

PATENT SPECIFICATION

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(72) Inventor ROBERT FRANKLIN EVANS



(54) ELECTRICAL SOCKETS

(71) We, E.I. DU PONT DE NEMOURS AND COMPANY, a Corporation organized and existing under the laws of the State of Delaware, United States of America, of
5 Wilmington, State of Delaware, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a female electrical socket for electrical connectors for removable engagement with male contact
15 pins.

United States Patent Specification No. 2,942,231 discloses an electrical connector for a male pin. A number of electrical connectors may be mounted in an assembly
20 for engagement with a plurality of male contacts projecting from a support and arranged conventionally in a rectangular pattern, for example, as described in United States Patent Specification No. 3,656,086.

25 Conventional miniature socket-type electrical connectors for mounting on male pins have a limited current carrying capacity and for that reason are not suitable for use in high amperage applications. Conventional
30 high amperage electrical connectors are relatively bulky and can not be mounted together in a dense assembly as presently required by the electronics industry. Because male pins are small and easily
35 arranged on a support in a dense grid, the size of the conventional high amperage electrical connectors prevents desired miniaturization of high amperage power distribution panels such as the type used in computers
40 and other electronic equipment where power is distributed from a source to a number of conductors extending to individual modules or components. The bulk of conventional power distribution panels is a particular problem in applications, such as computers,

where other electronic components have been miniaturized and the size of the distribution panel prevents further miniaturization of the equipment.

According to the present invention there
50 is provided a female electrical socket comprising a body portion and a plurality of elongate contact fingers projecting from the body portion and spaced around the longitudinal axis of the socket, each contact
55 finger having a first inwardly bowed portion adjacent said body portion, a second inwardly bowed portion spaced from said first inwardly bowed portion, and an outwardly bowed portion located between the
60 first and second inwardly bowed portions, the first inwardly bowed portions of adjacent contact fingers being differentially spaced along the length of the respective contact finger from the body portion.

65 If a male pin is moved into a socket of the invention, the lead end freely passes the second inwardly bowed portions on the fingers and then engages the first inwardly bowed portions which are located on adjacent fingers at different distances along
70 the insertion path so that adjacent fingers are successively stressed. The inwardly bowed portions define contacts which thereby form high pressure electrical connections
75 with the pin. The successive stressing of the fingers reduces the insertion force required to form the redundant electrical connections between the pin and the electrical socket. The fingers may be wider than in conventional
80 connectors and have sufficient cross-sectional area to carry high amperage current safely. The socket preferably comprises an even number of fingers greater than two.

An embodiment of the present invention
85 will hereinafter be described by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a sectional view of a female electrical socket in accordance with the in-
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vention in position to be mounted on a male pin.

Figure 2 is a sectional view taken along line 2-2 of Figure 1;

Figure 3 is a view similar to Figure 1 following assembly of the socket and pin; and

Figure 4 is a view of part of a preform used in the manufacture of the body portion and fingers used in the electrical socket.

Electrical socket 10 includes a metal female terminal 12 positioned within the interior recess 14 of a hollow square insulating housing 16. The terminal 12 is preferably stamp-formed from flat sheet metal stock and includes a wire crimp barrel 18 and an insulation crimp barrel 20 at one end for establishing electrical and physical connection with an insulated conductor 22 extending outwardly of opening 24 at one end of housing 16.

A plurality of contact fingers 28 and 30 extend longitudinally from the central tubular body portion 26 of the terminal in a direction toward the pin-receiving opening 32 at the end of housing 16 away from opening 24. Latch 34 and projection 36 extend radially outwardly from tubular body portion 26. When the terminal 12 is inserted into the insulating housing 16 through opening 24 and moved to the seated position as illustrated, projection 36 extends into slot 38 in the housing so that the terminal is angularly oriented and the latch is depressed and then snaps back to lock against shoulder 40 and secure the terminal in the body. Projection 36 seats against the end of slot 38 to prevent over-insertion of the terminal.

As illustrated, the tubular body portion 26 is fitted snugly within an inner cylindrical wall 42 of recess 14. Alternate fingers 28 and 30 extend from the end of the cylindrical portion 26 along the wall 52 in a serpentine configuration. Fingers 28 and 30 include inner inwardly bowed contact portions or bends 46 and 44 respectively adjacent the tubular body portion 26, outwardly bowed portions or bows 48 engaging surface 42 and outer inwardly bowed contact portions or bends 50 spaced from the tubular body portion 26 and adjacent the opening 32. Thus, wall 42 serves as a collar circumscribing bows 48. The inner contact bends 44 on finger 30 are spaced further from the opening 32 than the inner contact bends 46 on fingers 28. As shown in Figure 2, fingers 28 and 30 alternate around the circumference of the terminal so that the inner contact bends 44 and 46 carried by these fingers are alternately spaced or staggered longitudinally of the terminal.

The width of the fingers 28 and 30 at the inner bends 44 and 46 requires longitudinal

staggering in order to position the bends equidistant from the longitudinal axis for engagement with the contact pin. The spacing permits the use of fingers wider than the reduced width otherwise required. The increased width of the fingers improves their spring characteristics and current carrying capacity. The staggered inner bends 44 and 46 also reduce the insertion force needed to form an electrical connection between the terminal and a male pin.

Figure 4 illustrates a broken away preform 60 used in the manufacture of terminal 12 having a base 62 which is subsequently rolled to form the tubular portion 26 of the terminal. Serpentine shaped fingers 28 and 30 extend from one end of base 62. The staggered positioning of the inner contact bends 44 and 46 is clearly illustrated. Each finger is tapered from a point outwardly of the inner contact bend to the outer contact bend 50 so that the width is reduced outwardly of the inner bend. The reduction in width of the fingers permit bows 48 to engage surface 42 and the outer bends to be positioned together for engagement with the pin adjacent opening 32. The uniform tapering of the fingers away from the inner contact bend assures uniform stress loading of the fingers upon insertion of the pin.

The electrical connector 10 is used to form an electrical connection with a male pin 52 which may be mounted on a circuit board 54 and surrounded by an insulating housing 56. Figure 1 illustrates the connector 10 in position for engagement with the male pin. The connector is moved toward the pin so that the lead end of the pin passes through opening 32 and past the outer contact bends 50. The outer contact bends lightly wipe the pin. With further insertion, the lead end of the pin engages inner bends 46 of fingers 28 and as it passes, forces the bends radially outwardly so that the bows 48 of fingers 28 rock or pivot on the surface 42 and the outer bends 50 are forced radially inwardly against the pin. The result is that high pressure electrical connections are formed between the pin and the inner and outer contact bends of each finger 28. Continued insertion of the pin brings its lead end into engagement with the inner contact bends 44 of fingers 30 and with movement of the pin to the fully inserted position of Figure 3, similarly stress fingers 30 to form high pressure electrical connections between the pin and both contact bends on the fingers 30.

The outer contact bends are spaced for initial sliding engagement with the pin so that when the lead end of the pin engages the inner contact bends and rocks or pivots the fingers, the outer ends are immediately forced against the pin to achieve the highest

pressure connection possible without wasting any movement.

Electrical sockets 10 may use female terminals formed of flat 0.018 inch thick solder coated brass having six fingers as illustrated with a finger width of 0.055 inch adjacent the cylindrical portion and a width of 0.040 inch at the outer contact bends. The connector is mounted on a contact pin having a diameter of 0.092 inch. The tests show that the electrical socket has a current carrying capacity of 30 amps so that, on average, each contact area between the pin and the terminal carries $2\frac{1}{2}$ amps of current. The current carrying capacity of the pin was maintained after repeated disengagement and re-engagement with the pin.

Because the inner contact bends are longitudinally spaced, the fingers 28 are stressed to form electrical connections with the pin prior to stressing of fingers 30 so that the insertion force required to mate the connector with the pin is substantially reduced over that which would be required were the inner bends located at the same axial position so that the pin would simultaneously engage the bends and stress the fingers.

WHAT WE CLAIM IS:—

1. A female electrical socket comprising a body portion and a plurality of elongate contact fingers projecting from the body portion and spaced around the longitudinal axis of the socket, each contact finger having a first inwardly bowed portion adjacent said body portion, a second inwardly bowed portion spaced from said first inwardly bowed portion, and an outwardly bowed portion located between the first and second inwardly bowed portions, the first inwardly bowed portions of adjacent contact fingers being differentially spaced along the length of the respective contact finger from the body portion.

2. A socket as claimed in claim 1, further comprising an insulating housing surrounding said fingers such that the outwardly bowed portion of each contact finger pivots against said housing on insertion of a male pin into the socket so as to increase the

contact pressure of each of said second inwardly bowed portions against the male pin.

3. A socket as claimed in claim 2, further comprising locking means for securing the body portion and fingers in the insulating housing.

4. A socket as claimed in claim 3 wherein said locking means comprises a shoulder and latch connection.

5. A socket as claimed in claim 2, 3 or 4, further comprising means for angularly positioning the body portion and fingers within the insulating housing.

6. A socket as claimed in any preceding claim, wherein the first inwardly bowed portions of alternate contact fingers are equally spaced along the length of the fingers from said body portion.

7. A socket as claimed in any preceding claim, wherein the contact fingers decrease in width along their length away from said body portion.

8. A socket as claimed in any preceding claim, wherein the distance of the first inwardly bowed portion of each contact finger from the longitudinal axis of the socket is less than the distance of the second inwardly bowed portion from said longitudinal axis.

9. A socket as claimed in any preceding claim, having an even number of contact fingers greater than two.

10. A socket as claimed in any preceding claim, wherein the body portion is tubular and the contact fingers project from one end of the body portion.

11. A socket as claimed in any preceding claim formed from thin metal stock.

12. A female electrical socket substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

For the Applicants,
FRANK B. DEHN & CO.,
Imperial House,
15-19 Kingsway,
London, WC2B 6UZ.



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Because the inner contact bends are longitudinally spaced, the fingers 28 are stressed to form electrical connections with the pin prior to stressing of fingers 30 so that the insertion force required to mate the connector with the pin is substantially reduced over that which would be required were the inner bends located at the same axial position so that the pin would simultaneously engage the bends and stress the fingers.

WHAT WE CLAIM IS:—

1. A female electrical socket comprising a body portion and a plurality of elongate contact fingers projecting from the body portion and spaced around the longitudinal axis of the socket, each contact finger having a first inwardly bowed portion adjacent said body portion, a second inwardly bowed portion spaced from said first inwardly bowed portion, and an outwardly bowed portion located between the first and second inwardly bowed portions, the first inwardly bowed portions of adjacent contact fingers being differentially spaced along the length of the respective contact finger from the body portion.

2. A socket as claimed in claim 1, further comprising an insulating housing surrounding said fingers such that the outwardly bowed portion of each contact finger pivots against said housing on insertion of a male pin into the socket so as to increase the

contact pressure of each of said second 50 inwardly bowed portions against the male pin.

3. A socket as claimed in claim 2, further comprising locking means for securing the body portion and fingers in the insulating 55 housing.

4. A socket as claimed in claim 3 wherein said locking means comprises a shoulder and latch connection.

5. A socket as claimed in claim 2, 3 or 60 4, further comprising means for angularly positioning the body portion and fingers within the insulating housing.

6. A socket as claimed in any preceding claim, wherein the first inwardly bowed 65 portions of alternate contact fingers are equally spaced along the length of the fingers from said body portion.

7. A socket as claimed in any preceding claim, wherein the contact fingers decrease 70 in width along their length away from said body portion.

8. A socket as claimed in any preceding claim, wherein the distance of the first inwardly bowed portion of each contact finger 75 from the longitudinal axis of the socket is less than the distance of the second inwardly bowed portion from said longitudinal axis.

9. A socket as claimed in any preceding claim, having an even number of contact fingers greater than two.

10. A socket as claimed in any preceding claim, wherein the body portion is tubular and the contact fingers project from 85 one end of the body portion.

11. A socket as claimed in any preceding claim formed from thin metal stock.

12. A female electrical socket substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

For the Applicants,
FRANK B. DEHN & CO.,
Imperial House,
15-19 Kingsway,
London, WC2B 6UZ.