(54) Title: SIM CARD SOCKET AND MANUFACTURING METHOD THEREFOR

(57) Abstract: Disclosed are a SIM card socket and its manufacturing method, in which board-engaging free ends and card-engaging free ends of pin contacts of the SIM card socket are disposed within the outer dimensions and extend inwardly of the SIM card socket, thereby reducing the dimension of the mobile communication device. The SIM card socket has a plurality of U-shaped pin contacts mounted in a socket housing. Each of the pin contacts has a bight portion, a board-engaging free end and a card-engaging free end. The board-engaging free end and the card-engaging free end extend in the same direction away from the bight portion and define an acute angle therebetween. The socket housing has through-hole windows, in which the board-engaging free ends and the card-engaging free ends of the pin contacts are located, so that the board-engaging free end and the card-engaging free end are located within the dimensions of the socket housing. The board-engaging free ends and the card-engaging free ends elastically come into contact with contacts of a printed circuit board of the mobile communication device and the SIM card, respectively. The card socket further includes a metal reinforcement to strengthen the socket housing.
SIM CARD SOCKET AND MANUFACTURING METHOD THEREFOR

Field of the Invention:

The present invention relates to a Subscriber Identity Module (SIM) card socket and its manufacturing method, in which the SIM card socket is mounted in a mobile communication device and receives a SIM card, so as to enable the mobile communication device to be used in making or receiving a phone call.

Description of the Prior Art:

As generally known in the art, a Subscriber Identity Module (SIM) card is used in identifying a user of a mobile communication device, and contains such information as a personal identity number, a password, personal identity information, and bank account information. A SIM card socket is disposed within a mobile communication device, so that the SIM card can be assembled in the SIM card socket, thereby enabling the owner to use the mobile communication device. Fees for the use of the mobile communication device are ascribed to the owner of the SIM card on the basis of the information in the SIM card.

As is typical in today’s tendency toward reduction in size and improved performance, such mobile communication devices are tending toward reduction in size and a performances of higher quality, so that the size of mobile communication devices are decreasing and the sensitivity of mobile communication devices are improving. Similarly, the SIM card socket, in which the SIM card is seated, has a corresponding tendency toward a reduced size and a higher quality. Hereinafter, the SIM card, the SIM card socket, and their assembling construction will be described.

Figure 1 is a perspective view of a conventional SIM card socket, Figure 2 is a perspective view of a conventional SIM card socket and a conventional SIM card, and Figure 3 is an exploded perspective view of a mobile communication device in which a conventional SIM card socket is disposed.

As shown in Figures 1 and 2, a conventional SIM card socket 20 includes a socket housing 22, a card-receiving surface 24, and a plurality of connector pin contacts 26. Socket housing 22 defines the external appearance of the conventional SIM card socket 20. The card-receiving surface 24 is defined by the upper surface of socket housing 22, and a SIM card 30 is mounted on this surface 24. Pin contacts 26 are supported at surface 24 of socket housing
22. One end of each of pin contact 26 forms a solder end 26a adapted to be soldered to a connection node of a printed circuit board (not shown), while the other end of each of pin contact 26 forms a contact end 26b to be electrically connected to a corresponding contact 32 of SIM card 30. Contact ends 26b of pin contacts 26 are adapted to be elastically deformed.

Conventional SIM card socket 20 having the construction as described above is received in the mobile communication device, in such a manner as shown in Figures 2 and 3. First, a socket seating recess 14 dimensioned to accommodate SIM card socket 20 is formed on a surface of mobile communication device 10, for example, on a battery seat 12 on which a battery 16 is assembled, and SIM card socket 20 is assembled in socket seating recess 14. Solder ends 26a of pin contacts 26 are soldered to corresponding connection nodes of the printed circuit board, which is exposed in socket seating recess 14 of mobile communication device 10, so that the SIM card socket is fixed in socket seating recess 14.

As shown in Figures 2 and 3, SIM card 30 is inserted from above and placed on SIM card socket 20 fixed within socket seating recess 14. In this case, SIM card 30 placed on SIM card socket 20 in socket seating recess 14 is supported by contact ends 26b of pin contacts 26, which are adapted to be elastically deformed. That is, SIM card 30 is not completely assembled, but is held at an elevated position by contact ends 26b of pin contacts 26. In this unstable state, battery 16 is then assembled on battery seat 12, so that SIM card 30 is completely seated on SIM card socket 20 in socket seating recess 14 and contacts 32 of SIM card 30 are electrically connected to pin contacts 26 of SIM card socket 20.

However, in the conventional SIM card socket as described above, since the solder ends 26a for fixing SIM card socket 20 to the printed circuit board protrudes outside of the dimensions of socket housing 22, the presence of solder end 26a is a main factor in making it difficult to reduce the overall dimension of the mobile communication device.

Further, in the conventional SIM card socket 20 described above, since solder ends 26a of pin contacts 26 is soldered to the printed circuit board of the mobile communication device, there is a difficulty in reducing the height of SIM card socket 20, to thereby reduce the dimension of the mobile communication device. However, even in the cases where the height of a SIM card socket could be reduced, the strength of the socket housing could be compromised if the height of the socket housing was correspondingly reduced.

In addition to the above-mentioned problem, in the conventional SIM card socket construction, the difficult and costly labor of soldering is necessary in order to fix the
conventional SIM card socket 20 to the printed circuit board of mobile communication device 10.

**Summary of the Invention:**

Accordingly, the present invention has been made to solve the above-mentioned problems occurring in the prior art, and an object of the present invention is to provide a SIM card socket and its manufacturing method, in which the board-engaging free ends and the card-engaging free ends of the pin contacts of the SIM card socket, which electrically connect to corresponding contacts of the SIM card and the printed circuit board in a mobile communication device, are located inside the dimensions defined by the SIM card socket, so as to reduce the dimensions of elements of the mobile communication device, thereby reducing the entire dimension of the mobile communication device.

It is another object of the present invention to provide a SIM card socket and its manufacturing method, in which the board-engaging free ends and the card-engaging free ends of the pin contacts of the SIM card socket do not necessitate a solder construction can effect an electrical connection by simply putting the free ends in contact with the corresponding contacts, thereby reducing the thickness or height of the SIM card socket, and correspondingly reducing the entire dimension of the mobile communication device.

It is another object of the present invention to provide a SIM card socket and its manufacturing method, in which the SIM card socket can be easily mounted, since the board-engaging free ends and the card-engaging free ends of the pin contacts of the SIM card socket do not have a solder construction but have the contact construction described.

In order to accomplish this object, there is provided a SIM card socket, which is adapted to be mounted in a mobile communication device, so that a SIM card can be mounted on the SIM card socket and the mobile communication device can be used in making or receiving a phone call, wherein the SIM card socket comprises: a plurality of pin contacts, each of the pin contacts having a bight portion, a board-engaging free end and a card-engaging free end, the pin contacts being arranged in two mirror image rows in such a manner as that the pin contacts arranged in one row are opposed to the pin contacts arranged in the other row, wherein the board-engaging free end and the card-engaging free end extend in the same general direction away from the bight portion and define an acute angle therebetween; and a generally rectangular socket housing having through holes windows
formed therethrough, the bight portion of the pin contacts being mounted generally along two side edges of the socket housing, wherein the board-engaging free end and the card-engaging free end of each of the pin contacts are positioned within the through hole windows of the socket housing and extend inwardly toward a free end of an oppositely positioned mirror-image contact, and wherein the socket housing has outer dimensions which define the rectangular shape of the housing and both the card-engaging free end and the board-engaging free end of the pin contacts are positioned inside of the outer dimensions of the housing.

In this case, the socket housing comprises an upper plate portion and a lower plate portion, and the bight portion of each of the pin contacts is insert-molded between the upper plate portion and the lower plate portion of the socket housing.

The socket housing may further comprise a metal reinforcement insert-molded between the upper plate portion and the lower plate portion in two longitudinal side portions and a central transverse portion of the socket housing, so as to reinforce a strength of the socket housing.

It is preferred that the socket housing further comprises partitions disposed in the through hole windows of the socket housing spaced in regular intervals to separate adjacent pin contacts from each other.

The socket housing may further include an alignment protuberance formed on a lower surface of the lower plate portion of the socket housing, so that the SIM card socket can be mounted at a predetermined location on the printed circuit board of the mobile communication device.

In accordance with another aspect of the present invention, there is provided a method of manufacturing a SIM card socket, the SIM card socket being mounted on a socket seat formed in a rear surface of a mobile communication device, so that the SIM socket can receive a SIM card and enable the mobile communication device to be used in making or receiving a phone call, the method comprising the steps of: stamping and forming a metal plate portion to produce a pin contact frame, the pin contact frame including an H-shaped metal reinforcement and a plurality of pin contacts connected integrally through the metal reinforcement, each of the pin contacts having a bight portion, a board-engaging free end and a card-engaging free end, the board-engaging free end and the card-engaging free end extending from the bight portion in the same general direction and defining an acute angle therebetween, wherein the metal reinforcement includes two side longitudinal extensions and
a central transverse extension and the board-engaging free ends and card-engaging free ends of the pin contacts are arranged in two rows on opposite sides of the central transverse extension; molding a socket housing including an upper plate portion and a lower plate portion; inserting the pin contact frame between the upper plate portion and the lower plate portion; insert-molding the pin contact frame between the upper plate portion and the lower plate portion, so that the bight portions of the pin contacts and the metal reinforcement are fixed between the upper plate portion and the lower plate portion; and cutting portions of the pin contact frame, so as to mechanically and electrically isolate the pin contacts and the metal reinforcement from each other.

In accordance with another aspect of the invention, a SIM card socket according to the above invention may further comprise engagement protuberances formed on longer side portions of the socket housing; alignment protuberances formed on the longer side portions of the socket housing, wherein the alignment protuberances have different dimensions to facilitate mounting the socket in the mobile communication device, wherein the alignment protuberances are adapted to engage alignment grooves of the mobile communication device and the engagement protuberances are adapted to engage engagement thresholds of mobile communication device. The engagement protuberances of the socket housing and the engagement thresholds of the socket seat may comprise a chamfered surface, so as to enable the SIM card socket to be easily assembled on the mobile communications device.

Although the present invention is described in relation to the SIM card socket throughout the specification, it goes without saying that the present invention may be employed not only in the SIM card socket but also in any socket capable of mounting other chip cards or IC cards.

Other objects, features and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings.

**Brief Description of the Accompanying Drawings:**

The above and other objects, features and advantages of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a perspective view of a conventional SIM card socket;
FIGURE 2 is a perspective view of a conventional SIM card socket and a conventional SIM card;

FIGURE 3 is an exploded perspective view of a mobile communication device in which a conventional SIM card socket is disposed;

FIGURE 4 is a perspective view of a SIM card socket according to an embodiment of the present invention;

FIGURE 5 is a front view of the SIM card socket shown in FIG. 4;

FIGURE 6 is a sectional view taken along line A-A in FIG. 5;

FIGURE 7 is an exploded perspective view of a mobile communication device employing the SIM card socket shown in FIG. 4;

FIGURE 8 is a partial sectional view of a mobile communication device, in which the SIM card socket shown in FIG. 4 is assembled;

FIGURE 9 is a perspective view of a pin contact frame employed in the SIM card socket shown in FIG. 4;

FIGURE 10 is an exploded perspective view of the pin contact frame shown in FIG. 9 and a socket housing shown in FIG. 4, for showing an assembly between them;

FIGURE 11 is a perspective view of the SIM card socket of FIG. 4 in states just before and when it is completely manufactured;

FIGURE 12 is a perspective view of a SIM card socket according to another embodiment of the present invention;

FIGURE 13 is a front view of the SIM card socket shown in FIG. 12;

FIGURE 14 is a rear view of the SIM card socket shown in FIG. 12;

FIGURE 15 is a front perspective view of a SIM card socket of FIG. 12 assembled with a rear case of a mobile communication device;

FIGURE 16 is an exploded perspective view of a mobile communication device employing the SIM card socket shown in FIG. 12;

FIGURE 17 is a rear perspective view of a SIM card socket of FIG. 12 assembled with a rear case of a mobile communication device;

FIGURE 18 is a partial rear view of a rear case of a mobile communication device, with which the SIM card socket shown in FIG. 12 is assembled;

FIGURE 19 is a sectional view taken along line A-A in FIG. 18;

FIGURE 20 is a sectional view taken along line B-B in FIG. 18;
FIGURE 21 is a sectional view taken along line C-C in FIG. 18;
FIGURE 22 is an exploded perspective view of a pin contact frame and a socket housing employed in the SIM card socket shown in FIG. 12, for showing an assembly between them; and
FIGURE 23 is a perspective view of the SIM card socket of FIG. 12 in states just before and when it is completely manufactured.

The invention, together with its objects and the advantages thereof, may be best understood by reference to the following description taken in conjunction with the accompanying drawings, in which like reference numerals identify like elements in the figures and in which:

Description of the Preferred Embodiments:

Hereinafter, SIM card sockets and their manufacturing method according to several preferred embodiments of the present invention will be described with reference to the accompanying drawings.

Figure 4 is a perspective view of a SIM card socket according to an embodiment of the present invention, Figure 5 is a front view of the SIM card socket shown in Figure 4, Figure 6 is a sectional view taken along line A-A in Figure 5, Figure 7 is an exploded perspective view of a mobile communication device employing the SIM card socket shown in Figure 4, and Figure 8 is a partial sectional view of a mobile communication device, in which the SIM card socket shown in Figure 4 is assembled.

Referring to Figures 4 to 8, a SIM card socket 100 according to an embodiment of the present invention includes a socket housing 120 and a plurality of pin contacts 110. Each pin contact 110 is generally U-shaped and includes a board-engaging free end 110a and a card-engaging free end 110b extending from a bight portion 110c. Socket housing 120 is generally rectangular in shape and includes an upper plate portion 120a and a lower plate portion 120b. Board-engaging free end 110a and card-engaging free end 110b of each pin contact 110 extend in the same generally direction away from bight portion 110c and define an acute angle therebetween (see Figure 8).

That is, in comparison with the construction shown in Figures 1 to 3, in which solder ends 26a of pin contacts 26 are soldered to corresponding contacts of the printed circuit board, SIM card socket 100 has an improved construction, in which board-engaging free ends
110a and card-engaging free ends 110b of pin contacts 110 are electrically connected with contacts 312 of a printed circuit board 310 and contacts 210 of a SIM card 200, are located inside the dimensions defined by the rectangular shape of socket housing 120.

Further, differently from the prior art shown in Figures 1 to 3, in which solder ends 26a of pin contacts 26 are electrically connected with contacts of the printed circuit board by soldering, board-engaging free ends 110a of pin contact 110 can be electrically connected with contacts 312 of printed circuit board 310 by simply mounting SIM card socket 100 on printed circuit board 310 in the invention shown in Figures 4 to 8.

As described above, in SIM card socket 100 according to an embodiment of the present invention, board-engaging free end 110a and card-engaging free end 110b of pin contact 110 are located inside the dimensions of socket housing 120, and are electrically connected to contacts 312 of printed circuit board 310 and contacts 210 of SIM card 200 by simply mounting SIM card socket 100 on printed circuit board 310, that is, no secondary attachment steps such as soldering or welding are necessary (although soldering could be performed to further reinforce the connection if and when desired). Therefore, the height and the entire dimension of SIM card socket 100, which is an element of a mobile communication device 300, can be reduced. As a result, the dimension of mobile communication device 300 employing SIM card socket 100 can also be reduced.

Hereinafter, a more detailed description of SIM card socket 100 will be given. First, pin contacts 110 are electrically conductive elements for electrically connecting SIM card 200 and printed circuit board 310 of mobile communication device 300 with each other, and each pin contact 110 includes board-engaging free end 110a extending generally downwardly to electrically connect to a corresponding contact 312 of printed circuit board 310 and card-engaging free end 110b extending generally downwardly to electrically connect to a corresponding contact 210 of SIM card 200. In this case, board-engaging free end 110a and card-engaging free end 110b of pin contact 110 are connected integrally with each other and extend in the same general direction away from bight portion 110c.

Further, board-engaging free end 110a and card-engaging free end 110b of pin contact 110, which form the free ends of the pin contact 110, extend from bight portion 110c of pin contact 110 with a predetermined acute angle between them. That is, since card-engaging free end 110b of pin contact 110 extends in a direction inclined upward and board-engaging free end 110a of pin contact 110 extends in a direction inclined downward from bight portion
110c of pin contact 110, board-engaging free end 110a and card-engaging free end 110b define a predetermined acute angle therebetween.

Due to the construction in which board-engaging free end 110a and card-engaging free end 110b of pin contact 110 extend with the acute angle therebetween, board-engaging free end 110a and card-engaging free end 110b are designed to form a secure connection with contacts 312 of printed circuit board 310 and contacts 210 of SIM card 200 when SIM card socket 100 is mounted on printed circuit board 310 and when SIM card 200 is mounted on SIM card socket 100. That is, when board-engaging free end 110a and card-engaging free end 110b of pin contact 110 are elastically deformed, board-engaging free end 110a and card-engaging free end 110b come into tight contact with contact 312 of printed circuit board 310 and contact 210 of SIM card 200 by means of the restoring force of board-engaging free end 110a and card-engaging free end 110b.

Pin contacts 110, each having the construction as described above, are arranged in two parallel mirror image rows within SIM card socket 100, and pin contacts 110 arranged along one row are opposed to those arranged along the opposite row. That is, the bight portion of pin contacts 110 are fixedly mounted generally along two opposite outside edges of SIM card socket 100, and board-engaging free ends 110a and card-engaging free ends 110b of pin contacts 110 extend toward each other away from the fixed bight portion of the pin contact.

Bight portion 110c of pin contacts 110 are fixed to socket housing 120 and along with the rectangular shape of socket housing form the external appearance of SIM card socket 100. Socket housing 120 has a pair of through holes 122 formed in two sides thereof, so that board-engaging free ends 110a and card-engaging free ends 110b of pin contacts 110 are exposed in through holes 122. In this case, the bight portion pin contacts 110 are fixed between upper plate portion 120a and lower plate portion 120b of socket housing 120 by insert molding the pin contacts between the two plate portions.

Socket housing 120 is formed by upper plate portion 120a and lower plate portion 120b respectively having a rectangular shape with a central transverse portion therebetween as shown in Figures 4 and 5. Bight portions 110c of pin contacts 110 are fixed between outside edges of upper plate portion 120a and lower plate portion 120b by insert molding, and board-engaging free end 110a and card-engaging free end 110b are exposed in through holes 122. Furthermore, a plurality of partitions 124 are disposed in regular intervals in through
holes 122 of socket housing 120. Each partition 124 extends in a longitudinal direction of SIM card socket 100 and separates two adjacent pin contact 110.

In two longitudinal side portions and a central transverse portion of socket housing 120, that is, in an H-shaped portion of socket housing 120, a metal reinforcement 130 is used to reinforce the strength of socket housing 120. Specifically, between upper plate portion 120a and lower plate portion 120b, the metal reinforcement is fixed, such as by insert molding or the like.

Further, an alignment protuberance 126 may be formed on a lower surface of lower plate portion 120b of socket housing 120, so that when SIM card socket 100 is mounted on printed circuit board 310 of mobile communication device 300, SIM card socket 100 can be placed at a predetermined location by inserting the alignment protuberance 126 in a corresponding alignment groove 314 formed in the printed circuit board.

SIM card socket 100 having the construction shown in Figures 4 to 6 is assembled as shown in Figures 7 and 8. First, in mobile communication device 300 in which SIM card socket 100 is employed, a SIM card seating recess 322 for seating the SIM card 200 is formed in a predetermined portion of a battery seat 320 over which a battery 330 is subsequently assembled. In this case, printed circuit board 310 is exposed within SIM card seating recess 322.

When SIM card socket 100 is inserted in SIM card seating recess 322 so that alignment protuberance 126 of lower plate portion 120b is inserted in alignment groove 314 of printed circuit board 310, board-engaging free end 110a of pin contact 110 is electrically connected with contact 312 of printed circuit board 310. In this case, board-engaging free end 110a of pin contact 110 is in contact with contact 312 of printed circuit board 310.

Hereinafter, the processes of mounting and detaching SIM card 200 on and from SIM card socket 100 described above will be described. First, in the state where SIM card socket 100 is mounted in SIM card seating recess 322 while alignment protuberance 126 of socket housing 120 is inserted in alignment groove 314 of printed circuit board 310, SIM card 200 is inserted in SIM card seating recess 322 and mounted on SIM card socket 100, so that SIM card 200 is electrically connected with printed circuit board 310 of mobile communication device 300.

In the state that SIM card 200 is mounted in SIM card seating recess 322 in the way described above, battery 330 is assembled on battery seat 320, so as to fix SIM card socket
100 and SIM card 200 to each other. Then, mobile communication device 300 can be used in making and receiving a phone call.

Meanwhile, when it is necessary to disassemble and replace SIM card 200, after battery 330 is separated from battery seat 320, SIM card 200 can be detached from SIM card seating recess 322.

SIM card socket 100 according to the present invention as described above does not require a solder portion, but is mounted by inserting alignment protuberance 126 of SIM card socket 100 into corresponding alignment groove 314 of printed circuit board 310, so that board-engaging free end 110a of pin contact 110 is mechanically and electrically in contact with contact 312 of printed circuit board 310. That is, SIM card socket 100 according to an embodiment of the present invention can be easily assembled and disassembled in and from a mobile communication device.

Further, SIM card socket 100 according to an embodiment of the present invention does not have a solder construction but has a contacting construction, so as to reduce the thickness or the height of SIM card socket 100 and the mobile communication device.

Further, in SIM card socket 100 according to an embodiment of the present invention, board-engaging free end 110a and card-engaging free end 110b of pin contact 110 are not located outside the dimensions of socket housing 120 but are located within the dimensions defined by the rectangular socket housing 120, so as to reduce the overall outside dimension of socket housing 120, thereby reducing the entire dimension of SIM card socket 100.

Figure 9 is a perspective view of a pin contact frame employed in the SIM card socket shown in Figure 4, Figure 10 is an exploded perspective view of the pin contact frame shown in Figure 9 and a socket housing shown in Figure 4, for showing an assembly between them, and Figure 11 is a perspective view of the SIM card socket of Figure 4 in states just before and after it is completely fabricated.

In SIM card socket 100 shown in Figures 9 to 11, the same reference numerals as those in Figures 4 to 8 are used, but elements not provided with reference numerals in Figures 9 to 11 may be referred to by the reference numerals in Figures 4 to 8.

Figures 9 to 11 show a process of manufacturing SIM card socket 100 according to the present embodiment, which includes the steps of: stamping and formed a pin contact frame 140; molding the socket housing 120; insert-molding the pin contact frame 140 between the upper plate portion 120a and the lower plate portion 120b of the socket housing.
120; and cutting portions of the pin contact frame 140 to mechanically and electrically isolate the pin contacts from each other.

In more detailed description, in the step of manufacturing the pin contact frame 140, a metal plate portion is stamped and formed to produce an integral pin contact frame 140 as shown in Figure 9, in which board-engaging free ends 110a and card-engaging free ends 110b of the pin contacts 110 are integrally connected to metal reinforcement 130.

When pin contact frame 140 has been stamped and formed as described above, pin contact frame 140 has the shape as shown in Figures 9 and 10, in which pin contacts 110 are arranged at two sides of pin contact frame 140 and pin contacts 110 on one side pin contact frame 140 are opposed to those on the other end of pin contact frame 140.

In the step of manufacturing and specifically molding socket housing 120, upper plate portion 120a and lower plate portion 120b each have planar transverse and central insert molding portions 150, between which pin contacts 110 and metal reinforcement 130 are placed. Specifically, the pin contact frame is insert-molded between upper plate portion 120a and lower plate portion 120b. In this case, each of the insert molding portions 150 has through hole windows 122 formed therethrough, so that insert molding portions 150 has the shape as shown in Figure 10. Insert molding portion 150 has a longitudinal length smaller than that of pin contact frame 140, so that parts of bight portions 110c of pin contacts 110 may protrude out of the front and rear ends of upper plate portion 120a and lower plate portion 120b.

After pin contact frame 140 and socket housing 120 having the construction described above are manufactured, pin contact frame 140 is insert-molded between upper plate portion 120a and lower plate portion 120b of socket housing 120. The insert molding is carried out after the pin contact frame 140 is positioned between the upper and lower plate portions of the socket housing 120. Specifically, the insert molding is carried out such that portions of the bight portions 110c of pin contacts 110 of pin contact frame 140 partially protrude out from the side edges of socket housing 120.

After the insert molding is carried out in the way described above, portions of bight portions 110c of pin contacts 110 (A in Figure 11) protruding out of the side edges of socket housing 120 are cut, so that pin contacts 110 and metal reinforcement 130 are mechanically and electrically isolated from each other. Then, the process of manufacturing SIM card socket 100 according to the present embodiment is completed.
Figure 12 is a perspective view of a SIM card socket according to another embodiment of the present invention, Figure 13 is a front view of the SIM card socket shown in Figure 12, Figure 14 is a rear view of the SIM card socket shown in Figure 12, Figure 15 is a front perspective view of a SIM card socket of Figure 12 assembled with a rear case of a mobile communication device, Figure 16 is an exploded perspective view of a mobile communication device employing the SIM card socket shown in Figure 12, Figure 17 is a rear perspective view of a SIM card socket of Figure 12 assembled with a rear case of a mobile communication device, Figure 18 is a partial rear view of a rear case of a mobile communication device, with which the SIM card socket shown in Figure 12 is assembled, Figure 19 is a sectional view taken along line A-A in Figure 18, Figure 20 is a sectional view taken along line B-B in Figure 18, and Figure 21 is a sectional view taken along line C-C in Figure 18.

A SIM card socket 400 shown in Figures 12 to 16 according to the present embodiment has the same construction as that of SIM card socket 100 shown in Figures 4 to 11, in which SIM card socket 400 includes a socket housing 410 having a rectangular shape. Socket housing 410 includes an upper plate portion 410a and a lower plate portion 410b and a plurality of pin contacts 420, each having a bight portion 420c, a board-engaging free end 420a and a card-engaging free end 420b. SIM card socket 400 includes an additional construction for enabling SIM card socket 400 to be mounted on an inner surface of a rear case 602 of a mobile communication device 600.

As in SIM card socket 100 shown in Figures 4 to 11, in SIM card socket 400, board-engaging free end 420a and card-engaging free end 420b of pin contact 420 positioned within the dimensions of socket housing 410.

Further, SIM card socket 400 is assembled on a socket seat 622 formed at a peripheral surface of a socket receiving hole 620 formed through rear case 602 of mobile communication device 600, so that board-engaging free end 420a of pin contact 420 comes into contact and is electrically connected with the contact of the printed circuit board as soon as rear case 602 is assembled with a front case 604.

As described above, in SIM card socket 400, board-engaging free end 420a and card-engaging free end 420b of pin contact 420 are located within the dimensions of socket housing 410, and SIM card socket 400 is assembled on socket seat 622 of mobile communication device 600, so that board-engaging free ends 420a of pin contacts 420 can be
electrically connected to corresponding contacts of the printed circuit board when rear case 602 is assembled to front case 604. As a result, the height and the dimension of SIM card socket 400, which is an element of mobile communication device 600, can be reduced, so that the entire dimension of mobile communication device 600 employing SIM card socket 400 can also be reduced.

Hereinafter, a more detailed description of SIM card socket 400 according to the present embodiment will be given. First, socket housing 410 along with the exposed portions of pin contacts 420 form the external appearance of SIM card socket 400. Socket housing 410 includes upper plate portion 410a on one side and lower plate portion 410b on the other side. Upper plate portion 410a may be longer and narrower than lower plate portion 410b, as shown in Figure 12.

Meanwhile, two through holes 412 are formed through predetermined portions of each of upper plate portion 410a and lower plate portion 410b, and through holes 412 formed through upper plate portion 410a are aligned with through holes 412 formed through lower plate portion 410b.

Upper plate portion 410a and lower plate portion 410b are placed over each other and molded together while through holes 412 formed through upper plate portion 410a are aligned with through holes 412 formed through lower plate portion 410b, to complete socket housing 410. In this case, when upper plate portion 410a is placed atop of lower plate portion 410b and through holes 412 of upper plate portion 410a are aligned with through holes 412 formed through lower plate portion 410b, longer side portions of lower plate portion 410b partially protrude out from longer side portions of upper plate portion 410a.

A pair of alignment grooves 414b, whose dimensions are different from each other, are formed on the longer side portions of lower plate portion 410b of socket housing 410. When SIM card socket 400 is assembled with rear case 602, alignment grooves 414b engage alignment protuberances 624 formed on socket seat 622 of rear case 602 of mobile communication device 600, so as to fix the location of SIM card socket 400 and prevent it from being moved.

Further, engagement protuberances 414a may be formed on the longer side portions of upper plate portion 410a, and engagement protuberances 414a are located on both sides of alignment grooves 414b of lower plate portion 410b. When SIM card socket 400 is assembled with rear case 602, engagement protuberances 414a engage with engagement thresholds 626.
formed on socket seat 622 of rear case 602 of mobile communication device 600, so as to fix SIM card socket 400 to socket seat 622 of rear case 602 of mobile communication device 600, which will be described later.

Front upper corners of engagement protuberances 414a may be chamfered to form first chamfered surfaces 416a which facilitate the engagement between engagement protuberances 414a with engagement thresholds 626 formed on socket seat 622.

SIM card socket 400 having the construction shown in Figures 12 to 21 according to the present embodiment is assembled as shown in Figures 15 to 21. First, in mobile communication device 600 in which SIM card socket 400 is employed, socket receiving hole 620 is formed through a portion of rear case 602 of mobile communication device 600, which has a battery seat 630 for seating a battery 632, and socket seat 622 on which SIM card socket 400 is mounted is formed at a boundary surface forming socket receiving hole 620. Socket receiving hole 620 and socket seat 622 are formed to correspond to the dimension and shape of SIM card socket 400.

Alignment protuberances 624, which are adapted to engage with corresponding alignment grooves 414b of lower plate portion 410b of socket housing 410, are formed at along the longer sides of socket seat 622, and engagement thresholds 626, which are adapted to engage with corresponding engagement protuberances 414a of upper plate portion 410a of socket housing 410, are formed at corresponding locations on the longer sides of socket seat 622. In this case, rear corners of engagement thresholds 626 are chamfered to form second chamfered surfaces 626a.

When SIM card socket 400 is mounted on socket seat 622, alignment grooves 414b formed at lower plate portion 410b of socket housing 410 are located on alignment protuberances 624 of socket seat 622. SIM card socket 400 is then pressed in toward the socket, so that engagement protuberances 414a formed on upper plate portion 410a engage with engagement thresholds 626 of socket seat 622. At this point SIM card socket 400 is completely mounted on socket seat 622, and upper surface of SIM card socket 400 is exposed to a space above battery seat 630 formed on rear case 602 of mobile communication device 600.

In the state where SIM card socket 400 is mounted on socket seat 622 of rear case 602 as described above, rear case 602 is assembled with front case 604 of mobile communication
device 600, so that board-engaging free end 420a of pin contacts 420 come into contact and electrically connect to corresponding contacts of the printed circuit board.

In this state, the SIM card is mounted in a SIM card seating hole 640 formed at battery seat 630, and subsequently battery 632 is mounted on battery seat 630, so that card-engaging free end 420b of pin contacts 420 come into contact and are electrically connected with corresponding contacts of the SIM card.

In the state that the SIM card is mounted in SIM card seating hole 640 in the way described above, battery 632 is assembled on battery seat 630, so as to fix the SIM card on SIM card seating hole 640. At this point mobile communication device 600 can be used in making and receiving a phone call.

Figure 22 is an exploded perspective view of a pin contact frame and a socket housing employed in the SIM card socket shown in Figure 12, for showing an assembly between them, and Figure 23 is a perspective view of the SIM card socket of Figure 12 in states before and after being fabricated.

Figures 22 and 23 show a process of manufacturing the SIM card socket 400 according to the present embodiment, which is the same as the process of manufacturing SIM card socket 100 shown in Figures 4 to 11, except for the alignment grooves 414b formed at lower plate portion 410b and the engagement protuberances 414a formed at upper plate portion 410a of socket housing 410.

In Figures 22 and 23, reference numerals 440 and 450 not described above respectively designate a pin contact frame and an insert molding portion.

In a SIM card socket and its manufacturing method according to the present invention as described above, the board-engaging free ends and the card-engaging free ends of the pin contacts of the SIM card socket, which electrically connect with corresponding contacts of the SIM card and the printed circuit board in a mobile communication device, are disposed within the dimensions defined by the rectangular shape and extend inward of the SIM card socket, so as to reduce the dimensions of elements of the mobile communication device.

Also, in a SIM card socket and its manufacturing method according to the present invention, the board-engaging free ends and the card-engaging free ends of the pin contacts of the SIM card socket do not necessitate a solder construction but can effect an electrical and mechanical contact by simply putting the free ends of the pin contacts in contact with
corresponding contacts of a printed circuit board and SIM card respectively. Accordingly, this design reduces the thickness or the height of the SIM card socket.

Further, a SIM card socket and its manufacturing method according to the present invention enables the entire dimension of the mobile communication device to be reduced, since the dimensions of elements of the mobile communication device can be reduced in the way as described above.

Moreover, in a SIM card socket and its manufacturing method according to the present invention, the SIM card socket can be easily mounted, since the board-engaging free ends and the card-engaging free ends of the pin contacts of the SIM card socket do not have a solder construction but have a contacting construction.

Although several preferred embodiments of the present invention have been described for illustrative purposes, those skilled in the art will appreciate that various additional modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

It will be understood that the invention may be embodied in other specific forms without departing from the spirit thereof. The present examples and embodiments, therefore, are to be considered in all respects as illustrative and not restrictive, and the invention is not to be limited to the details given herein.
CLAIMS:

1. A SIM card socket for receiving a SIM card and adapted to be mounted on a printed circuit board in a mobile communication device comprising:
   a plurality of pin contacts, each contact being generally U-shaped and including a fixed bight portion and two free end portions extending in the same direction away from the bight portion, the free end portions including a board-engaging free end extending downwardly from the bight portion and adapted to engage a corresponding contact of the printed circuit board and a card-engaging free end extending upwardly from the bight portion and adapted to engage a corresponding contact of the SIM card, wherein the board-engaging free end and the card-engaging free end of each contact define an acute angle therebetween,
   a generally rectangular socket housing for mounting the contacts therein in two generally parallel mirror image rows, wherein the housing includes windows formed though the housing, and wherein the bight portion of the contacts are mounted generally along two opposite outside edges of the housing and the free ends of each contact extend inwardly toward a free end of an oppositely positioned mirror-image contact and are positioned within the windows, and
   wherein the housing has outer dimensions which define the rectangular shape of the housing and the card-engaging free end and the board-engaging free end of the contacts are positioned inside of the outer dimensions of the housing.

2. A SIM card socket as claimed in claim 1, wherein the socket housing comprises an upper plate portion and a lower plate portion, and the bight portion of each of the pin contacts is fixed between the upper plate portion and the lower plate portion of the socket housing.

3. A SIM card socket as claimed in claim 2, wherein the socket housing further comprises a metal reinforcement located between the upper plate portion and the lower plate portion.

4. A SIM card socket as claimed in claim 3, wherein the metal reinforcement is generally H-shaped and is located in two longitudinal side portions and a central transverse portion of the socket housing.
5. A SIM card socket as claimed in claim 4, wherein the contacts and the metal reinforcement are insert-molded between the upper plate portion and the lower plate portion of the socket housing.

6. A SIM card socket as claimed in claim 1, wherein the socket housing further comprises spaced-apart partitions disposed in the windows of the socket housing, each of the partitions separating two adjacent pin contacts from each other.

7. A SIM card socket as claimed in claim 1, wherein the socket housing further comprises an alignment protuberance formed on a lower surface of the lower portion of the socket housing, so that the SIM card socket can be mounted at a predetermined location on the printed circuit board of the mobile communication device.

8. A SIM card socket as claimed in claim 1, wherein each card-engaging free end of the pin contact extends further away from the fixed bight portion than the adjacent board-engaging free end.

9. A method of manufacturing a SIM card socket, the SIM card socket being mounted in a mobile communication device and being adapted to receive a SIM card, the method comprising the steps of:

   stamping and forming a metal plate portion to produce a pin contact frame, the pin contact frame including a metal reinforcement and a plurality of pin contacts, each of the pin contacts being generally U-shaped and having a bight portion, a board-engaging free end and a card-engaging free end, the board-engaging free end and the card-engaging free end extending in the same direction away from the bight portion and defining an acute angle therebetween;

   molding a generally rectangular socket housing with an upper plate portion and a lower plate portion, each of the upper plate portion and the lower plate portion being formed with a window portion such that the board-engaging free ends and the card-engaging free ends of the pin contacts are adapted to be located in the through hole windows;

   placing the pin contact frame between the upper plate portion and the lower plate portion,
insert-molding the pin contact frame between the upper plate portion and the lower plate portion; and

cutting portions of the pin contact frame to mechanically and electrically isolate the pin contacts from each other and from the metal reinforcement.

10. The method of manufacturing a SIM card socket as set forth in claim 9, wherein the step of stamping and forming the metal plate portion includes stamping and forming the pin contact frame so that the metal reinforcement and the pin contact frame are integrally connected.

11. The method of manufacturing a SIM card socket as set forth in claim 9, wherein the step of stamping and forming the metal plate portion includes stamping and forming the metal reinforcement in the shape of an "H" with two side longitudinal extensions and a central transverse extension, and wherein the pin contacts are stamped and formed on opposite sides of the central transverse extension in two mirror image rows.

12. The method of manufacturing a SIM card socket as set forth in claim 9, wherein the socket housing is molded to be shorter than the pin contact frame so as to allow a portion of the pin contact frame to protrude out of the socket housing when the pin contact frame is placed between the upper plate portion and the lower plate portion.

13. A SIM card socket adapted to be mounted in a mobile communication device for receiving a SIM card, comprising:

a rectangular socket housing including an upper plate portion and a lower plate portion and having through hole windows formed therethrough; and

a plurality of generally U-shaped pin contacts mounted in the socket housing in two parallel mirror image rows, each of the pin contacts having a bight portion, a board-engaging free end and a card-engaging free end, wherein the free ends of each of the pin contacts extend away from the bight portion in the same general direction and define an acute angle therebetween, the bight portions of the pin contacts being fixed generally along two outside edges of the socket housing between the upper plate portion and the lower plate portion of the socket housing and the free ends of each contact extend inwardly toward the free ends of an
oppositely positioned mirror image contact, so that board-engaging free ends and card-engaging free ends of the pin contacts are located in the through hole windows of the socket housing.

14. The SIM card socket as claimed in claim 13 wherein the socket housing has outer dimensions which define the rectangular shape of the socket housing and wherein both the card-engaging free ends and the board-engaging free ends of the pin contacts are positioned inside of the outer dimensions of the socket housing.

15. A SIM card socket as claimed in claim 13 wherein the upper plate portion is longer than the lower plate portion, such that the longer side portions of the upper plate portion extend past the longer side portions of the lower plate portion.

16. A SIM card socket as claimed in claim 13, wherein the card socket further comprises a generally "H" shaped metal reinforcement between the upper plate portion and the lower plate portion.

17. A SIM card socket as claimed in claim 13, wherein the socket housing further comprises spaced apart partitions disposed in the through hole windows of the socket housing separating adjacent pin contacts.

18. A SIM card socket as claimed in claim 13 wherein the socket housing further comprises an alignment protuberance formed on two opposite sides thereof, wherein the alignment protuberances have different dimensions and are adapted to engage corresponding alignment grooves within the mobile communication device.

19. A SIM card socket as claimed in claim 13 wherein the socket housing further comprises engagement protuberances formed on two opposing sides of the socket housing for engaging corresponding engagement thresholds within the mobile communication device.

20. A SIM card socket as claimed in claim 19, wherein each of the engagement protuberances of the socket housing includes a chamfered surface.
FIG. 1  (PRIOR ART)

FIG. 2  (PRIOR ART)
FIG. 3 (PRIOR ART)
FIG. 10