# United States Patent [19]

**Marechal**

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[54] **CONNECTOR TERMINAL HAVING A CONTACT SOCKET ASSEMBLY FOR RECEIVING THE END OF A CONDUCTOR**


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**Related U.S. Application Data**

[63] Continuation-in-part of Ser. No. 166,789, July 28, 1971, abandoned.

[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** .....**339/272 R,** 24/125 N
[51] **Int. Cl.** .....**H01r 11/10**
[58] **Field of Search**.....339/45, 272; 24/125 N, 135 N



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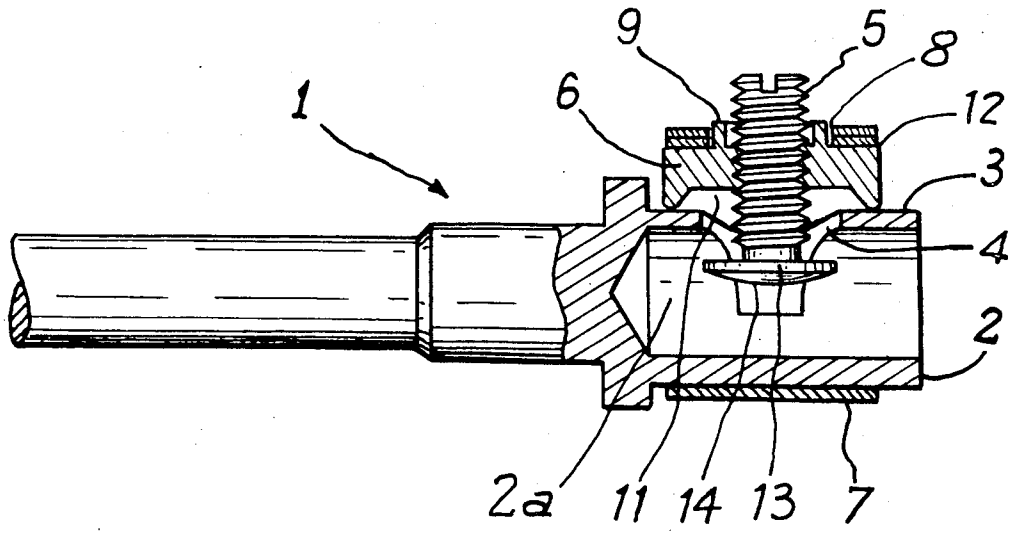
[57] **ABSTRACT**

In order to resiliently clamp the stripped end of a conductor to a connector terminal, the latter is provided with a contact socket assembly in which the clamping setscrew is threadedly supported by a nut held on the socket casing by a resiliently deformable spring band. In the operative position of the contact socket assembly, the nut is spaced from the casing wall and the setscrew clamps down on the conductor end by virtue of the force exerted thereon by the deformed spring band.


**13 Claims, 7 Drawing Figures**



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2 Sheets-Sheet 1

Fig: 1

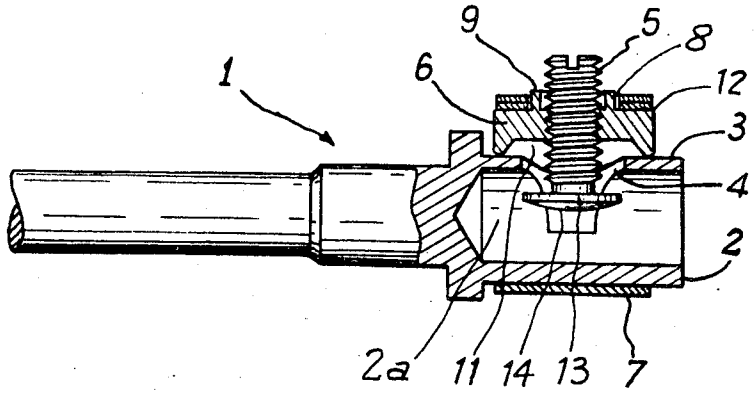


Fig: 2

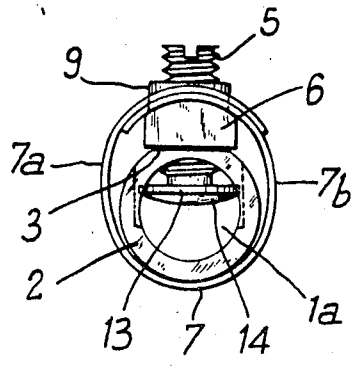


Fig: 3

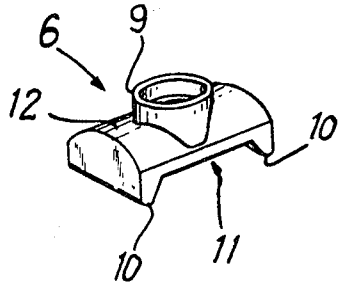


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Fig:4

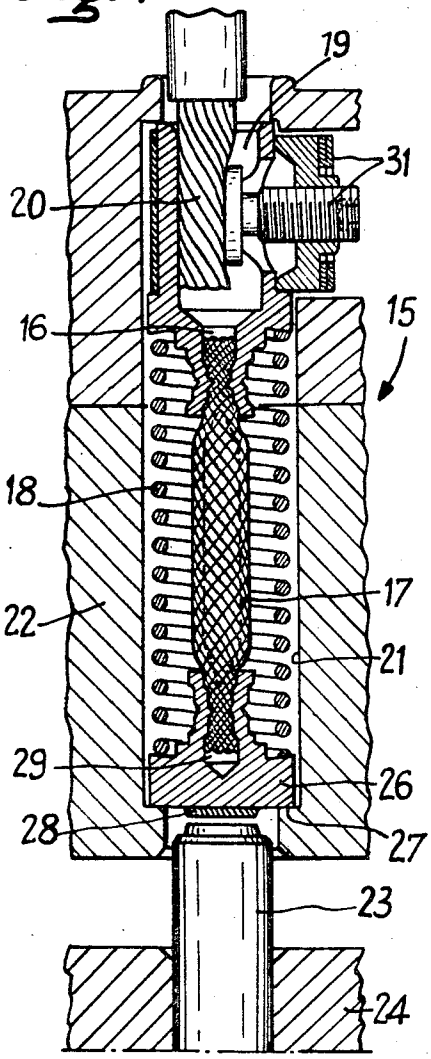



Fig:5

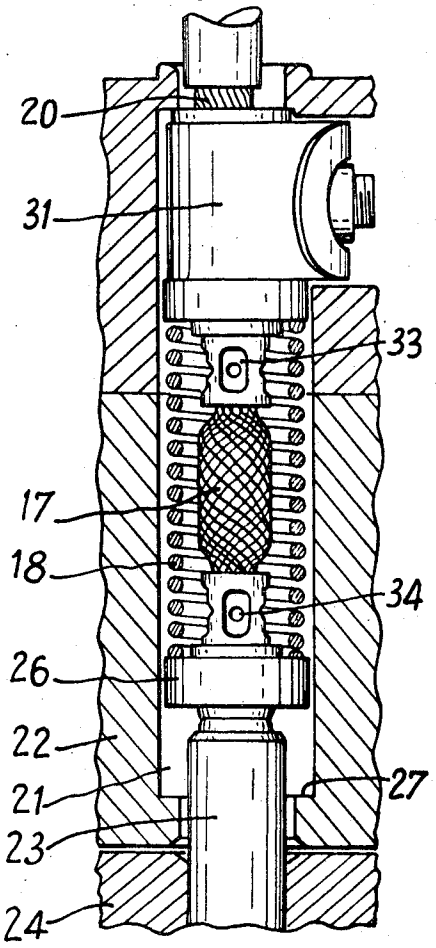



Fig:6

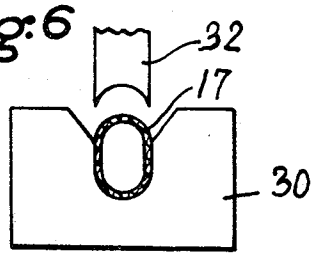
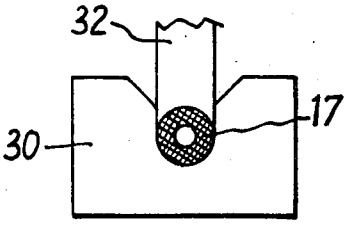



Fig:7



# CONNECTOR TERMINAL HAVING A CONTACT SOCKET ASSEMBLY FOR RECEIVING THE END OF A CONDUCTOR

This application is a Continuation-In-Part of application Ser. No. 166,789, filed July 28, 1971, now abandoned.

## BACKGROUND OF THE INVENTION

This invention relates to connector terminals of the type having at least one integral contact socket assembly for receiving the stripped end of a conductor, such as a multi-strand cable.

A number of clamping arrangements have been proposed for fastening the bared end of an electrical wire or cable in a contact socket.

Thus, some known devices utilize a simple setscrew which has an outwardly projecting head and which is screwed transversely across the body of the contact socket. Others comprise additional locking and wedging means for the conductor. These arrangements do not resist satisfactorily to sharp pulls on the conductor and have, among others, the disadvantage of not opposing accidental loosening of the screw especially under the effect of vibrations.

This is why other arrangements implementing locking by resilient clamping have been perfected.

According to one such arrangement, a resilient member, made for example of spring steel, is sandwiched between the conductor and the lower face of the projecting head of the setscrew. In this arrangement, as soon as the tightening motion of the setscrew is started, the conductor is subjected to an increasing elastic pressure. Thereafter, the end of the screw comes into contact with the resilient member and starts a direct clamping which continues until the locking of the conductor is achieved. The resilient member then assumes a role analogous to that of a resilient washer and opposes an accidental loosening of the screw. This arrangement has a disadvantage common to those already stated: the setscrew cooperates with a feeding thread in the body of the contact socket which is generally of brass and which therefore must have a substantial thickness. This requirement, in turn, increases the weight of a component made of a very expensive material.

Another arrangement for resiliently locking and clamping a conductor comprises a screw crossing freely the casing of the contact socket through an opening. The screw is in engagement with a nut situated on the exterior of the clamping socket and maintained against the latter by a non-deformable yoke applied to the lateral face of the clamping socket opposite said opening. The yoke has a planar face provided with an aperture for the passage of the screw while a resilient washer is interposed between the nut and the aid planar face of the yoke. The nut and the screw are made of steel. At the end of the clamping operation, the screw withdraws slightly from the contact socket by compressing the elastic washer against the planar face of the yoke. This arrangement eliminates the disadvantages previously mentioned, but still has a drawback common to all the known arrangements that is, a total, rigid locking of the screw. This risks a deterioration of the conductor and the engaged threads. This last-named arrangement introduces two additional disadvantages: an unsatisfactory guiding of the screw and a somewhat circumstantial assembly of four distinct components on the contact socket.



## OBJECT AND SUMMARY OF THE INVENTION

It is an object of the invention to provide an improved connector terminal of the aforeoutlined type which has relatively few components, is easy to assemble and ensures an improved, resilient contacting relationship between the strands of the conductor and the wall of the contact socket body.

Briefly stated, according to the invention, the contact socket assembly comprises a screw freely transversing the socket body through a lateral opening provided therein and cooperating with an externally situated nut. The latter is held against the contact socket body by a resilient band, preferably of spring steel, applied against the lateral face of the contact socket opposite the opening and against the external face of the nut. For the passage of the screw, the resilient band is provided with an aperture aligned with the base of said nut.

The invention will be better understood, as well as further objects and advantages become more apparent from the ensuing detailed specification of several exemplary embodiments taken in conjunction with the drawing.

## BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal section of a contact socket assembly according to the invention;

FIG. 2 is an end elevational view of the assembly shown in FIG. 1 taken from the right;

FIG. 3 is a perspective view of one component of the same assembly;

FIG. 4 is a longitudinal section of a female terminal incorporating the assembly shown in FIGS. 1–3;

FIG. 5 is a view similar to that of FIG. 4, showing the structure in an alternate position and

FIGS. 6 and 7 are schematic and elevational views of two operational positions of a form for preshaping a braided conductor.

## DESCRIPTION OF THE EMBODIMENTS

As shown in FIGS. 1–3, an electric terminal 1, here a male plug or jack, has at one end an integral socket body 2 which forms part of a contact socket assembly and which has an open-ended axial bore 2*a*. The latter receives the bared end of an electrical conductor having twisted strands (not shown).

The socket body 2 comprises an external planar surface portion 3, having a circular aperture 4 centered on the longitudinal axis of the surface portion 3.

The contact socket assembly further comprises a nut 6 which has a rectangular base 10 and an external face 12. The latter is cylindrical and has an axis which is parallel to the longer center line of the rectangular base 10. The base 10 which is designed to be placed on the planar surface portion 3 of the socket body 2 comprises at its middle portion, a recess 11 which, in the example shown, forms a broad transversal channel. The external face 12 of the nut 6 has at its center a cylindrical protrusion 9 traversed axially by a threaded nut bore.

The nut 6 cooperates with a headless screw 5 designed for clamping the conductor and which, at its extremity inside the axial recess 2*a* carries a disc 13 having a slightly convex work face 14. The diameter of the disc 13 is slightly smaller than that of the circular aperture 4. The depth and the width of the channel 11 in the

nut 6 are such that the disc 13 may be entirely withdrawn thereinto without protruding beyond the plane of the base 10.

The contact socket assembly further includes a strip of rolled spring steel forming a resilient band 7 designed to maintain the nut 6 securely on the planar surface portion 3 of the socket body 2. The band 7 has an oval cross section and is applied respectively against the lateral surface of the socket body 2 diametrically opposite the planar surface portion 3 and against the external face 12 of the nut 6, at the two ends of the major axis of the oval. The band 7 is provided with an opening to receive the protrusion 9 of the nut 6. In the emboidment shown, the last-named opening is provided in the two thicknesses of the band which overlap after formation of the closed band. This arrangement provides a fixation of the two extremites of the band and avoids the necessity of joining the overlapping layers by soldering or the like.

The components of the contact socket are assembled as follows: The screw 5 is threaded into the nut 6 from the side of its base 10 until the disc 13 entirely nests in the recess 11. Then, the screw-and-nut assembly is introduced into the band 7 in such a manner that the slotted end of the screw 5 and then the projection 9 pass through the opening in the wall of the band 7. Thereupon the latter is inserted onto the socket body 2, while the base 10 of the nut 6 glides on the planar surface portion 3 of the socket body 2. A few turns of the screw 5 suffice for the disc 13 to reach or pass through the aperture 4, whereupon the assembly of components 5, 6, 7 can no longer be separated from the socket body 2.

Subsequent to introducing the end of the electric conductor in the axial bore 2*a* of the socket body 2, the screw 5 is turned inwardly which brings the face 14 of the disc 13 against the conductor. By virtue of the engagement between the planar surface portion 3 of the socket body 2 and the base 10 of the nut 6, the advancement of the screw is effected perpendicularly to the axis of the socket bore 2*a*. As soon as the resistance of the conductor to the advancement of the screw reaches a certain magnitude, a further tightening of the screw 5 will cause a movement of the nut 6 away from the socket body 2, resulting in a deformation of the resilient band 7. Thus, the major axis of the band 7 increases, its minor axis decreases, while side portions 7*a*, 7*b* (FIG. 2) tend to assume a flat shape. It is apparent that the elastic resistance of the band 7 increases proportionally with its deformation and that it may be calculated to reach a greater value than that of the force of the screw before the deformation becomes maximum, that is, before the side portions 7*a* and 7*b* become actually planar. Thus, an extremely forceful clamping is obtained which, nevertheless, still remains resilient. Consequently, a completely rigid locking of the conductor will not occur.

It is to be noted that the convex form of the work face 14 of the screw 5 enhances its penetration into the conductor. Thus, the convex face 14 "bites into" the conductor spreading the strands without harming them and forcefully presses them against the internal surface of the contact socket assuring an almost individual contact between each strand, on the one hand, and the inner wall of casing 2, on the other hand. For a further improvement of the electric contact between the connector terminal and the conductor, the stripped end of the latter may be tinned and the setscrew 5 with disc 13 annealed or silver-plated.

Turning now to FIGS. 4 and 5, there is shown a female terminal 15 adapted to receive a prong or jack 23 of a male terminal 24. The terminal 15 incorporates a contact socket assembly 19, 31, identical in structure and in operation to the assembly described hereinabove in connection with FIGS. 1–3. Accordingly, to the terminal 15 there is secured, by means of the contact socket assembly 19, 31 a conductor by its stripped end 20. The socket body 19 has a crimping jaw 16 which holds one end of a tubular metallic braiding 17 disposed coaxially in a shaft 21 of the terminal base 22. The crimping jaw 16 is annealed and outwardly flared. The other end of the braiding 17 is affixed to a similar crimping jaw integral with a contact head 26 provided at its end with a silver or silverplated rivet 28. In the shaft 21 between the socket body 19 and the head 26 there is disposed a helicoidal spring 18 under compression, urging the contact head 26 into engagement with an inner annular shoulder 27 of the terminal base 22 in the absence of the prong 23. Each strand of the braiding 17 is tinned at least at its end. The diameter of the shaft 21 and the coil spring 18 is so designed as to allow a free ballooning of the braiding 17 when the head 26 moves inwardly.

After having cut the braiding 17 to the desired length, each of its ends are preshaped. For this purpose, as shown in FIGS. 6 and 7, each end is placed in a mold 30 having a channel of semicircular bottom and a width substantially equal to the smallest inner diameter of the crimping jaws 16, 29. The braiding then takes a substantially oval cross sectional shape (FIG. 6). A punch 32, the working surface of which is a corresponding semicircular groove, is then lowered (FIG. 7) to give the end of the braiding a circular cross section of small diameter. At the same time, this operation produces an increase in the thickness of the wall of the tubular braiding. Advantageously the ends of the braiding are then coated with conducting grease to correct any damage that might have been caused by the preshaping operation to the tinning of some of the strands. The braid ends are then introduced respectively into the crimping jaws 16 and 29. By virtue of the flared configuration of the jaws 16, 29, the said introduction may be performed with ease. Thereafter, the clamping is effected in a known manner. The clamping jaws are deformed circularly, or preferably hexagonally in order that the braiding be in alignment with the contacts.

In order to prevent the possible occurrence of an undesirable voltage drop due to a faulty annealing of crimping jaws 16, 29 resulting in an imperfect electric contact with the braiding 17, each crimping jaw is punched at diametrically opposite locations to provide clamping deformations such as indicated at 33 on the crimping jaw 16 and at 34 on the crimping jaw 29.

A structure as described in connection with FIGS. 4 and 5 improves the parasite contacts which appear in every electric connection and consequently reduces an ohmic voltage drop and thus the joule-type heat effect. The aforenoted pressure contact-type structure, however, has to be further improved for currents of more than 60 amperes.

The phenomenon of energy losses in such structure for currents in excess of 60 A is not yet well explained; it is the result of the interaction between the conductors forming the braiding 17 and the spring 18 which

probably gives rise to Foucault currents. The energy losses increase with the current intensity, with the number of turns of spring **18** and with the cross section of the spring wire.

It has now been found that, all other parameters being constant, the aforenoted energy losses decrease as the magnetic susceptibility of the spring material is decreased. Accordingly, the invention provides a spring which is made of a metal having the necessary resilient characteristics and has, in addition, a very small magnetic susceptibility.

As it may be observed from the Table which follows, the INOX 12 R 10 non-magnetic steel yields very satisfactory results. In the tests, in all instances the current intensity was 125 A, the spring **18** had 18 turns of a wire of 3.14 $mm^2$ cross section. The temperatures were taken at the base of the crimping jaw carried by the head **26.**

TABLE

| Type of the Spring Material (French Standard Designations) | Voltage Drop | Temperature of Heating |
|---|---|---|
| No Spring | 17.5 mV | 41°C |
| Electrolytic Copper | 18.5 mV | 39°C |
| INOX 12 R 10 non-magnetic steel | 17.5 mV | 41°C |
| INOX 18/8 Z 15 CN 18-08 Steel | 20 mV | 44°C |
| XC-70 Spring Steel, isolated from the contacts | 35 mV | 48°C |
| XC-70 Spring Steel, not isolated | 36.5 mV | 50°C |

The electric contact has to be established between the head **26** of the female member **22** and the prong **23** with a well defined firm pressure. The latter should not vary significantly while the contact is being made so as not to increase to an excessive extent the force of engagement. Also, in order to maintain the aforenoted voltage drop at a minimum value, it is essential not to increase the number of turns in the spring **18.** But, in order to ensure that the contact pressure varies only slightly as the contact head **26** moves between its two limiting positions, the closer the spring is to its relaxed position, the greater should be the number of turns. For reconciling the foregoing opposing requirements, and thus to ensure an approximately constant contacting pressure without considerably increasing the number of turns in the spring **18,** the latter is preferably used in the zone of half-compressed state instead of using it in the zone of its relaxed state. Consequently, even in the absence of the prong **23,** significant residual elastic forces will be present which normally would cause an elongation of the braiding **17,** a deterioration of the connection of the braiding **17** in the crimping jaws and eventually a deterioration of the braiding itself. For avoiding these harmful effects, the expansion of the spring **18** has to be limited. Thus, in accordance with the invention, the shaft **21** terminates in an inwardly extending radial shoulder **27** against which — as set forth earlier — the contact head **26** abuts under spring pressure in the absence of an external counterforce. In this manner the movement of the contact head **26** and thus the expansion of the spring **18** is outwardly limited. By virtue of this arrangement it is effectively prevented that at any time the force of the spring is transmitted to the braiding **17.** Such an occurrence would cause an undesired elongation of the braiding **17** and a weakening of its crimped connections.

What is claimed is:

**1.** A contact socket assembly for clamping an electric conductor, comprising,

A. an elongated socket body having

**1.** an axial bore open at least at one end,

**2.** a lateral opening,

B. a setscrew freely passing through said opening and having a path of travel normal to the axis of said axial bore, said setscrew adapted to press said conductor in said axial bore against said socket body,

C. a nut disposed externally of said socket body and having a threaded bore in alignment with said lateral opening for threadedly engaging and holding said setscrew and

D. a resilient band surrounding circumferentially said socket body and said nut to resiliently urge the latter into engagement with said socket body.

**2.** A contact socket assembly as defined in claim **1,** wherein said resilient band is in engagement with that part of said socket body which is diametrically opposed to said lateral opening.

**3.** A contact socket assembly as defined in claim **2,** wherein said nut has a curved external surface to conform to the curvature of that portion of said resilient band that is in engagement with said nut.

**4.** A contact socket assembly as defined in claim **3,** wherein said resilient band has the shape of an oval.

**5.** A contact socket assembly as defined in claim **1,** wherein said nut includes an outwardly extending annular projection surrounding an opening of said threaded bore, said band is provided with an aperture through which said projection passes.

**6.** A contact socket assembly as defined in claim **1,** wherein the external face of said socket body is provided with a planar surface portion surrounding said lateral opening, said last-named portion serving as an engagement face for said nut.

**7.** A contact socket assembly as defined in claim **1,** wherein said setscrew carries, on its end oriented towards said axial bore, a disc having an outer work face for engaging said conductor in said axial bore.

**8.** A contact socket assembly as defined in claim **7,** wherein said work face has an outwardly convex configuration.

**9.** A contact socket assembly as defined in claim **7,** wherein the diameter of said disc is slightly less than that of said lateral opening.

**10.** A contact socket assembly as defined in claim **9,** wherein that face of said nut which is oriented towards said socket body is provided with a recess to receive said disc when said setscrew is fully withdrawn from said axial bore.

**11.** A contact socket assembly as defined in claim **1,** extended by a clamping terminal in order to form a terminal designed to assure the connection between a flexible conductor inserted in the crimping terminal and the end of a cable introduced into the socket characterized in that the internal surface of the crimping terminal and each of the strands of the flexible conductor, at least in the neighborhood of its extremity, are protected by tinning and/or silver-plating; the said crimping terminal is annealed and presents a flared shape; the end of the flexible conductor being preshaped before mounting; said crimping terminal having two diametrically opposed stamping marks or clamping deformations.

12. A contact socket assembly as defined in claim 11, including a movable contact head, a braiding constituting said flexible conductor, said braiding having one end secured to said contact socket assembly and another end secured to said contact head, a coil spring surrounding said braiding and urging said contact head away from said contact socket assembly, said coil spring being made of a material of small magnetic susceptibility.

13. A contact socket assembly as defined in claim 12, including means defining a shaft accommodating said coil spring, said braiding and said contact head, a shoulder disposed in said shaft and in the path of travel of said contact head, said coil spring urging said contact head into engagement with said shoulder in the absence of external forces opposing said coil spring, said shoulder limiting the displacement of said contact head in a direction away from said contact socket assembly.

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