leads **47, 48, 49, 50, 51** and **52,** extending from the other end thereof. In this embodiment, a selective connection can be made between any lead or leads extending from one end of the connector **10'** to any lead or leads extending from the other end of the connector **10'**. To achieve an interval selective connection between the leads, the contact ring elements as, for example, the contact rings **16'** and **34'** of the receptacle **11'** and the plug **13'**, respectively, are divided into incremental contact ring sections so that upon swiveling of either the receptacle **11'** or the plug **13'** one or more leads connected to one contact ring section in the receptacle is electrically connected to one or more leads connected to an interlocking contact ring section on the plug.

To illustrate specifically, the contact rings **16'** and **34'**, FIGURES 7 and 8, are each divided into four equal and distinct contact ring sections separated one from the other by the insulation of the receptacle **11'** and the plug **13'**, respectively, and designated by the numerals **53, 54, 55** and **56**, and by the numerals **57, 58, 59** and **60**, respectively. One or more leads extending from one end of the connector **10'** as, for example the lead **41**, may be connected to one section, as for example the section **53**; and one of the leads extending from the other end of the connector **10'**, as for example the lead **47**, may be connected to the mating section **57** so that an electrical connection between the conductors **47** and **51** will be created when the sections **53** and **57** are rotated into electrical contact with each other. Although the sections formed by the contact elements **16'** and **34'** axially interlock for reasons discussed in regard to the embodiment illustrated in FIGURES 1 to 5, inclusive, the interlocking connection permits swiveling movement between the receptacle **11** and the plug **13** and thus the establishment of an electrical connection between any contact section on the plug **13'** and any contact section in the receptacle **11'**. Single or plural leads may be connected to the section **53** and single or plural leads connected to other sections of the ring **16'**, or single or plural leads may be connected to the receptacle rings **14** and/or **15**, as needed. In the embodiment illustrated in the drawings, lead pairs **41** and **44** are connected to the contact ring **16'**; lead pairs **42** and **45** to the contact ring **15'**, lead pairs **43** and **46** to the contact ring **14'**, lead pairs **47** and **51** to the contact ring **34'**, lead pairs **48** and **52** to the contact ring **33'**, and lead pairs **49** and **50** to the contact ring **32'**. It will be apparent to those working the art, however, that the number of sections into which the receptacle is divided is ordinarily a matter of choice, dependent upon the number of leads which are to be selectively connected together by the connection.

The various sections can be rotated through any desired angle for achieving a variety of results. For example, an external ring gear **61** could be affixed to the periphery of the base **36** of the plug **13'** and a pinion **62** connected to drive the base **36** through the gear **61** from a motor M. If the receptacle **11'** were held stationary in a supporting structure, timed switching could be effected between the leads extending from each end of the connector **10'** by the rotation of the plug and the receptacle relative to one another at predetermined cyclic rates in opposite or the same direction determined by the motor M to effect at least one cycle of timed switching. Alternatively, the plug **13'** might be held stationary while the receptacle **11'** is rotated at some constant predetermined velocity to effect at least one continuous cycle of timed switching. Obviously, the plug **13'** may be manually swiveled relative to the receptacle **11'** as desired in the event the plug is inadvertently turned while in the receptacle **11'**, or in the event the plug **13'** is improperly oriented in the receptacle **11'** after the demounting and subsequent reinsertion of the plug into the receptacle.

Since the contact rings **14, 15** and **16** interlock with the contact rings **32, 33** and **34** respectively, a mechanism may be incorporated in the receptacle **11**, as illustrated in FIGURES 9 and 10, to facilitate the disconnection of the plug **13** from the receptacle **11**, and the tapered end of the plug **13** modified to accept this mechanism. The mechanism preferably comprises a pair of levers **63** and **63'**, pivotally mounted by pins **64** and **64'**, respectively, in diametrically opposed tapered slots **65** and **65'** formed in the base of the receptacle **11**. The ends **66** and **66'** of the levers **63** and **63'** that extend into the bore **12** are preferably yoke shaped, as shown in FIGURE 10, and are positioned to bear against a shoulder **68** formed at the tapered end of the plug **13**. The yoke-shape of the ends **66** and **66'** provides essentially equal distribution of pressures on each half of the shoulder **68** upon outward pivotal movement of the ends **66** and **66'**. The ends **70** and **70'** of the levers **63** and **63'** extend from the surface of the receptacle **11** and are inclined at an angle with respect thereto so that by gripping the ends **70** and **70'**, for instance between the thumb and forefinger, and squeezing, the ends **66** and **66'** will force the plug **13** outwardly from the bore **12** a distance sufficient to release the plug from interlocking contact with the receptaccle **11**. It will be apparent that the lever release mechanism may also be embodied in the connectcor **10'** to effect breakage of the interlock between the various contact sections.

Referring now to FIGURES 11–15, inclusive, there is shown another embodiment of a connector **10''** (FIGURE 15) in accordance with the instant invention. The connector **10''** illustrated in these figures comprises a receptacle **11''** which is essentially identical to the receptacle **11'** discussed hereinabove, the receptacle **11''** including three pairs of diametrically opposed ring contact sections similar in construction to the contact sections **14', 15'** and **16'** illustrated in FIGURE 7. One pair of diametrically opposed contact sections is shown in FIGURE 12, each section being designated by the numeral **72** and **73**, respectively. A plurality of leads **41'–46'**, inclusive, extend from the receptacle **11''**, each lead being connected to a contact ring section. The lead **41'** may for example, be connected to the ring **72** whereas the lead **46'** may be connectced to the contact ring **73**. An annular groove **74** is formed in the receptacle **11''** at the entrance of the receptacle, and as illustrated in FIGURE 12, the angle formed between the axis of symmetry of the receptacle **11''** and the ends of the groove **74** is slightly less than 180 degrees; for instance 175 degrees.

FIGURE 13 illustrates a plug 13'', similar to the plug **13'** disclosed in the embodiment shown in FIGURE 7, and comprises three diametrically opposed pairs of segmented contact elements, one group of contacts forming one element of a pair being designated by the numerals **75, 76** and **77** in FIGURE 13, and one pair of diametrically opposed contact elements being illustrated in FIGURE 14, and referred to by the numerals **75** and **78**. The two segmented contact elements forming pairs with the elements **76** and **77** are positioned in the same relative position as the contact element **78** on the tapered surface of the plug **13''**. The angles formed at the axis of symmetry of the receptacle **11'** and the plug **13''** between the ends of each arcuate contact element are preferably slightly less than 90 degrees, as illustrated in FIGURE 14. Leads **47'–52'**, inclusive, extend from the base end of the plug **13''** and may be connected to any one of the segmented contact elements on the plug periphery. For example, the lead **47'** may be connected to the contact element **75** and the lead **52'** may be connected to the contact element **78**. A protruding element **80** is formed at the junction between the base of the plug **13''** and the tapered surface, as shown in FIGURE 13. The element **80** is designed to fit into the travel in the groove **74**, FIGURE 12, and will effectively limit the angle of swiveling between the plug **13''** and the receptacle **11''** by abutting either end of the groove **74**.

FIGURE 15 illustrates a cross-section taken on the

section line 14—14 when the plug 13'' is inserted into the receptacle 11''. As will be apparent, the projecting element 80 limits the total rotation of the contact elements to an angle preferably slighlty less than 180 degrees, so that the mating elements always remain in contact, as shown in FIGURE 15. Thus the projection 80 traveling in the groove 74 permits swiveling between plug 13'' and the receptacle 11'' through an arc slightly less than 180 degrees and prevents internal disconnection between the contract elements and their associated leads 41–46, and 47'–52', inclusive.

In the embodiment disclosed hereinabove the plug and receptacle could be of cylindrical shape rather than of conical shape. If so desired, an extraneous locking mechanism such as a coaxial threaded bolt could be incorporated in the connector which would permit swiveling between the plug and receptacle and yet provide an additional restraint against axial movement between these members.

While I have described and illustrated one specific embodiment of my invention, it will be clear that variations of the details of construction which are specifically illustrated and described may be resorted to without departing from the true spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A multiple-lead connector of the swivel type having male and female portions adapted for relative rotation on a longitudinal axis, the combination comprising:

a female receptacle and a complementary shaped insertable male plug rotatably seated in said receptacle, said plug and receptacle being comprised of electrical insulating material;

a first plurality of axially spaced arcuate contact elements of electrical conducting material concentrically fixed with respect to said axis to the outer surface of said male plug, said first plurality of contact elements having an inclined leading surface in the direction of plug insertion, and having a substantially V-shaped circumferential raceway formed immediately aft of said leading surface, the apex of the V of said raceway being oriented radially with respect to said axis;

a second plurality of axially spaced arcuate contact elements of electrical conducting material concentrically fixed with respect to said axis to the inner surface of said female receptacle, said second plurality of contact elements being axially spaced and in complementary relationship to said first plurality, each of said second contact elements being formed with spring material, one end of said contact elements being secured to said female receptacle and the other end being free and inclined in the direction of plug insertion forming the first leg of V-shaped contacts and terminating in an angularly dependent tip forming the second leg of said V-shaped contacts complementary to said raceway, each of said V-shaped contacts being positioned in mating relationship with a respective V-shaped circumferential raceway when said plug is seated in said receptacle, each of said V-shaped contacts bearing against the sides of said respective V-shaped circumferential raceways so that electrical connection is established between respective ones of said first and second pluralities of contact elements, said leading surface radially urging said second contact elements outwardly during plug insertion, whereby the inclination of the other end of said second contact elements in the direction of plug insertion in cooperation with said leading surface results in the requirement of less force to connect the contact elements than required to disconnect the contact elements; and

electrical leads connected to each of said contact elements.

2. The invention as defined in claim 1 wherein said plug and receptacle are conically tapered in complementary relationship.

3. The invention as defined in claim 2, and a guide member integral with said female receptacle, said guide member extending axially within said female receptacle, said male plug having a complementary opening therein for receiving said guide member for aligning said male plug concentrically in said female receptacle, and lever means positioned at the tapered end of said receptacle and extending therein, said lever means contacting the tapered end of said male plug, whereby the application of force to said lever means will break the interlocking contact between said contact elements upon actuation thereof.

4. The connector as claimed in claim 1, wherein means are provided in said receptacle for concentrically positioning said plug in said receptacle.

5. The invention as defined in claim 1, and means coacting in said plug and receptacle for limiting the degree of swiveling movement therein.

6. The invention as defined in claim 1 wherein said arcuate contact elements extend less than 180 degrees and wherein is provided means for timed relative rotation between said plug and said receptacle so that connection and disconnection are effected for each of said first and second contact elements at predetermined time intervals.

References Cited by the Examiner

UNITED STATES PATENTS

1,090,238	3/14	Schwartz	219—533
2,192,943	3/40	Sumner	339—258
2,298,172	10/42	Rose et al.	339—182 X
2,476,735	7/49	Johnson	339—45
2,551,533	5/51	Gernheuser	339—45
2,551,630	5/51	Page	339—182 X
2,787,771	4/57	Francis	339—81

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