United States Patent

[11] 3,609,632

[72] Inventor **Ottomar H. Vetter**
Minneapolis, Minn.

[21] Appl. No. **753,690**
[22] Filed **Aug. 19, 1968**
[45] Patented **Sept. 28, 1971**

[73] Assignee **TRW Inc.**
Cleveland, Ohio

---

[54] **RELEASABLE ELECTRICAL CONNECTOR**
30 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **339/14,** 339/45, 339/46, 339/90
[51] **Int. Cl.** **H01r 13/62**
[50] **Field of Search** 339/14, 45, 46, 65, 88, 90, 91, 143, 61, 62; 287/316, 320

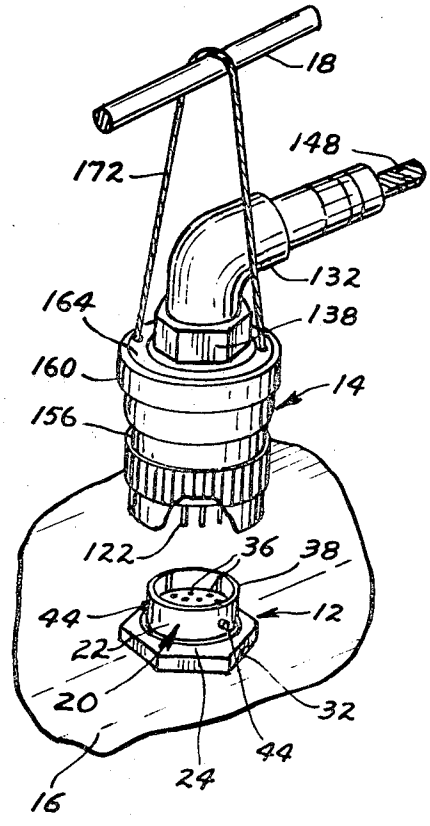
[56] **References Cited**

UNITED STATES PATENTS

1,738,893	12/1929	Grady	339/90
2,961,630	11/1960	Duncan	339/90
2,984,811	5/1961	Hennessey et al.	339/45 M
3,063,032	11/1962	Brush	339/45 M
3,156,512	11/1964	Peterson et al.	339/45 M
3,182,280	5/1965	Daut et al.	339/66
3,322,923	5/1967	Brush	200/142
3,328,743	6/1967	Acord	339/45 M

Primary Examiner—Marvin A. Champion
Assistant Examiner—Robert A. Hafer
Attorney—Dugger, Peterson, Johnson and Westman

ABSTRACT: A releasable electrical connector is composed of two halves or components, one being of conventional construction and having a shell provided with a plurality of socket contacts and radially directed bayonets that are latched with the other half or component constructed in accordance with the invention. After the bayonets are inserted into slots formed in a pawl carrier sleeve in the second connector half, the carrier sleeve is angularly shifted in a direction to effect latching of the pawls with the bayonets. The pin contacts are mounted in a rubber insert contained in a shell belonging to the second connector half; a grounding ring encircles the last-mentioned shell. Through helical ramp grooves formed on the exterior of the shell and antifriction rollers extending inwardly from an encircling drive sleeve, the rectilinear movement required for shell advancement is derived from rotation of the drive sleeve. The shell advancement first results in the spring tines of the grounding ring moving into the shell of the first connector half, then the entry of the pin contacts into the socket contacts, and finally a slight facial compression of the rubber insert in which the pin contacts are mounted. The tendency for the rubber insert to expand provides a seal and in conjunction with a detent formed at one end of each of the ramp grooves into which the rollers move prevents inadvertent retraction of the second shell and its pin contacts. Tension springs normally bias the shell into a retracted position, but the action of these springs is easily overcome during the coupling process. Relatively rotatable pin and groove means on the carrier and drive sleeves become effective at the end of the coupling procedure to assure that the pawls and bayonets will remain latched until their release is desired. An indicator, capable of being both seen and felt, is forced outwardly to signify that the two halves are fully mated and latched. A lanyard is anchored to the improved connector half and a 360° swiveling can be realized. When a predetermined load is applied to the two halves, they pull apart. A backshell can be securely attached in any angular position to the second connector half.

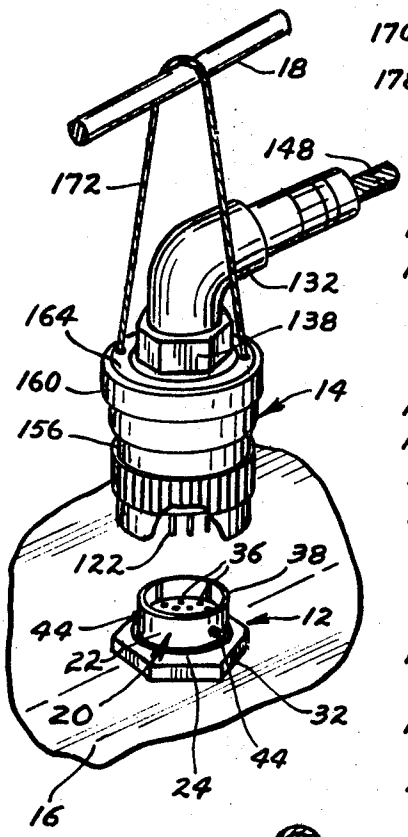


PATENTED SEP 28 1971

3,609,632

SHEET 1 OF 2

FIG. 1



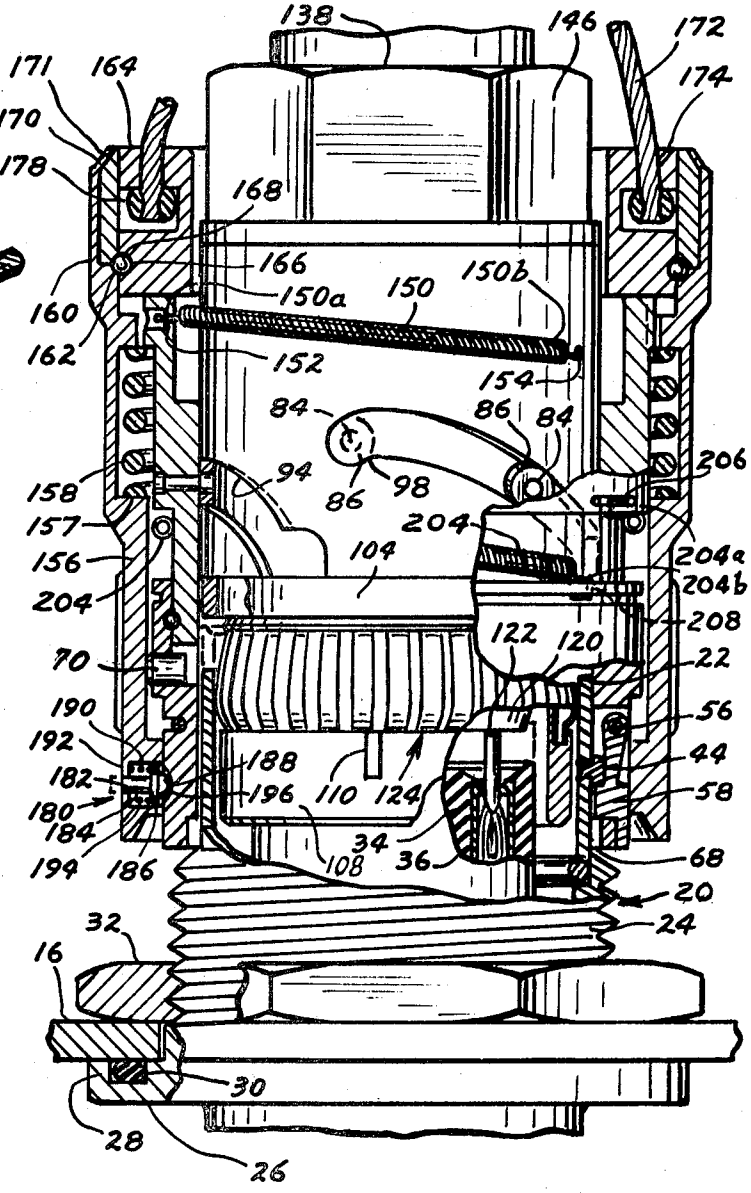


FIG. 3

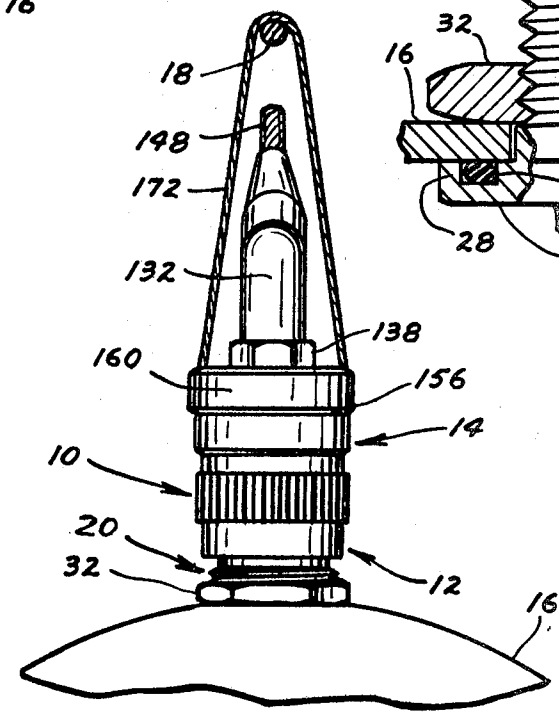


FIG. 2

INVENTOR.
OTTOMAR H. VETTER

BY

Dugger Peterson Johnson & Westman

ATTORNEYS

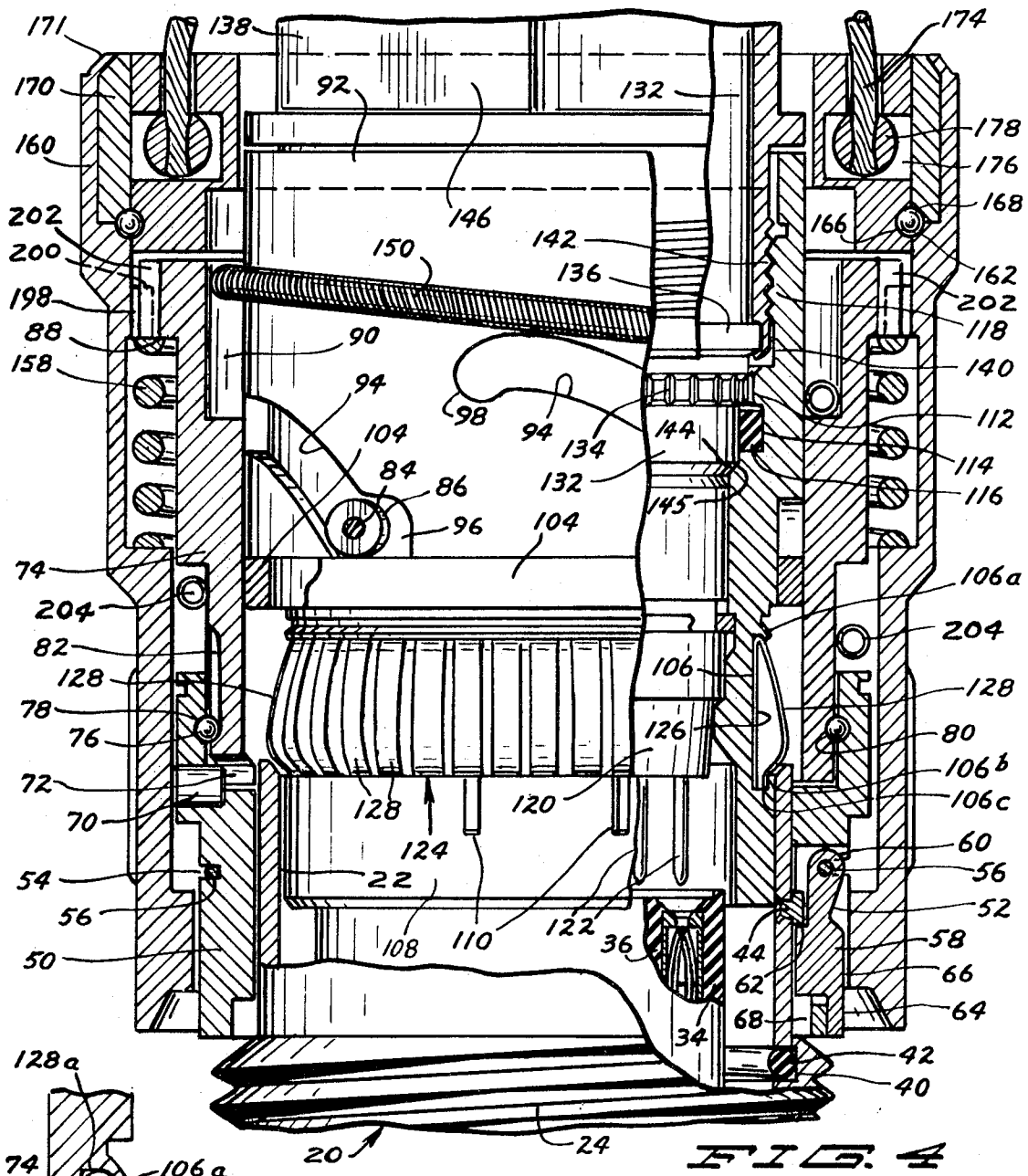


FIG. 4

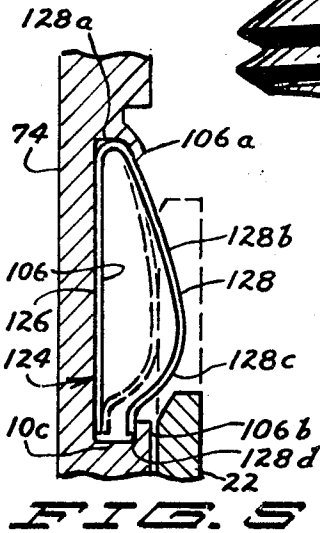


FIG. 5

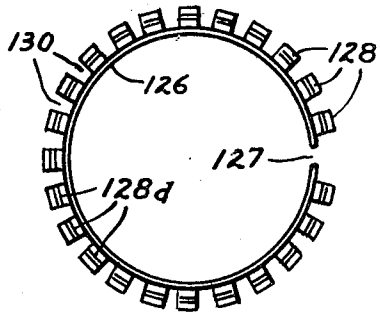


FIG. 7

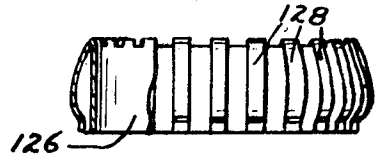


FIG. 6

INVENTOR.
OTTOMAR H. VETTER

BY

Hugger Peterson Johnson & Westman
ATTORNEYS

RELEASABLE ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to electrical connectors, and pertains more particularly to a releasable connector having a lanyard associated therewith.

2. Description of the Prior Art

Release-type connectors are old and well known. However, there are situations in which a high degree of reliability is mandatory. The problems are compounded when it is either necessary or highly advantageous to be able to couple on connector half or component to a conventional half and still meet all the requirements that are demanded. Aircraft and aerospace operations are two situations where my connector will find especial utility and where existing connectors have been inadequate in a number of ways.

SUMMARY OF THE INVENTION

Having mentioned aircraft operations as one place where my invention will be particularly advantageous, it will be well to explain that in such an environment, especially when of a military nature, it is necessary to release a device, whether it be a fuel tank, missile or other object. Usually there is very little space in which to house the connector through which must pass the necessary control and data signals until the object is released. Access to the interior of the compartment, frequently a pylon, for the purpose of coupling the two connector halves together is virtually always difficult. When it is further appreciated that emergency developments can demand almost an immediate achieving of the connection, yet without any possibility of an improper or incomplete mating of the connector halves, the need for an improved connector over what is currently available should be manifest.

Accordingly, the invention has for a general object the provision of a compact electrical connector that will possess a number of features required in specialized applications, only certain of which features have been available in the past. In other words, while individual features have been incorporated into some prior art connectors, and sometimes a combination of desirable features, the need still remains for a connector having a number of features contained in a single connector without degradation of any particular feature.

A more specific object of the invention is to provide an electrical connector, one half of which may be of conventional construction.

Another object of the invention is to provide a releasable electrical connector in which the mechanical coupling is first initiated, and then grounding or shielding is accomplished before engagement of the electrical contacts with the contacts of the other connector half, all of which is accomplished in sequence by a simple twisting action.

A further object is to provide a connector in which the coupling and contact engagement can be effected with but very little manual force. Not only are antifriction means employed, but the shell with the pin contacts carries a grounding ring possessing a configuration that automatically completes a grounding path with but little frictional resistance.

Another object of the invention is to provide a grounding ring that not only contributes a small amount of resistance to movement, as in the preceding object, but which functions in a manner to assure that a good electrical path to ground will be provided.

A further object of the invention is to effect a mating of the electrical contacts of two connected halves and the latching of the two halves together with but a simple rotation of the outer or coupling sleeve.

Another object is to provide spring means that will always assure that the movable set of contacts will normally be retracted into a protected position where they are not vulnerable to damage, such a feature also eliminating any time that the person performing the coupling operation would be compelled to take in first manually retracting the pin contacts in preparation for their proper advancement toward the socket contacts.

The invention has for an additional object the providing of indicating means that can be both seen and felt when the connector halves have been fully coupled together.

Still further, an important object of the invention is to provide a releasable connector that will be certain to separate when subjected to prescribed load conditions, thereby making it also exceedingly reliable in this respect.

Yet another object of the present invention is to provide rotatable means for anchoring the ends of a lanyard in a manner such that fouling and shortening thereof due to twisting is avoided.

It is also within the contemplation of the invention to provide means for attaching a backshell to the connector in any angular position oriented about the longitudinal axis of the connector.

Briefly, the invention envisages a connector composed of two separable halves or components that remain latched together until a sufficient load has been applied to pull them apart. To couple or latch the connector halves or components together and at the same time cause their respective contacts to become engaged, the two halves need only be pushed toward each other followed by a relative rotation. First, the bayonets on the conventional half are moved into juxtaposition with the pawls on the other half. Secondly, the linear keys of the second half engage the prealigned keyways, of the first half. As the keys move further into the keyways, the spring tines on the grounding ring meet the end of the shell of the first connector half. Thirdly, rotation of the outer coupling sleeve or the second half causes the following to occur in sequence: the pawls to be angularly shifted into latching engagement with the bayonets, the grounding spring tines to move into the shell of the first half; advancement of the pin contacts into engagement with the socket contacts; compressive facial deformation and sealing; actuation of an indicator button; prevention of rotational unlatching of the pawls from the bayonets, and finally an engagement of antirotational detent means.

Any preferred number of coiled tension springs assure that the mating of the contacts is started from a retracted position. A special grounding ring has its spring tines or fingers forced inwardly in what is believed to be a unique way, the establishing of a grounding path occurring simultaneously with the advancing of the pin contacts into the socket contacts.

The ends of a lanyard are anchored in a ball bearing assembly and allow the connector to be swiveled with respect to the lanyard which not only prevents fouling of the lanyard but permits the latching operation to be easily accomplished. Also, since the conductors or wires from the connector may have to extend in virtually any angular direction, the means by which a backshell is attached is of value when practicing the general teachings of my invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of my connector with the lower half or component ready to be moved upwardly and coupled to the upper connector half;

FIG. 2 is an elevational view of the coupled connector;

FIG. 3 is a sectional view depicting the connector with the halves or components thereof coupled together but with the shell and its pin contacts (one shown) being advanced downwardly to effect engagement with the socket contacts (one shown);

FIG. 4 is a view generally similar to FIG. 3 but on a somewhat larger scale and with the advancing action just starting;

FIG. 5 is a fragmentary sectional view of the grounding ring, the view being even larger than in FIG. 4 and the phantom position of the spring tine illustrating the position into which it is flexed by the sleeve of the lower connector half when the

shell on which the ring is carried has been advanced downwardly to its fullest extent;

FIG. 6 is a side elevational view of the grounding ring on a smaller scale than in FIGS. 3, 4 and 5 with several of the spring tines removed in order to show its construction to better advantage; and

FIG. 7 is a bottom plan view of the grounding ring for the purpose of picturing its configuration with even clarity.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in detail to the drawings, the releasable electrical connector exemplifying my invention has been designated in its entirety by the reference numeral **10**. The connector **10** comprises a first half in the form of a receptacle component or unit **12** and a second half in the form of a plug component or unit **14**.

The usefulness of the invention will be better appreciated, it is believed, if the environment with which the connector **10** will find especial utility is generally referred to. Accordingly, a fragmentary portion of an object **16** to be jettisoned, such as a missile or fuel tank, is depicted in FIGS. **1–3**. It is this device that the component **12** is secured to. A small section of a steel bar **18** also is shown, this section appearing in FIGS. **1** and **2**. It will be appreciated that the bar **18** would be attached to the underside of an airplane wing (not shown), actually extending horizontally through a pylon (also not shown). It will be recognized that the dimensions of a pylon are fairly small resulting in an interior that poses access problems. However, with the connector **10**, actually including the half **12** that is conventional, very little difficulty is encountered as will be more fully appreciated as the description progresses. One of the advantages of the present invention, as explained above, is that the component **12** may be of conventional construction. However, a brief description thereof will be of assistance in appreciating the benefits to be derived from a practicing of the invention. Therefore, it will be discerned that shell **20** has a cylindrical end portion **22**, an intermediate threaded portion **24** and a flange portion **26** (FIG. **3**), the flange portion **26** having an annular sealing groove **28** formed in the upper face thereof in which is disposed a resilient O-ring **30**. A backup nut **32** encircles the threads **24** so as to pull the flange **26** upwardly against the interior of the casing forming a part of the device **16**, thereby compressing the O-ring **30** to effect the sealing action.

Contained within the shell **20** is a dielectric insert **34** which functions as a holder for a plurality of female or socket contacts **36**, a number of such contacts being visible in FIG. **1** and one such contact being visible in FIGS. **3** and **4**. A plurality of angularly spaced keyways **38** collectively determine a configuration so that only a certain type of component **14** having a specified "live" contact pattern may be coupled the particular component **12**. Also, as can be seen from FIG. **4**, there is an internal groove **40** having a resilient O-ring **42** therein. Still further, three bayonets **44** project radially outward from the cylindrical end portion **22** of the sleeve **20**, these bayonets **44** being spaced at 120° locations.

Describing now the other component **14**, this component being constructed in accordance with the teachings of the present invention, it will be noted that a pawl carrier sleeve **50** is three slots **52** formed therein only one of which can be seen in FIGS. **3** and **4** owing to their 120° locations. A circumferential groove **54** contains a pawl collector spring or wire **56**. Three pawls **58**, only one of which is visible in FIGS. **3** and **4**, has an apertured end **60** through which the spring or wire **56** passes so as to pivotally mount each of the pawls for movement in a radial plane within its respective slot **52**. Close inspection of FIGS. **3** and **4** will show that the pawl **58** there illustrated has a latch tooth **62**, a finger **64** that limits inward movement, and a back limit edge **66** that restricts outward movement as will become clear hereinafter. The pawl **58** in each instance occupies approximately one-half the width of its slot **52**. The remainder of the slot **52** provides an opening or entranceway **68** for the accommodation or reception of one of the bayonets **44** on the sleeve **50** in manner better reserved for later discussion rotatively moves the pawls **58** into their latching relation with the several bayonets **44**. Hence, when the bayonets **44** are inserted in the openings **68** and are advanced upwardly toward the closed ends of the slots **52** to reach the position shown in FIGS. **3** and **4**, a small amount of twisting or rotative action of the sleeve **50** will bring the teeth **62** on the pawls **58** into a latched or coupled relationship with the bayonets **44**. Hence, it will be apparent that the bayonets **44** and the pawls **58** constitute a latching mechanism that maintains the components **12** and **14** in a coupled or locked relationship. However, the pawls **58** will be allowed to move outwardly and release the bayonets **44** in a manner later described.

At this time, attention is called to a dowel pin **70** that is pressed or force fitted into the pawl carrier sleeve **50**. The dowel pin **70** is instrumental in maintaining the latching action alluded to above. Actually, it extends into a groove **72** formed at the end of a drive sleeve **74**. The drive sleeve **74**, by means of ball bearings **76**, is rotatably connected to the pawl carrier sleeve **50**. More specifically, an internal groove **78** formed within the pawl carrier sleeve **50** partially receives the various ball bearings **76**. An external groove **80** cooperates with the groove **78** to receive therein the other half of the various ball bearings **76**. The manner in which the ball bearings **76** are introduced into the semicircular grooves **78, 80** is by means of a longitudinal groove **82** in the drive sleeve **74** as can be seen at the left in FIGS. **3** and **4**. However, a cooperating longitudinal groove in the interior of the pawl carrier sleeve **50** is not visible, being angularly displaced from alignment with the groove **82** that originally is made use of in inserting the various balls **76**. The dowel pin **70** assures that the two longitudinal grooves, that is the groove **82** and the one not shown, cannot be realigned so that the balls **76** can be dislodged. In practice the groove **72** would subtend an arc of about 95° which arc would not permit the alluded to groove registry because the dowel pin **70** would be confined to the arcuate length of the groove **72** and would strike either end of the groove before realignment could occur.

Securely held in the drive sleeve **74** and three pins **84** that carry rollers **86** thereon. The rollers **86** function as bearing elements to provide an antifriction action that will presently become manifest. At this time, through, it will be perceived that there is an outwardly extending flange or shoulder **88** at the upper end of the drive sleeve **74**. Also, the upper end of the drive sleeve **74** is counterbored at **90**. The reason for the flange or shoulder **88** in the counterbore **90** will be explained shortly.

Playing an important role in the present invention is a shell **92** having formed therein helical ramp grooves **94** which terminate in a first, relatively short, circumferentially directed end section **96** and a second, relatively short, circumferentially directed end section **98** that curves downwardly to form a detent for its particular roller **86**, the various rollers **86** in this way being retained in the detent sections **98** when at the upper ends of the ramp grooves **94**. Closing the end section **96** of each helical ramp groove **94** is a collar **104** Consequently, the various rollers **86** are held captive and can move in the helical ramp grooves **94** from the end sections **96** until they reach the detent end sections **98**. It will be recognized from the description up to this point that the drive sleeve **74** is twisted or rotated to cause the shell **92** to be either advanced or retracted. Just as the rollers **86** approach the detent ends **98** of the helical grooves **94**, this being the dotted position of the roller **86** in FIG. **3**, the end of the groove **72** blocks the dowel pin **70** extending inwardly from the pawl carrier sleeve **50**. It will soon be seen that at this state any rotation of the pawl carrier sleeve **50** in a direction to shift the pawl **58**, more specifically their latching teeth, from an obstructive or latching relation with the bayonets **44** is precluded.

A circumferential groove **106** is located intermediate the ends of the shell **92**. Describing the circumferential groove

106 with greater particularlity, as can be seen best from FIG. 5, the groove has a lip 106*a* and a lip 106*b*, the latter lip 106*b* forming an upwardly directed circular groove 106*c*. The function of the groove 106 will be explained hereinafter.

Beneath the circumferential groove 106 is a cylindrical end portion 108 that is an integral part of the shell 92. It is on the exterior of the cylindrical end portion 108 that a number of keys 110 are formed, these keys being angularly oriented so as to ride or fit within the previously mentioned keyways 38 on the interior of the cylindrical end portion 22 belonging to the sleeve 20 of the component 12.

Near the upper end of the shell 92 is a splined section 112 comprising a number of inwardly directed angularly spaced teeth. Just beneath the splined section 112 is an internal groove 114 that contains therein a resilient O-ring 116. ABove the splined section 112 is an internally threaded section 118.

Within the shell 92 is a rubber insert 120 that has mounted therein a number of pin contacts 122, the pin contacts 122 being matable with the previously mentioned socket contacts 36 of the receptacle component 12. In other words, the various socket contacts 122 constitute a second contact means, the two being engageable with each other to complete a preferred number of electrical paths.

The circumferential groove 106 has already been mentioned. It is at this time that the function of the groove 106 will become understandable. Within the groove 106 is a metal grounding ring 124 having a split band 126 forming a gap at 127 as can be discerned from FIG. 7. The grounding ring 124 forms a relatively large number of resilient tines 128 having reversely bent ends 128*a* where the tines 128 are attached to the split band 126. The tines 128 include straight shank portions 128*b* that diverge downwardly and outwardly from the band 126. The shank portions 128*b* merge into inwardly and downwardly inclined cam portions 128*c*. At the lower ends of the cam portions 128*c* are straight tips 128*d*. Hence, it will be appreciated that the upper lip 106*a* bears against the reversely bent ends 128*a* of the grounding ring 124 and that the lower lip 106*b* serves to limit the outward movement of the various tips 128*d*, confining them to the upwardly facing groove 106*c* forming a part of the groove 106. The various tines 128 have spaces 130 therebetween.

A backshell 132 has a cylindrical end portion formed with an external splined section 134 providing a number of teeth that mesh with the teeth constituting the previously mentioned splined section 112 on the interior of the shell 92. Above the external splined section 134 is an annular rib 136 that is integral with the backshell 132. A nut 138 has a lip 140 (FIG. 4) bent over the rib 136 so that the nut 138 causes the backshell 132 to be moved downwardly when the nut is rotated in a clockwise direction. There are external threads 142 that engage the previously mentioned threads 118 formed on the interior of the shell 92. Hence, there is a downward advancement of the backshell 132 in order to effect an intermeshing of the splined sections 112, 134 It will be pointed out at this time that by means of the interfitting splined sections 134 and 122, the backshell 132, which is actually in the form of an elbow as an be seen in FIG. 1, and can be readily oriented in any angular direction. The tapered end 144 of the backshell 132 limits the downward movement of the backshell, bearing against a corresponding tapered internal shoulder 145 in the shell 92 when the splined sections 122 and 134 are fully engaged. It is by means of flats 146 formed on the nut 138 that the rotation of the nut is accomplished when engaging the backshell.

From FIG. 1, it will be seen that a number of electrical conductors constitute a cable 148 that pass upwardly and outwardly through the backshell 132. It is these various conductors that form the cable 148 that are electrically connected with the various pin contacts 122. The cable 148 umbilically extends to the cockpit of the aircraft to thereby convey the control and information signals.

It is advantageous to employ a number of tension springs 150 having hooked ends 150*a* and 150*b*. The end 150*a* of each tension spring 150 is engaged in a hole 152 provided in the drive sleeve 74, whereas the end 150*b* of each spring 150 that is employed is engaged in a hole 154 in the shell 92. The tension springs 150 assure that various rollers 86 will be moved or biased upwardly into the end sections 98 of the helical ramp grooves 94 to cause the shell 92 and its pin contacts 122 to be normally retracted. Thus, when the connector components 12, 14 are to be coupled together the position of the shell 92 will be always known.

A coupling ring sleeve 156 has an internal shoulder at 157 against which the lower end of a coil spring 158 bears. The upper end of the coil spring 158 engages the earlier-mentioned shoulder 88 on the exterior of the upper end of the drive sleeve 74. The spring 158 determines the load that will effect a release of the two components 12 and 14 comprising the electrical connector 10. The spring constant can be selected so that the release is realized when a predetermined load is applied downwardly.

The upper end, labeled 160, of the coupling ring sleeve 156 acts as an outer bearing race, having formed therein a quarter-round groove 162. An inner race member 164 is employed, it having an external semicircular groove 166 extending circumferentially therearound. Confined to the grooves 162, 166 are a number of ball bearings 168, their retention being assured by reason of a ball retainer sleeve 170 that is press fitted between the outer race 160 and the inner race 164. There is a lip 171 integral with the upper end 160 that is bent or spun over so as to hold the retainer sleeve 170 captively in place.

A lanyard 172 has its bight portion extending over the previously mentioned steel bar 18. The lower ends of the lanyard 172 are anchored to the inner race member 164. To do this, a pair of diametrically located axial passages 174 are drilled downwardly into the race member 164 and it is through these passages that the lower ends of the lanyard 172 extend into radially directed recesses 176. By means of bands 178 that are crimped onto the lower extremities of the lanyard, the removal of the lanyard 172 from its anchored relationship is prevented.

Since it is of the utmost importance to make certain that the component 14 is properly coupled to the component 12 and that the contacts 122 mated with the contacts 36, a visual means for determining this is provided. From FIG. 3, it will be observed that an indicator button 180 has a tip 182 on a shank 184 that will be projected radially outward onto its dotted position when the proper coupling has been made. There is a flange 186 on the button 180 and inwardly of the flange 186 is a rounded head 188. The indicator button 180 is constrained for radial movement by reason of a passage 190 that has an inwardly directed lip 192 forming an opening having a diameter such that the top 182 can be forced outwardly therethrough. A compression spring 194 is confined between the flange 186 and the lip 192. Because of a groove 196 in which the rounded head 188 rides until the contacts 122 and 36 have been mated, there will only be a projecting of the tip 182 when there is a complete engagement of the contacts.

At this time, the manner in which rotation from the outer or coupling ring sleeve 156 to the pawl carrier sleeve 50 is accomplished will be described. At a location subjacent the ball bearing assembly 160–164 for the lanyard 172 are any preferred number of linear keyways 198 formed in the interior of the coupling ring sleeve 156, more specifically in an inwardly directed flange 200 integral with the sleeve 156. Received in the keyways 198 are radially projecting keys 202 on the drive sleeve 74, two of which keys 202 can be seen in FIG. 4. In this way the drive sleeve 74 is rotatively coupled to the coupling sleeve 156, yet the sleeve 156 can move longitudinally or axially with respect to the sleeve 74 when the spring 158 is subjected to a sufficient compressive load.

From the drive sleeve 74 rotative forces are transmitted to the pawl carrier sleeve 50 through the intermediary of coil springs 204, much like the earlier-mentioned springs 150. As with the springs 150, two springs 204 are employed in the illustrated situation. Close inspection of FIG. 3 will reveal that the upper of the two springs 204 has one hooked end 204*a*

anchored in a hole **206** provided in the drive sleeve **74**. The other end of the upper spring **204** is not visible but it can be seen that the hooked end **204***b* of the lower spring **204** is attached to pawl carrier sleeve **50** by means of a hole at **208**. Hence, when the drive sleeve **74** is rotated by the coupling ring sleeve **156**, the springs **204** act to rotate the carrier sleeve **50**. It will be recalled that the sleeve **50** is rotatively connected to the sleeve **74** by means of the ball bearings **76**. It is in this way, through, that the pawls **58** are angularly shifted into latching engage carried on the sleeve **50**.

OPERATION

Although fragmentary portions of the operation of my connector **10** have been presented concomitantly with the description of the various parts of which it is comprised, nonetheless a brief sequential explanation of how the parts interact will be of assistance in completely understanding the benefits to be gained from a practicing of the invention. Assuming that the connector component **12** has been mounted on the object or device **16** to be released or jettisoned, the component **12** is moved upwardly so that its bayonets **44** enter the openings or entranceways **68**. Continued movement upwardly causes the bayonets **44** to pass along one side of the pawls **58**. Since a given pawl fills or occupies only about half the width of its slot or groove **52**, leaving the other half of the slot available for the upward passage of a bayonet **44**, it will be appreciated that sufficient upward movement of the connector component **12** will result in the bayonets **44** reaching the closed or upper ends of the various slots **52**. This positions the bayonets **44** at a height so that the latch teeth **62** formed on the pawls **58** can be moved into obstructive relationship with the bayonets. Stated somewhat differently the two connector components **12**, **14** are in readiness at this stage to be mechanically coupled or latched together. The step that has been taken up to this point has been to merely have the bayonets **44** properly received in the slots **52**.

During the upward movement of the component **12** with respect to the component **14**, the keyways **38** receive therein the various linear keys **110**. It will be understood that once the keys **110**, relatively speaking, have entered the keyways **38** of the shell **20**, the keyways **38** actually being disclosed in what has been termed a cylindrical end portion **22** of the shell **20**, the shell **92** of the connector component **14** is constrained for only axial or longitudinal movement with respect to the shell **20**. When the bayonets **44** reach a height within the various slots **52** just above the latch teeth **62** on the pawls **58**, the spring tines **128** of the grounding ring **124** are just starting to engage the circular edge of the cylindrical end portion **22** of the shell **20**. This relationship can be readily seen from FIG. **4**.

Having inserted the bayonets **44** in the manner described above, the outer or coupling ring sleeve **154** can then be rotated. The initial rotation of the coupling sleeve **154** results in the drive sleeve **74** being rotated also, this being by reason of the interfitting keys **202** and the keyways **198**. Owing to the coil springs **204** which connect from the drive sleeve **74** to the pawl carrier sleeve **50**, the elongation of the springs **204** will exert a rotative pull on the carrier sleeve **50** with the consequence that the latch teeth **62** formed on the pawls **58** will be moved into obstructive engagement with the bayonets **44**. It will be remembered that the pawls **58** are mounted on the carrier sleeve **50** by reason of the spring or wire **56** that is contained in the peripheral groove **54**. The roller **86** that is visible in FIG. **4** will simply be moved to the position in which it appears, being moved from the extreme end of the groove section **96**. In other words, the particular roller **86** will be shifted toward the left this being the position that has been pictured. The point to be realized is that the various rollers **86** have not at this moment been moved into the helical ramp portions of the grooves **94**.

It is when the rollers **86** enter the inclined portions of the ramp grooves **94** that they act on the lower wall of these grooves so as to force the shell **92** downwardly. In other words, the shell **92** is advanced by means of the engagement of the several rollers **96** with one side of the respective ramp grooves The first thing that happens is that the spring tines **128** on the grounding ring **124** begin to enter the end portion **22** of the shell **20**, the shell **20** and its end portion **22** being a part of the lower component **12**.

As rollers **86** progress farther into the ramp grooves **94**, that is moving from the end sections **96** in the direction of the end sections **98**, the advancement of the shell **92** also increases. An intermediate stage of advancement is depicted in FIG. **3** where it will be discerned that the particular roller **86** that is visible in this FIG. is approximately midway between the end sections **96** and **98**. Hence, the various spring tines **128** on the grounding ring **124** have been moved from the position depicted in FIG. **4**, which position shows the spring tines **128** as just meeting the upper edge of the shell **20**, into a midway position as illustrated in FIG. **3**. What has occurred, as can be easily understood from FIG. **5**, is that the cam portions **128***c* have been forced inwardly by the cylindrical portion **22** of the shell **20** and that the shank portions **128***b* then bearing against the interior of the cylindrical end portion **22** of the shell **20** as graphically portrayed in FIG. **3**.

It should be manifest, especially from FIG. **3**, that as the spring tines **128** are moving downwardly within the cylindrical end portion **22** of the shell **20**, that the various pin contacts **122** are moving downwardly into the socket contacts **36**. There is, however, a delay intentionally introduced between the entry of the pin contacts **122** into the socket contacts **36** and the initial entry of the spring tines **128** into the circular end portion **22** of the shell **20**. By having the grounding spring **124** engage the shell **20** before any contact engagement is made, the appropriate shielding action is obtained.

A full mating of the pin contacts **122** with the socket contacts **36** occurs by the time that the rollers **86** reach the detent end sections **98** of the helical ramp grooves **94**. Owing to the slight downward curvature imparted to the end sections **98**, they function as detents for holding the rollers **86** at the end of their travel within the grooves **94**. Concurrently with the rollers **86** reaching the detent end sections **98** is the facial compression of the rubber insert **120** against dielectric insert **36** contained in the shell **20**. This not only provides a good sealing action as far as the mated contacts **122** and **36** are concerned, but the tendency for the rubber insert **120** to return to its uncompressed state forces the detent end sections **98** tightly against the rollers **86** so as to assist in the retention of these rollers within the end sections **98** and thus avoid any undesired return travel of the rollers **86** within the helical ramp grooves **94**. This is an important feature of the invention.

It is the rotation of the outer or coupling ring sleeve **156** that produces the downward movement or advancement of the shell **92**. The pawl carrier sleeve **50** cannot be rotated after its angular shift has taken place, because the bayonets **44** prevent further rotation after such initial angular shift. However, since the outer or coupling ring sleeve **156** is being rotated relative to the carrier sleeve **50**, it follows that the rounded head **188** of the indicator button **180** is moving in the groove **196** formed on the exterior of the carrier sleeve **50**. When the rounded head **188** has been rotatively advanced sufficiently so as to reach the end of the groove **196**, the groove extending only over a segment of the exterior of the carrier sleeve **50** as hereinbefore explained, the head **188** will ride out of the groove onto the cylindrical surface of the carrier sleeve **50**. Thus, the indicator button **180** is literally cammed outwardly so that its tip **182** is projected into the dotted outline position appearing in FIG. **3**. In other words, the indicator button **180** is projecting outwardly and the tip **182** can be either visually seen or can be felt, usually the latter being the way in which the full coupling is checked.

When the button **180** is thrust outwardly at the end of the groove **196**, it will be recognized that the groove **72** is continually being rotated by reason of the fact that it is formed on the drive sleeve **74**. Just after the button **180** has been forced

outwardly, the end of the groove **72** is brought into adjacency with the dowel pin **70**. It does not actually engage the dowel pin **70** but the end of the groove **72** is sufficiently close thereto so that there can be no backward rotation of the dowel pin **70**. It will be recalled that the dowel pin **70** is affixedly held by the pawl carrier sleeve **50**. Since the pawl carrier sleeve **50** supports the various pawls **58**, there can be no backward shifting of the pawls **58** so as to allow the disengagement of the bayonets **44** with respect to the latch teeth **62**.

Inasmuch as it is within the contemplation of the invention to allow the pawls **58** to release the bayonets **44** when the connector **10** is subjected to a sufficient load, the coil spring **158** will compress enough under predetermined load conditions so that the outer or coupling ring sleeve **156** can move upwardly to expose the pawls **58**. When the sleeve **156** is in an overlying relationship with the pawls **58**, the back edge **66** bears against the interior of the sleeve **156**. It is only when the sleeve **156** has been moved sufficiently upwardly, the coil spring **58** compressing to permit this, that the pawl **58** can release the bayonets **44** with the consequence that the connector component **12** is free to separate from the component **14**.

Although not visible from the drawings, one highly desireable result derivable from a practicing of the invention is that the resistance encountered by the downward movement of the shell **92** can be compensated for. Stated somewhat differently, the resistance met with as the shell **92** is advanced downwardly is not uniform, yet a uniform, low resistance torque is very desirable as far as the twisting action applied to the outer or coupling ring sleeve **156** is concerned. The reason for the nonuniformity as far as resistance to mating of the contacts **122** with the contacts **36** is concerned is because initially the spring tines of the grounding ring **124** must be deflected inwardly. While the configuration of the grounding ring **124** as shown in FIG. **5** minimizes the force needed to deflect the various tines **128**, nonetheless there is a resistance to advancement of the shell **92** attributable to this initial insertion of the grounding spring **124** into the cylindrical portion **22** of the shell **20**. When the pin contacts **122** start to enter the socket contacts **36**, there is an additional increment of resistance encountered, and when the insert **120** abuts the insert **34**, there is still further resistance stemming from the force needed to compress the insert **120**.

Having presented an operational sequence and having mentioned the resistance that is experienced with respect to the downward movement or advancement of the shell **92**, it is believed that a sufficient background has been given so that a person familiar with the connector art will recognize that the helical ramp grooves **94** can be contoured or shaped so that the torque exerted by the person effecting the coupling of the two components **12, 14** together will be uniform even though the resistance is not uniform. It is virtually impossible to depict the curvature of the ramp grooves **94** so as to reflect this compensation, but it is felt that the compensation can be readily derived for a particular type of connector and that the mating and coupling of the two connector components **12, 14** together will be facilitated. Very briefly, several stepped increments of resistance are met, yet compensation is introduced so that the various degrees of interference as far as mating forces are concerned are simply not noticeable when a connector is constructed in accordance with the teachings of the present invention.

I claim:

1. A releasable electrical connector comprising first and second shells of a size such that an end portion on said second shell fits in an end portion on said first shell, latch means including a first plurality of latch members associated with said first shell and a second plurality of latch members associated with said second shell and angularly shiftable so that portions thereof are moved into a latching engagement with the first latch members for releasably coupling said shells together, first contact means contained in said first shell, second contact means contained in said second shell, means for initially shifting said second latch members so that said portions are moved into latching engagement with said first latch members, said portions being mounted for movement outwardly from said first latch members to cause release of said shells, means normally preventing radial outward movement of said portions, and means for then advancing said second shell with respect to said first shell in a rectilinear direction to effect engagement of said second contact means with said first contact means.

2. A releasable electrical connector in accordance with claim **1** including at least one longitudinal key on the exterior of said second shell and said first shell having at least one keyway therein complementing said key for constraining said second shell for rectilinear movement with respect to said first shell.

3. A releasable electrical connector comprising first and second shells of a size such that an end portion on said second shell fits in an end portion on said first shell, latch means including a first plurality of latch members for releasably coupling said shells together, first contact means contained in said first shell, second contact means contained in said second shell, at least one longitudinal key on the exterior of said second shell and said first shell having at least one keyway there in complementing said key for constraining said second shell for rectilinear movement with respect to said first shell, means for initially shifting said second latch members into latching engagement with said first latch members and then advancing said second shell with respect to said first shell in a direction to effect engagement of said contact means with said first contact means, said second shell being formed with a plurality of helical ramp grooves, said last-mentioned means including a drive sleeve encircling a portion of said second shell and a plurality of bearing members mounted on said drive sleeve and extending into said helical ramp grooves, and means rotatably mounting said drive sleeve with respect to said second shell.

4. A releasable electrical connector in accordance with claim **3** in which said bearing members include a roller for each helical ramp groove and a pin rotatably supporting each roller, each of said pins being fixedly attached to said drive sleeve and extending inwardly therefrom.

5. A releasable electrical connector in accordance with claim **4** in which said latch means includes a carrier sleeve, said drive sleeve being rotatably connected to said carrier sleeve, and said first plurality of latch members constitute a plurality of bayonets on aid first shell and said second plurality of latch members constitute a plurality of pivotal pawls carried ton said carrier sleeve for engaging said bayonets to effect the latching action.

6. A releasable electrical connector in accordance with claim **5** in which said carrier sleeve is formed with a plurality of generally longitudinal grooves for guiding said bayonets on said first shell rectilinearly into said second shell.

7. A releasable electrical connector in accordance with claim **6** in which said last-mentioned grooves each have an offset end portion into which said bayonets are received when said carrier sleeve is rotated in one direction relative to said first shell to move said pawls into latching engagement with said bayonets.

8. A releasable electrical connector in accordance with claim **7** including a coupling ring sleeve, and spring means normally urging said coupling ring sleeve into an obstructive encircling relation with said pawls to prevent outward pivoting of said pawls and thereby maintain said coupling engagement.

9. A releasable electrical connector in accordance with claim **7** in which said coupling ring sleeve has an internal shoulder, said spring means constituting a coil spring having one end bearing against said shoulder, and said drive sleeve having an outwardly projecting shoulder the other end of said coil spring bearing against said outwardly projecting shoulder.

10. A releasable electrical connector in accordance with claim **9** in which said coupling ring sleeve forms an outer bearing race, an inner bearing race rotatably disposed within said outer race, a plurality of ball bearings located between said races, and a flexible lanyard having its ends anchored in said inner race.

11. A releasable electrical connector in accordance with claim 8 in which said second shell has circumscribed thereabout a grounding ring, said grounding ring being located so as to be received within the end portion of said first shell when said second shell has its end portion advanced thereinto.

12. A releasable electrical connector in accordance with claim 12 in which said second shell has a circumferential groove, an inner portion of said grounding ring being contained in said groove and said grounding ring having an outwardly diverging portion which bears against the end portion of said first shell when said end portion of said second shell is advanced into said first shell.

13. A releasable electrical connector in accordance with claim 12 in which said grounding spring includes a split band disposed in said circumferential groove and the outwardly diverging portion includes a plurality of individual spring tines, the free end of said tines curving inwardly toward said second shell.

14. A releasable electrical connector in accordance with claim 8 in which said coupling ring sleeve has a radially directed passage, an indicator button disposed within said passage, and a coil spring normally urging said button inwardly, said carrier sleeve having a groove extending part way therearound, said indicator button being forced outwardly at one end of said carrier sleeve groove so as to signify when said contact means have been engaged ad the latching of said pawls with said bayonets has been effected.

15. A releasable electrical connector in accordance with claim 10 in which said second shell is provided with an internally splined section formed in a portion nearer the other end of said shell, and a backshell member having an externally splined section engageable with said internally splined section, thereby allowing said backshell to be selectively oriented in an angular direction with respect to said second shell.

16. A releasable electrical connector in accordance with claim 4 in which said helical ramp grooves have detent sections at one end for receiving therein said rollers, and said second shell containing therein a compressible insert in which said second contact means are mounted, whereby when said drive sleeve is rotated to advance said second shell toward said first shell to effect mating of said second contact means with said first contact means said insert will be compressed to hold said detent sections against said rollers.

17. A releasable electrical connector comprising first and second components, said first component including first contact means and a plurality of outwardly directed bayonets, said second component including a pawl carrier sleeve having internal slots extending longitudinally from one end, a plurality of pivotal pawls partially occupying the width of said slots so that said bayonets can pass thereby, a drive sleeve, means rotatably connecting said drive sleeve to said carrier sleeve, a plurality of inwardly projecting elements journaled on said drive sleeve, a shell having inclined grooves into which said elements extend, second contact means supported on said shell so as to be movable therewith, means constraining said shell for rectilinear movement so that said second contact means are advanced with said shell into proper engagement with said first contact means, ad means for rotating said drive sleeve to cause said elements to advance said shell.

18. A releasable connector in accordance with claim 17 in which said inwardly projecting elements include a plurality of rollers journaled on said drive sleeve and said means for rotating said drive sleeve includes a coupling ring sleeve longitudinally keyed to said drive sleeve, a first coil spring having one end attached to said drive sleeve and its other end attached to said shell to retract said shell, a second coil spring having one end attached to said drive sleeve and its other end to said carrier sleeve so as to rotate said carrier sleeve and its pawls into latching engagement with said bayonets when said drive sleeve is rotated by said coupling sleeve.

19. A releasable electrical connector in accordance with claim 18 including an inwardly directed dowel pin on said carrier sleeve, said drive sleeve having a segmental groove into which said dowel pin extends, whereby rotation of said drive sleeve causes the end of said segmental groove to move into adjacency with said dowel pin when said rollers have fully advanced said shell and reside at one end of said inclined grooves.

20. A releasable electrical connector in accordance with claim 20 in which said one end of each inclined groove is formed with a detent portion for holding said rollers therein to prevent retraction of said shell.

21. A releasable electrical connector in accordance with claim 17 in which said means for rotating said drive sleeve includes a coupling ring sleeve in an axial location such that said pawls are prevented from pivoting outwardly to unlatch said bayonets until a predetermined load has been applied to overcome the reactive force of said compression spring and thereby allow said coupling ring sleeve to move out of obstructive engagement with said pawls so that said bayonets are released by the outward pivoting of said pawls.

22. A releasable electrical connector in accordance with claim 17 including a grounding ring on said sleeve, said ring including a band portion and resilient tine elements integral with said band portion, said first component including a shell encircling said first contacts, and said tine elements being flexed toward said first-mentioned shell when inserted into said last-mentioned shell.

23. A releasable electrical connector in accordance with claim 22 in which said tine elements include relatively straight shank portions diverging outwardly and curved cam portions on said shank portions curving inwardly, said last-mentioned shell first engaging said cam portions and then said shank portions as said first-mentioned shell is advanced.

24. A releasable electrical connector in accordance with claim 23 in which said shell has a circumferential groove formed therein, said band portion residing in said groove and said cam portions having top portions integral therewith and extending generally parallel to said band portion, said shell having a lip portion encircling said tip portions.

25. In a releasable electrical connector, sleeve means, latch means at one end of said sleeve means, a shell, contact means supported on said shell, means mounting said shell within said sleeve means for relative movement toward said latch means, second sleeve means encircling said first sleeve means, said latch means including a plurality of pivotal pawls, and spring means urging said second sleeve means into an obstructive relation with said pawls to prevent outward pivoting thereof until the action of said spring means is overcome.

26. A releasable electrical connector in accordance with claim 25 including a grounding ring disposed on the exterior of said shell so as to be movable with said shell and contact means.

27. A releasable electrical connector in accordance with claim 26 including a rotatable bearing means affixed to said second sleeve means adjacent the end thereof remote from said latch means, and a lanyard having its ends anchored in said bearing means so that said first and second sleeve means together with said shell may be swiveled with respect to said lanyard.

28. A releasable electrical connector in accordance with claim 27 including an internally splined section on said shell, a backshell having an externally splined section engageable with said internally splined section, and means for maintaining said splined sections in a preferred angular relationship to angularly orient said backshell.

29. A releasable electrical connector comprising first and second shells of a size such that an end portion on said second shell fits in an end portion on said first shell, latch means releasably coupling said shells together, first contact means contained in said first shell, second contact means container in said second shell, means for advancing said second shell with respect to said first shell in a direction to effect engagement of said second contact means with said first contact means, at least one longitudinal key on the exterior of said second shell sad said first shell having at least one keyway therein complementing said key for constraining said second shell for

rectilinear movement with respect to said first shell, said second shell being formed with a plurality of helical ramp grooves, a drive sleeve encircling a second portion of said second shell being formed with a plurality of helical ramp grooves, a drive sleeve encircling a second portion of said second shell, a plurality of antifriction members mounted on said drive sleeve and extending inwardly into said helical ramp grooves, means rotatably mounting said drive sleeve with respect to said second shell, and at least one coil spring having one end attached to said second shell and the other end thereof to said drive sleeve, whereby said second shell and said second contact means are normally maintained in a retracted position.

30. A releasable electrical connector comprising first and second components, said first component including a cylindrical shell having a plurality of latch members thereon and contact means contained in said shell, said second component including a cylindrical shell having at least one inclined groove, contact means contained in said second shell engageable with said first-mentioned contact means, a first sleeve rotatively encircling said second shell and having bearing means extending into said groove for longitudinally moving said second shell in the direction of said first shell when said first sleeve is rotated in one direction, a second sleeve having a plurality of latch members thereon cooperable with said first-mentioned latch members, yieldable resilient means interconnecting said first and second sleeves so that when said first sleeve is initially rotated in said one direction said second sleeve will be rotated to angularly shift said second-mentioned latch members into a latched relationship with said first-mentioned latch members, whereby further rotation of said first sleeve moves said second shell in the direction of said first shell to effect an electrical engagement of said second-mentioned contact means with said first-mentioned contact means.

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,609,632 Dated September 28, 1971

Inventor(s) Ottomar H. Vetter

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 13, "on" should be --one--. Column 3, line 53, after "coupled" insert --to--; line 62, delete "is" and insert --has--. Column 4, line 2, after "sleeve" insert --20 of the component 12. A rotative shifting of the sleeve--; line 42, "and" should be --are--. Column 5, line 15, "ABove" should be --Above--; line 21, after "contacts" insert --36 constitute one contact means, whereas the pin contacts--; line 55, after "134" insert --.--; line 56, "122" should be --112--; line 62, "corresponding" should be --correspondingly--; line 63, "122" should be --112--. Column 6, line 50, "top" should be --tip--. Column 7, line 10, delete "engage" and insert --engagement with the bayonets 44, since the various pawls 58 are--. Column 8, line 3, after "grooves" insert --94.--. Column 9, line 19, "pawl" should be --pawls--; lines 22-23, "desirea-ble" should be --desirable--. Column 10, line 17, after "members" insert --associated with said first shell and a second plurality of latch members associated with said second shell and angularly shiftable into a latching engagement with the first latch members--; line 45, "aid" should be --said--. Column 11, line 7, "12" should be --11--; line 26, "ad" should be --and--; line 58, "ad" should be --and--. Column 12, line 6, "20" should be --19--; line 11, after "sleeve" insert --encircling said carrier and drive sleeves, and a compression spring reactively engaging said drive sleeve and said coupling ring sleeve to position said coupling ring sleeve--; line 69, "container" should be --contained--. Column 13, lines 3-5, delete "a drive sleeve encircling a second portion of said second shell being formed with a plurality of helical ramp grooves,".

Signed and sealed this 9th day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents