

SPECIFICATION

A plug and socket connector assembly

5 The invention relates to a plug and socket connector assembly which includes an electrical circuit board and is enclosed in a housing adapted to be closing by means of a cover and which is provided with pins for the electrical connection of the circuit formed on
10 the circuit board to a socket member located in the housing.

In customary circuit board assemblies of this kind which have plug and socket type connectors, an insulator extends along a shorter edge of the circuit
15 board and the pins extend in or parallel to the main plane of the circuit board. Circuit boards of this kind which are equipped with plug-in type connectors are usually inserted on edge in sockets disposed in the rear region of a mounting frame housing. The
20 plug-in connection then serves not only for electrical connection of the circuit formed on the circuit board to the wiring provided in the housing, but also as a means of orienting the circuit board in relation to the housing, particularly in view of the fact that the
25 opposition shorter side of the circuit board frequently carries operating controls for adjustable components, such as trimmer potentiometers, which are likewise aligned parallel to the main plane of the circuit board, in order to make them accessible at the
30 projecting edges of the circuit boards disposed side by side in the frame.

The problem underlying the invention is that of so constructing a circuit board with a plug and socket connector of the kind outlined above, so that even
35 when the housing is open, the circuit board is so situated in the housing as to be mechanically protected, trouble-free electrical connection of the circuit board to the wiring disposed in the housing as ensured, and that in addition functionally essential
40 output control lines of the circuit formed on the circuit board will at the same time be accessible from outside when the housing is closed, without appreciable additional cost for construction or assembly.

According to the invention there is provided a plug
45 and socket connector assembly comprising a member provided with sockets and disposed within a hollow housing having a detachable cover closing an open end thereof and a plug-in member having contact means for connecting the plug in member
50 contact means to the sockets of the socket member, the plug-in member also having a circuit board electrically and mechanically fastened thereto, wherein the contact means of the plug-in member comprise pins which extend perpendicularly from
55 the plane of the circuit board towards said open end and the free end of the contact pins project inwardly from the direction of said open end, the plug-in member, when inserted into the socket member being enclosed by the housing and the cover, the
60 plug-in member being secured on that side of the circuit board which faces away from the socket member and towards the cover, the plug-in member also having sockets which are open at an outer end surface of the plug-in member and extend inwardly
65 towards the circuit board, said end surface being

located in a corresponding aperture in the cover.

A plug and socket connection constructed in this manner, through the height of its insulator, spans the distance, normal to the plane of the circuit board,
70 between the board and the outer end wall of the cover, in order to permit its engagement in an opening in the end wall. This end face of the insulator which does not protect beyond the end face is thus effectively protected against mechanical
75 damage, while on the other hand the sockets disposed in the circuit arrangement are accessible from outside even when the housing is closed. The disposing of the circuit board at a desired depth beneath a dividing plane on an abutment fastened to
80 the housing is merely a matter of the dimensioning of the height of the insulator in relation to the given axial length of the cover, so that the projecting end faces of the side walls of the housing provide effective mechanical protection of the electronic
85 components, and of electro-mechanical components, disposed on that surface of the circuit board which faces towards the cover. In one embodiment of the unit the pins of the plug-in member or connector, are preferably U-shaped, the end of one
90 arm of the U-shape pins serving for the electrical and mechanical connection of the plug-in member or connector to the circuit board, while the second arm of the U-shaped pins make the electrical connection is made to a socket member disposed in the housing
95 for the connection of the wiring extending inside the housing, the circuit board being inserted perpendicularly to its main plane, through the dividing plane of the opened housing, onto a circuit board abutment provided in the housing. In this way the circuit
100 board can be connected in the most functionally reliable manner and by a most simple operation in respect of mechanical and electrical insertion into the housing, while, after the housing has been closed by means of the cover, electrical access to the
105 circuit formed on the circuit board, through the outwardly open sockets is ensured by means of the same constructional element, and on the one hand the circuit board disposed parallel to the dividing plane of the housing is easily accessible in the entire plane for the purpose of testing and servicing once the cover has been removed, while on the other hand this arrangement makes a large free space inside the housing available for the accommodation of bulky components and circuit units, such as
110 capacitors, transformers, and rectifier assemblies, in a mechanically protected position, when for mechanical reasons they are not suitable to be carried by the circuit board itself.

An embodiment of the invention will now be described by way of example and with reference to the accompanying drawings, in which:

Figure 1 shows, in the form of a partly broken-away cross-section, a control box mounted on an electrical motor positioning drive,

125 *Figure 2* is a section through a plug-in connector member on the sectional line II-II in *Figure 3*,

Figure 3 is a view from below of the plug-in connector seen in the direction of the arrow III in *Figure 2*,

130 *Figure 4* is an end elevation of the plug-in

connector and of a circuit board carrying it, with the circuit board fastened to the housing of the control box and with the cover removed, viewed in the direction of the arrows IV in Figures 1 and 2, and

5 *Figure 5* is a partly broken-open side view of a socket member associated with the plug-in connector and fastened to the housing.

The housing 2 of a control box is disposed at the side of and below a motor housing 1, for example of
10 a positioning drive for industrial sewing machines; the control box serves to receive electromechanical or electronic switches and electronic control and regulation circuits and also the appertaining components of the power supply system, and also serves to
15 connect control devices and loads. Bulky components and circuit units 4, such as mains transformers, rectifier assemblies, and capacitors, are fastened on the base 3 of the housing 2. The other electronic components and circuit parts are disposed
20 on a circuit board 5 for wiring as a printed circuit. The circuit board 5 extends parallel to a dividing plane 6, in which the housing 2 can be opened by removing a closure hood 7 serving as a cover. The closure hood 7 is fastened to the housing 2 by means
25 of a fastening device 8. By means of a screw element 9, which is similar to a shank nut and which after being positively connected to the housing 2 presses the closure hood 7 in the dividing plane 6 against the end face of the side walls 11 of the housing by
30 means of a coil spring 10, the circuit board 5 is pressed against an abutment 12 fastened to the housing. A centring member 13 projecting from this abutment 12 secures the circuit board 5 in both coordinate directions of the main plane of the circuit
35 board even before the closure hood 7 is fitted, so that after the fastening device 8 has been fastened the circuit board 5 is located and fixed in relation to the surrounding housing 2.

In order to increase the stability of the arrangement of the circuit board 5 in the housing 2,
40 additional screw fastenings to the end faces of supporting ribs 14 may be provided in edge regions of the circuit board 5 after the position of the main plane of the circuit board has been adjusted by
45 means of the centring member 13.

A supply cable 15 is connected either directly or via the bulky circuit units 4 to the circuit on the circuit board 5 with the aid of a socket member 16, which is fastened to the housing, and of a plug-in connector
50 member 17 which is connected mechanically and electrically to the circuit board 5. This connector is fastened to that surface of the circuit board 5 which faces the closure hood 7. It consists of an insulator 18, the cross-section of which in the direction of
55 insertion is substantially L-shaped (*Figure 2*), the longer arm 19 of the L-shape lying with its free end face 20 on the circuit board 5, with the inter-position of a perforated heat sink 21. The shorter arm 22 of the L-shape points towards the neighbouring edge
60 23 of the circuit board 5 and projects beyond it. On the free outer surface 24 of the shorter arm 22, which surface extends parallel to the main plane of the circuit board 5, a stepped, raised portion 25 is formed and is extended so far beyond the free end
65 face 20 of the longer arm 19 that, with a given height

of the closure hood 7 mounted on the housing 2, in relation to the abutment 12 fastened to the housing, it projects into and lies flush in a correspondingly shaped opening 26 in the end face 27 of the closure
70 hood 7, the opening 26 having a profile corresponding to the cross-section of this raised portion 25.

Sockets 28 extend in the interior of the longer arm 19 of the L-shaped insulator in a direction parallel to the lengthwise extent of the said arm, and are
75 externally accessible in the region of the raised portion 25 of the insulator 18, particularly for example to connection plugs of clutch and brake coils, which are to be controlled by the circuit on the circuit board 5, in an industrial sewing machine
80 positioning drive. Pins 30 forming arms of unequal length of a U-shape serve for the electrical connection of the printed circuit on the lower side of the circuit board 5, facing the interior of the housing 2, to sockets 29 in the socket member 16. The longer arm
85 31 in each case extends on the inner surface 32 (see *Figure 2*) of the longer arm 19 of the insulator 18. The yoke 33 of the U-shaped 30 extends through the interior of the shorter arm 22, passing out near the free end face 34 to form a short U-arm 35 returning
90 in the direction of the main plane of the circuit board 5, but ending above the main plane of the heat sink 21. The longer arm 31 of the U-shaped pin projects freely through the heat sink 21 and into a bore 36 in the circuit board 5, while at its outlet end it can then
95 be soldered to the printed circuit formed there. Solder tags 37, which are formed integrally on the inner end of the hollow cylindrical plug sockets 28, project similarly through the bottom 38 of a recess in the insulator, so that they can likewise be soldered to
100 the rear side of the circuit board 5 without coming into contact with the heat sink 21, as shown in *Figure 1* and in great detail in *Figure 2*.

The U-shaped pins 30 are supported in that a part of the arms 31 and 35 and also the yoke 33 extend in
105 slots 39 which are formed in the inner surfaces 32 and 40 respectively of the longer and shorter arms 19, 22 of the L-shaped insulator and into each of which they can be inserted, with the yoke 33 facing forwards, from the end 20 of the longer arm 19. The
110 U-pins 30 are then secured in the insulator 18 in the region of the yoke 33 by compression with the aid of heat-deformable pinch points 41 on the partitions 42 between two neighbouring slots 39. Slots 39 of different cross-sections are expediently provided in
115 order to make it possible for U-shaped pins 30 of different thicknesses to be inserted into the insulator 18. The cross-section of the conductor can thus be adapted to the electrical loading of the individual connections and at the same time, through corresponding distribution of thicker and thinner pins 30
120 on the insulator 18, coding can be effected to prevent the association of a circuit board 5 provided with a plug-in connector 17 of this kind with a housing 2 which is provided with a differently coded socket
125 member 16.

As can be seen from the view of the insulator 18 in the direction of the free end face 20 or of the inner surface 40 of the longer arm 19 of the L or of the shorter arm 22 of the L, as shown in *Figure 3*, it is
130 expedient for the slots 39, which extend on the inner



surface 40 of the shorter arm 22 of the L, to be so aligned in relation to a centre transverse line 43 that in each case they are associated with one another in pairs to form the shorter sides of a trapezium whose bases extend parallel to the end face edge of the outer surface 24 of the shorter arm 22 of the L. The larger base of this trapezium thus lies in each case in the region of the transition from the shorter arm 22 of the L to the longer arm 19 of the L. This arrangement provides on the one hand the advantage of short U-arms 35 lying close side by side, which results in a coupler 16 with shorter length dimensions mounted on the housing 2, while on the other hand the ends of the longer U-arms 31 have great transverse distances between them and thus can be soldered without the danger of undesirable conductor bridges on the printed rear side of the circuit board 5.

As indicated in Figure 3, it is expedient for two stepped bores 45 to be provided in the longitudinal direction through the longer arm 19 of the L between recesses 44, intended to receive the sockets 28, and the edge of the shorter sides of the insulator 18; through these recesses, in addition to the soldering of the longer arms 31 of the U and of the socket solder tags 37, the plug in connector member 17 can be fastened on the circuit board 5 by means of screw bolts (not shown in the drawing).

Although the plug-in connector member 17 mounted on the circuit board 5 and the appertaining socket member 16 fastened to the housing do not position the circuit board 5 relation to the housing 2, because, as already explained in connection with Figure 1, the centring member 13 is provided for this purpose, nevertheless a desirable increase of the stability of the circuit board 5 itself and of the arrangement of the connector 17 on the circuit board 5 is achieved through the fact that the sturdy heat sink 21 is disposed in the region between the plug-in connector 17 and the circuit board 5. On it are disposed components 46 of the power electronics type, whose waste heat is transferred through the heat sink 21 and a connecting rib 47 (see Figure 4) over a large area to the metal housing 2, which acts as heat sink, the respective power circuits of those components incorporating the pins 30 or sockets 28 via short line connections on the printed rear side of the circuit board 5. Through this direct spatial association of the components 46 of the power electronics type for connection to the power circuits it is ensured that thermal and/or electrical disturbances acting on the other parts of the circuit provided on the circuit board 5 are practically eliminated. After the circuit board 5 has been aligned by means of the centring members 13 in relation to the housing 2 and thus also in relation to the side walls 11 of the housing, in the direction in which its main plane extends, it can be fastened with the aid of the laterally projecting heat sink 21 and of machine bolts 48 to the rib 47 serving for thermal connection but also for lateral support of the circuit board, that is to say it can be bolted to the end face 49 of the said rib.

In the region of the plug-in connector 17 that portion of the heat sink 21 which projects beyond the

edge 23 of the circuit board 5 has a cutout 50, which is associated with a recess 51 in the connecting rib. On the end face edges of this recess 51 the extended socket member 16 is only loosely fastened, so that when the plug connection is made it is itself centred relative to the plug type connector 17. For this purpose the socket member 16 is mounted on the housing 2 by means of screws 52, which pass through apertures 53 of larger diameter and are not tightened, so that the socket is captive on the housing 2, but has clearance on all sides.

As can be seen from Figure 5, the socket member 16 is provided on one shorter side with an orientation lug 54, but means of which, given corresponding profiling of the housing and in conjunction with the recess 51, the correct orientation of the socket member 16 is ensured. This is of particular importance when a given distribution of pins 30 of different thicknesses is to be uniquely associated with a corresponding distribution of sockets 29 of different diameters for the allocation of determined circuit boards 5 to a determined wiring of the socket member 16.

As can be seen from Figures 1, 2 and 4, an information carrier member 56 can be mounted on the outer surface 24 of the shorter arm 22 of the L, at the side of the raised portion 25, and may be fastened thereto by adhesive bonding or welding or be detachable fastened thereto by means of a latch connection: the outer surface of this member is roughly flush with the outer surface 55, and thus this member also extends through the correspondingly adapted opening 26 in the closure hood 7. This outer surface can in particular carry details of the contents, indicating which specific control and regulation circuit is formed on the circuit board 5 on which the insulator 18 is fastened. This is of particular interest when dealing with circuits, which are fundamentally identical but vary in respect of details, for the operating of electric motor positioning drives for industrial sewing machines, of which very numerous versions are in use and consequently have to be operated by suitable modified circuits. From the indications on the information carrier it can thus always be seen, both when the housing 2 is closed and when the closure hood has been removed for the purpose of servicing, whether the circuit board 5 inserted at a given moment into the housing 2 matches the positioning drive identified by the data on the data plate of the motor housing 1 on which this housing 2 is mounted.

CLAIMS

1. A plug and socket connector assembly comprising a member provided with sockets and disposed within a hollow housing having a detachable cover closing an open end thereof and a plug-in member having contact means for connecting the plug-in member contact means to the sockets of the socket member, the plug-in member also having a circuit board electrically and mechanically fastened thereto, wherein the contact means of the plug-in member comprise pins which extend perpendicularly from the plane of the circuit board towards said

surface 40 of the shorter arm 22 of the L, to be so aligned in relation to a centre transverse line 43 that in each case they are associated with one another in pairs to form the shorter sides of a trapezium whose bases extend parallel to the end face edge of the outer surface 24 of the shorter arm 22 of the L. The larger base of this trapezium thus lies in each case in the region of the transition from the shorter arm 22 of the L to the longer arm 19 of the L. This arrangement provides on the one hand the advantage of short U-arms 35 lying close side by side, which results in a coupler 16 with shorter length dimensions mounted on the housing 2, while on the other hand the ends of the longer U-arms 31 have great transverse distances between them and thus can be soldered without the danger of undesirable conductor bridges on the printed rear side of the circuit board 5.

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CLAIMS

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open end and the free ends of the contact pins project inwardly from the direction of said open end, the plug-in member, when inserted into the socket member being enclosed by the housing and the cover, the plug-in member being secured on that side of the circuit board which faces away from the socket member and towards the cover, the plug-in member also having sockets which are open at an outer end surface of the plug-in member and extend inwardly towards the circuit board, said end surface being located in a corresponding aperture in the cover.

2. A connector assembly according to Claim 1, wherein the plug-in member is in the form of an insulator which is of substantially L-shaped cross-section with the free end face of the longer arm of the insulator resting on the circuit board, and the shorter arm of the insulator pointed towards the neighbouring edge of the circuit board.

3. A connector assembly according to Claim 2 wherein the contact means of the plug-in member comprise U-shaped pins, the arms of which extend through the longer arm and the shorter arm of the insulator.

4. A connector assembly according to Claim 3, wherein in each case one arm of each pin is fastened along the longer arm of the insulator, the yoke lies in the shorter arm of the insulator, and the other arm projects freely from the shorter arm of the insulator.

5. A connector assembly according to any one of Claims 2 to 4 wherein the pins are in each case provided with U-shaped arms of different lengths, of which only the longer arm projects beyond the end face of the longer arm of the insulator.

6. A connector assembly according to any one of Claims 2 to 5, wherein the yoke and the respective adjoining region of the U-shaped arms are disposed in a slot formed in the inner surfaces of the L-shaped arms of the insulator, and in the region of the shorter arm of the insulator are fastened between neighbouring slot partitions.

7. A connector assembly according to Claim 6, wherein the slots formed in the inner surface of the shorter arm of the insulator are situated on the shorter sides of trapeziums disposed one inside the other, while the slots formed on the longer arm of the insulator end on the longer bases of the said trapeziums.

8. A connector assembly according to any one of Claims 2 to 7, wherein a perforated heat sink which projects beyond the neighbouring edge of the circuit board and is adapted to receive electrical components is disposed between the end face of the longer arm of the insulator and the circuit board.

9. A connector assembly according to Claim 8, wherein a heat sink is provided at the circuit board edge with a cutout which is slightly longer than the length of that portion of the socket member fastened to the housing with which the pins are in engagement.

10. A connector assembly according to any one of Claims 2 to 9, wherein the sockets in the plug-in member are disposed in blind recesses in the insulator and have solder tags integrally formed on them which pass through the bottom of the blind

recesses and project beyond the free end face of the longer arm of the insulator.

11. A connector assembly according to any one of Claims 2 to 10, wherein the outer surface of the shorter arm of the insulator there is fastened, an information carrier member whose outer surface is substantially aligned with the outer surface and lies in the correspondingly adapted opening in the closure hood.

12. A plug and socket connector assembly substantially as hereinbefore described with reference to the accompanying drawings.

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