Oct. 16, 1962 J. D. CUNNINGHAM 3,059,216

ELECTRICAL CONNECTOR

Filed Nov. 13, 1958

Fig. 1.

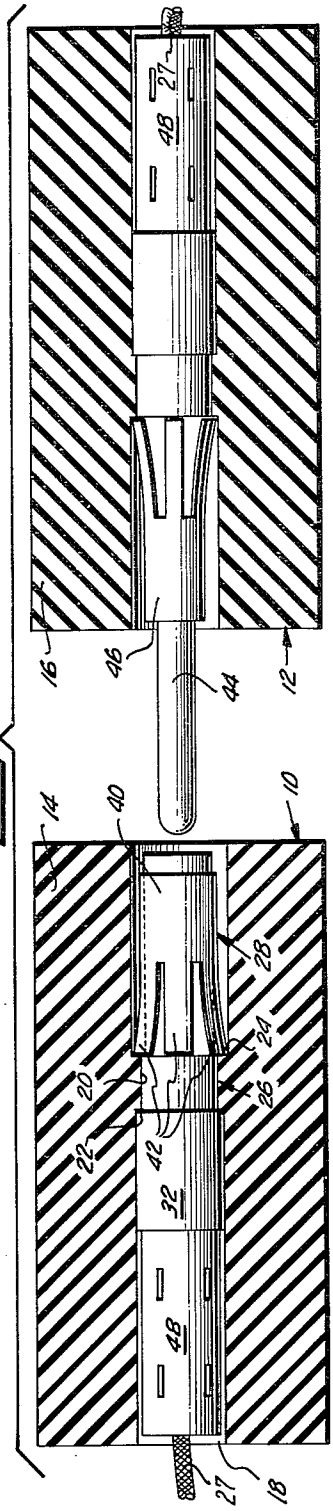


Fig. 2.

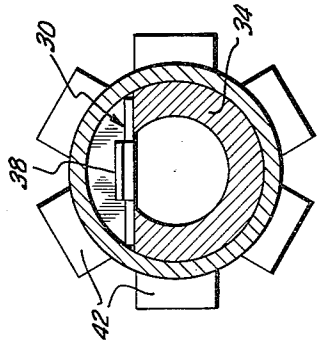


Fig. 3.

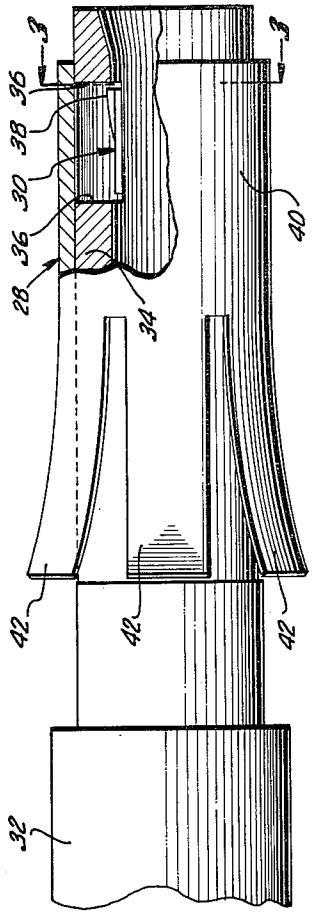
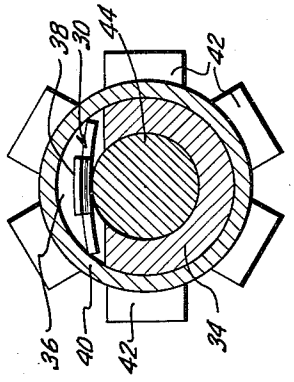


Fig. 4.



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ELECTRICAL CONNECTOR

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This invention relates to electrical connectors, and more particularly, is concerned with cable connectors having snap-in contacts of improved design.

Multiple-contact cable connectors are well known and may include a plurality of socket contacts secured in an insulating block with a plurality of corresponding mating pin contacts secured in the other block whereby multiple connections are completed by bringing the insulating blocks together and engaging the pins in the mating sockets. The use of contacts which can be snapped into position in the insulating block has found favor in recent years because the wires can be secured to the contacts by crimping or soldering more easily when the contacts are removed from the insulating block.

Optimum design requirements for multiple contact cable connectors impose the following limitations on design:

The contact pressure must be uniform and should be as low as possible to minimize insertion and withdrawal forces. Contacts must provide high conductivity and at the same time be strong and durable. Strength and durability are particularly important where test probes may be used for checking cable continuity. Thus the insertion of a single test probe in a contact socket may easily inflict damage on the contact. At the same time, the contact should preferably be made of a ductile material, particularly where the connection to the wire is made by crimping the contact around the wire. The snap-in contacts must be easily assembled and disassembled from the insulating block and yet be securely retained therein under all conditions.

In the past, in order to insure good electrical connection, the socket contacts have been made with two generally used configurations, one may be characterized as the cantilever beam type and the other may be characterized as the snap-ring type. In the cantilever beam type, the socket may be formed with one or more projecting spring fingers which contact the pin when inserted in the socket, the pin spreading the cantilever spring fingers, the fingers in turn gripping the pin to form a secure electrical contact. In the snap-ring type of contact, the socket is slotted and a split ring is fitted around the socket and ends of the split ring project into the slot so as to press against the pin when it is inserted in the socket.

Both of these designs present problems in meeting all of the above-enumerated optimum design requirements. The cantilever type of socket configuration requires that the contact be fabricated from a material which possesses high tensile strength, such as beryllium copper, Phosphor bronze, and the like. Such materials have low conductivity, poor machinability, and poor ductility. The snap-ring type of socket contact is inherently weak due to the small cross-sectional area of the contact in the slotted region and therefore is particularly prone to test probe damage.

The present invention provides an electrical connector having an improved contact design which avoids the above-enumerated limitations in the prior art contact configurations. Thus the present invention provides a low cost connector having snap-in contacts which are characterized by their uniformly low contact pressure. In brief, the invention in its basic aspect comprises a thin-walled socket contact with a small transverse slot of sufficient depth to extend completely through the wall of the socket. A flat transverse contact spring is positioned in the slot so that the spring provides a flat contact surface exposed to the interior of the socket which engages an inserted contact pin. The flat transverse spring is held in position by a tubular sleeve which is pressed on and surrounds the socket member in the region of the slot. This tubular sleeve not only holds the flat contact spring in position in the slot but reinforces the socket in the region of the slot to give it added strength. The sleeve may be further provided with integral spring fingers which are arranged to lock the contact in position in the associated insulating block.

For a more complete understanding of the invention, reference should be had to the accompanying drawing, wherein:

FIG. 1 is a sectional view of a cable connector incorporating the contact design features of the present invention;

FIG. 2 is an enlarged elevational view partly in section of a socket contact for the connector of FIG. 1;

FIG. 3 is a sectional view taken substantially on the line 3—3 of FIG. 2; and

FIG. 4 is a sectional view similar to FIG. 3 but showing the contact spring deflected by the insertion of a contact pin in the socket.

Referring to FIG. 1 in detail, the cable connector includes a female assembly 10 and a male assembly 12. These assemblies include substantially identical insulating blocks 14 and 16 respectively. Each of the blocks is provided with a plurality of holes extending therethrough, one of which is indicated at 18. The hole 18 is formed with an inner section of smaller diameter than the two outer sections, the inner section, indicated at 20, forming two internal shoulders 22 and 24. A snap-in contact assembly is inserted in each of the openings, the assembly providing either a socket contact or a pin contact respectively for the female connector 10 and the male connector 12.

The socket contact assembly for the female connector is shown in detail in FIGS. 2, 3 and 4. The contact assembly includes a socket member indicated generally at 26, made preferably of a highly conductive metal which is preferably also highly ductile to provide a crimped connection to the associated wire 27 of the cable. The contact assembly further includes a spring retainer member indicated generally at 28 and a flat spring contact member indicated generally at 30. The socket member 26 includes a solid central portion 32 having a diameter slightly less than the diameter of the outer sections of the hole 18. As shown in FIG. 1, the central portion 32 of the contact member engages the shoulder 22 formed in the hole 18 when the contact assembly is positioned in the block 14.

The contact assembly further includes a hollow socket or female contact portion 34 open at one end to receive the mating pin of the male connector 12. A transverse slot 36 is milled or otherwise formed in the socket portion of the contact member 26. The depth of the slot is slightly greater than the wall thickness of the socket portion 34 so that an opening is formed into the interior region of the hollow socket.

The flat contact spring 30 is positioned in the slot 36 as best shown in the sectional view of FIG. 3. The spring contact 30 bridges the opening formed by the slot to the interior of the socket portion 34 of the contact member 26. A portion of the contact spring is thus exposed to the interior of the socket where it comes in contact with the contact pin from the male connector member when it is inserted in the socket. The portion of the contact spring exposed to the interior of the socket is formed with a tab 38 which is bent outwardly with relation to the open-

ing in the socket, thus providing an inclined surface engaged by the inserted pin contact for ease of insertion.

The spring contact **30** is retained in position in the slot by the spring retainer **28** which includes a tubular sleeve portion **40** that is pressed onto the socket portion **34** of the contact member **26**. The sleeve portion **40** surrounds the socket portion **34** in the region of the slot **36**, the slot being positioned adjacent the open end of the socket and having a width in the direction of the longitudinal axis of the socket opening which preferably is substantially less than half the length of the socket opening. Longitudinal slits are formed in the tubular body of the spring retainer **28** to form a plurality of projecting fingers **42**. These spring fingers are curved radially outwardly from the central axis of the contact member **26**.

The outer diameter of the sleeve portion **40** of the spring retainer **28** is less than the diameter of the inner section **20** of the insulating block **14**. In this manner the socket end of the contact member **26** may be inserted into the back of the block **14** and pushed through the restricted opening of the inner section **20**, the spring fingers being pressed inwardly as they pass through the restricted opening and then snapping outwardly when the enlarged central portion **32** comes to rest against the shoulder **22**, as best seen in FIG. 1. Thus the fingers **42** engage the shoulder **24**, preventing withdrawal of the contact assembly from the hole **18**. However, the contact can be withdrawn by inserting a cylindrical tool into the opening **18** around the socket end of the contact member **26** so as to press in the ends of the fingers **42** to the point where they will slide back through the restricted opening **20**.

FIG. 4 shows the manner in which the contact spring **30** is deflected by insertion of the pin in the socket contact. It will be noted that the spring contact **30** acts as a simply or freely supported beam. As it is deflected in the center, the edges are drawn closer together and so ride up on the interior surface of the surrounding sleeve portion **40** of the spring retainer **28**. This arrangement has several advantages in that it provides substantially uniform contact pressure over the full range of deflection of the contact spring. The result is a much stronger and durable contact arrangement than the conventional snap-ring type or the cantilever beam type of contact. This is because a relatively large range of deflection at the center of the beam formed by the spring contact **30** requires relatively little bending of the beam due to the fact the supported ends of the beam also are displaced by the bending. As illustrated in FIGURES 1 and 4, the sleeve **28** serves as a spring retainer for the socket member **26** through the engagement of fingers **42** with shoulder **24**, and also serves as a retainer for flat contact spring **30** since the tubular sleeve portion **40** encloses slot **36**.

As seen in FIG. 1, the contact assembly of the male connector **12** is similar in construction except that a pin **44** is provided in place of the socket **34** of the contact assembly in the female connector **10**. A tubular spring retainer **46**, which is identical to the retainer **28** described above, locks the assembly in position within the insulating block **16**. All of the contact assemblies may be provided with wire gripping sections such as indicated at **48** in FIG. 1 into which the lead wires **27** are inserted and held by crimping the portions **48** around the wires.

What is claimed is:

1. An electrical connector comprising a body of insulating material having a hole therethrough, the hole having three sections with the two outer sections on either side of the inner section being of larger diameter than the inner section, whereby a pair of shoulders are formed in the hole, and a snap-in socket contact assembly positioned in the hole, the snap-in contact assembly including a socket member crimpable to an electrical conductor and formed of a metal of high electrical conductivity, the socket member having a solid central portion of a diameter slightly less than that of one of the outer sections of the hole in the insulating block but larger in diameter than the inner section, whereby the central portion engages one of the shoulders in the hole when positioned in one of the outer sections to limit movement of the socket member in one direction along the length of the hole, the socket member further having a hollow socket female contact portion of outer diameter slightly less than the diameter of the inner section of the hole in the block, the socket portion being integral with the central portion and projecting through the inner section of the hole into the other of the outer sections, the socket portion having a narrow transverse slot formed therein adjacent the open end of the socket portion, the maximum depth of the slot being greater than the thickness of the wall of the hollow socket portion but less than the radius of the hollow socket portion, the snap-in contact assembly further including a spring retainer member having a tubular portion surrounding the socket portion of the socket member in the region of the slot, and further having a plurality of fingers projecting in the direction of the central portion of the socket member, the fingers curving away from the socket portion so as to extend outwardly at the ends of the fingers to the surface of the outer section of the hole through the block, the retainer member being positioned such that the projecting ends of the fingers engage the other shoulder in the block, whereby the contact assembly is locked in position, the outer diameter of the tubular portion of the spring retainer being smaller than the diameter of the inner section of the hole in the block, whereby the contact assembly may be snapped into position by inserting the end of the socket member with the surrounding retainer into the hole and through the inner section, the contact assembly further including a flat spring member for engaging a male contact inserted in the socket, the spring member contacting at opposite ends the tubular retainer member surrounding the slot so as to provide a portion of the spring contact member within the confines of the interior of the socket portion for contact by an inserted male member, the spring member providing a surface inclined away from the socket portion in the direction of the open end of the socket to provide a wedging displacement of the spring member during insertion of a male contact pin member into the socket portion.

2. An electrical connector comprising a body of insulating material having a hole therethrough, the hole having three sections with the two outer sections on either side of the inner section being of larger diameter than the inner section, whereby a pair of shoulders are formed in the hole, and a snap-in socket contact assembly positioned in the hole, the snap-in contact assembly including a socket member having a central portion of a diameter slightly less than that of one of the outer sections of the hole in the insulation block but larger in diameter than the inner section, whereby the central portion engages one of the shoulders in the hole when positioned in one of the outer sections to limit movement of the socket member in one direction along the length of the hole, the socket member further having a hollow socket portion of outer diameter slightly less than the diameter of the inner section of the hole in the block, the socket portion being integral with the central portion and projecting through the inner section of the hole into the other of the outer sections, the socket portion having a narrow transverse slot formed therein adjacent the open end of the socket portion, the maximum depth of the slot being greater than the thickness of the wall of the hollow socket portion but less than the radius of the hollow socket portion thereby providing an aperture in the side of the socket portion, the snap-in contact assembly further including a spring retainer member having a tubular portion surrounding the socket portion of the socket member in the region of the slot, and further having a plurality of fingers projecting in the direction of the central portion of the socket member, the fingers curving away from

the socket portion so as to extend outwardly at the ends of the fingers to the surface of the outer section of the hole through the block, the retainer member being positioned such that the projecting ends of the fingers engage the other shoulder in the block, whereby the contact assembly is locked in position, the diameter of the tubular portion of the spring retainer being smaller than the diamter of the inner section of the hole in the block, whereby the contact assembly may be snapped into position by inserting the end of the socket member with the surrounding spring retainer into the hole and through the inner section, the contact assembly further including a flat spring male contact engaging member positioned in the slot and contacting the retainer member at opposite ends while a portion thereof extends within the confines of the interior of the socket portion for engagement by an inserted male contact member, the male contact engaging member having a tab positioned within the interior of the socket portion and bent away from the socket portion and toward the open end of the socket portion so as to be engageable with the free end of the inserted male contact member.

3. An electrical connector comprising a body of insulating material having a hole therethrough, a restricted diameter section forming a pair of shoulders, and a snap-in socket contact assembly positioned in the hole, the snap-in contact assembly including a socket member having a central portion engaging one of the shoulders in the hole, the socket member further having a hollow socket portion projecting through the restricted diameter section of the hole, the socket portion having a narrow transverse slot formed therein, the maximum depth of the slot being greater than the thickness of the wall of the hollow socket portion but less than the radius of the hollow socket portion, the snap-in contact assembly further including a spring retainer member having a tubular portion surrounding the socket portion of the socket member in the region of the slot, and further having a plurality of fingers projecting in the direction of the central portion of the socket member, the fingers curving away from the socket portion so as to extend outwardly at the ends of the fingers, the retainer member being positioned such that the projecting ends of the fingers engage the other shoulder in the block, whereby the contact assembly is locked in position, the diameter of the tubular portion of the spring retainer being smaller than the diameter of the inner section of the hole in the block, whereby the contact assembly may be snapped into position by inserting the end of the socket member with the surrounding spring retainer into the hole and through the inner section, the contact assembly further including a flat spring contact member positioned in the slot and contacting at opposite ends the tubular retainer member surrounding the slot so as to provide a portion of the spring contact member within the confines of the interior of the socket portion for contact by an inserted pin, the spring contact member including an inserted pin engageable surface extending away from the socket toward the open end of the socket to bow the spring outwardly on insertion of a contact pin.

4. A contact assembly for an electrical connector including a socket member having a central portion, the socket member further having a hollow socket portion of smaller diameter than the central portion, the socket portion having a narrow transverse flat-bottomed slot formed therein opening into the hollow socket portion but wherein the depth of the slot is less than one half the thickness of the hollow socket portion, a spring retainer member having a tubular portion surrounding the socket portion of the socket member in the region of the slot, and further having a plurality of fingers projecting in the direction of the central portion of the socket member, the fingers curving away from the socket portion so as to extend outwardly at the ends of the fingers, and a flat spring contact member positioned in the slot and contacting at opposite ends the tubular retainer member surrounding the slot so as to provide a portion of the spring contact member within the confines of the interior of the socket portion for contact by an inserted pin, the spring contact member including an inserted pin engageable surface extending away from the socket toward the open end of the socket to bow the spring outwardly on insertion of a contact pin.

5. A contact assembly for an electrical connector including a socket member having a central portion, the socket member further having a hollow socket portion of smaller diameter than the central portion, the socket portion having a narrow transverse slot formed therein, the maximum depth of the slot being greater than the thickness of the wall of the hollow socket portion but less than the radius of the hollow socket portion, a spring retainer member having a tubular portion surrounding the socket portion of the socket member in the region of the slot, and further having a plurality of fingers projecting in the direction of the central portion of the socket member, the fingers curving away from the socket portion so as to extend outwardly at the ends of the fingers, and a flat spring contact member positioned in the slot and contacting at opposite ends the tubular retainer member surrounding the slot so as to provide a portion of the spring contact member within the confines of the interior of the socket portion for contact by an inserted pin.

6. A contact assembly for an electrical connector including a socket member having a socket portion with a hollow circular interior, the socket member having a transverse slot formed therein, the depth of the slot being slightly greater than the thickness of the wall of the hollow socket portion so that the slot forms an opening with the socket interior, the width of the slot in a direcion parallel to the central axis of the socket portion being small compared to the axial depth of the hollow interior of the socket portion, a spring contact member retainer member having a tubular portion surrounding the socket portion of the socket member in the region of the slot, and a flat spring contact member positioned in the slot and forming a chord extending across the circular interior of the socket, the ends of the contact member contacting the interior of the tubular portion of the retainer member and being free to slide therealong when the contact member is bowed outwardly by a pin inserted into the socket portion.

7. A socket type electrical contact comprising a socket member having a hollow cylindrical thin-walled socket portion for receiving a pin connector, the socket portion having a narrow tangential slot of depth greater than the wall thickness of the socket portion extending transversely of the cylindrical axis adjacent the open end of the socket portion, the hollow portion of the slot opening into the interior of the hollow socket portion, a flat spring contact of substantially the same width and length as the bottom of the tangential slot, the flat spring being positioned on the portion of the socket portion forming the bottom of the slot and extending across the interior of the socket portion to form a chord across the circular interior thereby reducing the interior dimension of the socket to less than the outer diameter of the pin connector, and a sleeve fitting around the outside of the socket portion and enclosing the region of the slot for retaining the flat spring in position, insertion of the pin connector bowing the flat spring contact outwardly of the socket to lift the flat spring contact from the bottom of the slot into engagement with the inner surface of the sleeve, whereby the flat spring contact acts as a simply supported beam during deflection.

References Cited in the file of this patent

UNITED STATES PATENTS

1,001,035 Hubert ..... Aug. 22, 1911

(Other references on following page)

7

UNITED STATES PATENTS

2,689,337	Burtt et al.	Sept. 14, 1954
1,736,875	Protz	Feb. 28, 1956

FOREIGN PATENTS

597,134	Germany	May 17, 1934

8

982,410	France	Jan. 31, 1951
999,305	France	Oct. 3, 1951
1,009,830	France	Mar. 12, 1952
1,010,446	France	Mar. 26, 1952
1,161,384	France	Mar. 24, 1958