

Description

Title of Invention: TEST PROBE AND TEST DEVICE

Technical Field

- [1] The disclosure relates to a test probe and a test device, which are for high current to test the electrical characteristics of a subject-to-be-tested such as a secondary battery.

Background Art

- [2] A secondary battery undergoes charge/discharge tests or electrical characteristic tests based on contact between its electrode terminal and a test probe of a test device when being manufactured. The test device includes a pogo pin having a tip on a first side thereof with which the electrode terminal of the secondary battery comes into contact, a receptacle pipe having a first side to accommodate the pogo pin and a second side to which a signal line of a printed circuit board (PCB) terminal is soldered, and a supporting block that supports the receptacle pipe. The pogo pin includes a barrel, a spring inserted in the barrel, and a terminal sliding as partially inserted in a first end portion of the barrel.
- [3] During the test, the terminal slides toward the inside of the barrel while being in contact with the electrode terminal of the secondary battery. In this case, electric current flows from the secondary battery to the PCB terminal via the terminal, the barrel and the spring, the receptacle pipe, and the signal line. To make the terminal slide within the barrel, an appropriate gap is required between an outer surface of the terminal and an inner surface of the barrel. Such a gap is unsuitable for high current because it causes unstable contact and increases contact resistance.
- [4] To solve the problem of increasing the contact resistance between the terminal and the barrel, a test device using an integrated test probe has been disclosed. The integrated test probe is shaped like a rod that has a first side including a tip with which the secondary battery comes into contact, and a second side to which a signal line connected to the PCB terminal is soldered. The integrated test probe is supported on the supporting block and allowed to elastically move up and down. Therefore, the integrated test probe is suitable for high current because the electric current directly flows from the tip to the signal line. However, when some test probes among a plurality of test probes supported on the supporting block in the test device are damaged while their tips come into contact with the electrode terminals, it is not easy to selectively replace only the damaged test probes from the supporting block.

Disclosure of Invention

Technical Problem

- [5] An aspect of the disclosure is to provide a high current test probe, which is easy to replace, and a test device.

Solution to Problem

- [6] According to an embodiment of the disclosure, there is provided a test probe. The test probe includes a pin unit; and a terminal unit connected to the pin unit along a longitudinal direction. One of the pin unit and the terminal unit includes an engagement extending portion extending along the longitudinal direction, and including a plurality of cutting portions formed along the longitudinal direction to be elastically transformable in a radial direction, and a locking portion recessed in the radial direction. The other one of the pin unit and the terminal unit includes an engagement accommodating portion including an engagement portion engaging with the locking portion to prevent the engagement extending portion from separating in the longitudinal direction, and accommodating the engagement extending portion along the longitudinal direction.
- [7] The engagement portion may include an end portion decreased in diameter toward a lengthwise central axis. Thus, it is easy to form the engagement accommodating portion that engages with the locking portion of the engagement extending portion, thereby making separation possible and improving contact characteristics.
- [8] The engagement portion may include a hemispherical protruding portion formed by dimpling to protrude toward an inside of the engagement accommodating portion. Thus, it is easy to form the engagement portion that engages with the locking portion of the engagement extending portion.
- [9] The engagement portion may include a protruding portion formed by rolling to protrude inward along a circumferential direction of the engagement accommodating portion. Thus, it is easy to form the engagement portion that engages with the locking portion of the engagement extending portion.
- [10] The engagement extending portion may include a plurality of engagement extending bars separated in the longitudinal direction by the cutting portions. Thus, it is easy to form the engagement extending portion that is elastically transformable to engage with the engagement portion of the engagement accommodating portion, thereby making separation possible and improving contact characteristics.
- [11] According to an embodiment of the disclosure, there is provided a test device for testing electrical characteristics of a subject-to-be-tested. The test device includes: the foregoing test probe; a probe supporting block accommodating and supporting the test probe so that the test probe can move elastically and stretchably in an accommodating

direction; and a test circuit board provided under the probe supporting block and transmitting a signal to the test probe.

Advantageous Effects of Invention

- [12] According to an embodiment of the disclosure, the test probe is excellent in impedance characteristics and easy to replace when damaged because the pin unit having the tip and the terminal unit connected to the signal line are separatable but firmly and closely coupled.

Brief Description of Drawings

- [13] FIG. 1 is a view showing a test device according to a first embodiment of the disclosure.
- [14] FIG. 2 is a view showing an operation state of the test device according to the first embodiment of the disclosure.
- [15] FIG. 3 is a perspective view showing a test probe of FIG. 1.
- [16] FIG. 4 is a cross-sectional view of a test probe shown in FIG. 2.
- [17] FIG. 5 is a perspective view of an engagement extending portion and an engagement accommodating portion of FIG. 4.
- [18] FIG. 6 is an exploded view showing the test probe of FIG. 3.
- [19] FIG. 7 is a view showing a test probe according to a second embodiment of the disclosure.
- [20] FIG. 8 is a view showing an engagement extending portion and an engagement accommodating portion of a test probe according to a third embodiment of the disclosure.
- [21] FIG. 9 is a view showing an engagement extending portion and an engagement accommodating portion of a test probe according to a fourth embodiment of the disclosure.
- [22] FIG. 10 is a view showing an engagement extending portion and an engagement accommodating portion of a test probe according to a fifth embodiment of the disclosure.
- [23] FIG. 11 is an exploded perspective view of an engagement extending portion and an engagement accommodating portion of a test probe according to a sixth embodiment of the disclosure.
- [24] FIG. 12 is a cross-sectional view showing a state that the engagement extending portion and the engagement accommodating portion of the test probe shown in FIG. 11 are assembled.
- [25] FIG. 13 is a view showing an engagement extending portion and an engagement accommodating portion of a test probe according to a seventh embodiment of the disclosure.

- [26] FIG. 14 is a view showing an engagement extending portion and an engagement accommodating portion of a test probe according to an eighth embodiment of the disclosure.

Best Mode for Carrying out the Invention

- [27] Below, a test device 1 according to a first embodiment of the disclosure will be described in detail with reference to the accompanying drawings.
- [28] FIG. 1 is a view showing a test device 1 according to a first embodiment of the disclosure, FIG. 2 is a view showing an operation state of the test device 1 according to the first embodiment of the disclosure, FIG. 3 is a perspective view showing a test probe 4 of FIG. 1, FIG. 4 is a cross-sectional view of a test probe 4 shown in FIG. 2, FIG. 5 is a perspective view of an engagement extending portion 422 and an engagement accommodating portion 431 of FIG. 4, and FIG. 6 is an exploded view showing the test probe of FIG. 3.
- [29] Referring to FIGS. 1 to 6, the test device 1 includes a probe supporting block 2, a test circuit board 3, and a plurality of test probes 4 accommodated and supported in the probe supporting block 2.
- [30] The probe supporting block 2 refers to a block shaped like a plate, and includes a plurality of first probe holes 21 formed penetrating the probe supporting block 2 in a thickness direction to accommodate and support the plurality of test probes 4 therein.
- [31] The test circuit board 3 includes a plurality of second probe holes 31 provided at positions corresponding to the plurality of first probe holes 21 and formed penetrating the test circuit board 3 in the thickness direction to accommodate and support the plurality of test probes 4 therein, a pattern line 32 printed on one surface (i.e., a bottom surface), a pad terminal 33 provided in the pattern line 32, and a flexible signal connection line 34 connecting the pad terminal 33 and the test probe 4 and transmitting a signal. The test circuit board 3 may be supported by a connection member 35 in parallel with the probe supporting block 2 and below the probe supporting block 2.
- [32] The test probe 4 is made of a conductive material. The test probe 4 includes a pin unit 41, a terminal unit 42, a connection unit 43, a receptacle pipe 44, a spring holder 45, and a spring 46.
- [33] The pin unit 41 includes a pin main body 411 shaped like a rod, a pin head 412 provided in a first end portion of the pin main body 411, and a first coupling end 413 provided in a second end portion of the pin main body 411 to couple with the connection unit 43.
- [34] The pin head 412 includes at least one sharp tip to come into contact with a test terminal 51 of a subject-to-be-tested 5, for example, a secondary battery.

- [35] The first coupling end 413 is accommodated in the connection unit 43, and includes a first recessed portion 414 recessed along a circumferential direction. The first recessed portion 414 engages with a first protruding portion 435 of the connection unit 43 (to be described later).
- [36] The terminal unit 42 is made of a conductive material. The terminal unit 42 includes a terminal main body 421 shaped like a rod, the engagement extending portion 422 provided in a first end portion of the terminal main body 421, and a signal-line connecting end 424 provided in a second end portion of the terminal main body 421.
- [37] The terminal main body 421 is slidably inserted in the receptacle pipe 44. The terminal main body 421 includes a second recessed portion 425 recessed along the circumference to engage with a second protruding portion 441 protruding inside the receptacle pipe. The second recessed portion 425 is formed to have a predetermined length along the longitudinal direction of the terminal main body 421. The slidable range of the terminal main body 421 is varied depending on the length of the second recessed portion 425.
- [38] The engagement extending portion 422 includes a tapering end portion 422E to be easily inserted in the engagement accommodating portion 431 of the connection unit 43, and a locking portion 423 engaging with an engagement portion 434 of the connection unit 43. The locking portion 423 is recessed along the circumferential direction of the engagement extending portion 422.
- [39] The signal-line connecting end 424 connects with the second side of the signal connection line 34, of which the first side is connected to the pad terminal 33 of the test circuit board 3, by soldering, but there are no limits to the soldering.
- [40] The connection unit 43 is shaped like a tube, and has a first side coupled to the first coupling end 413 of the pin unit 41 and a second side detachably fastened to the engagement extending portion 422 of the terminal unit 42. The connection unit 43 includes the engagement accommodating portion 431 to accommodate the engagement extending portion 422 of the terminal unit 42, and the first protruding portion 435 to engage with the first recessed portion 414 provided in the first coupling end 413 of the pin unit 41.
- [41] As shown in FIG. 5, the engagement accommodating portion 431 includes four slits 432 cut in the longitudinal direction, a skirt portion 433 formed by four slits 432, and the engagement portion 434 provided at the end portion of the skirt portion 433 and decreased in diameter along the longitudinal direction. The opening of the engagement portion 434, through which the engagement extending portion 422 of the terminal unit 42 passes, is equal to or smaller than the outer diameter of the locking portion 423 of the terminal unit 42. Therefore, the engagement portion 434 continuously maintains

contact with the locking portion 423 of the terminal unit 42, thereby decreasing contact resistance.

- [42] Further, when the test probe 4 is defective, the engagement portion 434 of the connection unit 43 and the locking portion 423 of the terminal unit 42 may be released from each other by pulling the pin unit 41 from the terminal unit 42 so that the skirt portion 433 can be elastically transformed outwards in a radial direction. Each number of slits 432 and skirt portions 433 is not limited to four.
- [43] The receptacle pipe 44 is secured as inserted in the first probe hole 21 of the probe supporting block 2 and/or the second probe hole 31 of the test circuit board 3. The pin unit 41 having the first side, to which the connection unit 43 is coupled, and the terminal unit 42 are inserted in both ends of the receptacle pipe 44. Further, the engagement portion 434 provided in the engagement accommodating portion 431 of the connection unit 43 and the locking portion 423 of the engagement extending portion 422 of the terminal unit 42 engage with each other inside the receptacle pipe 44.
- [44] The receptacle pipe 44 includes the second protruding portion 441 deformed to protrude inwards along the circumferential direction by dimpling or rolling. The second protruding portion 441 engages with the second recessed portion 425 of the terminal unit 42 slidably within a predetermined range along the longitudinal direction.
- [45] The spring holder 45 includes a tubular holder body 451, and an expansion flange 452 radially expanding from a first end portion of the holder body 451. The holder body 451 is inserted in the first end of the receptacle pipe 44 inserted in and secured to the first probe hole 21 of the probe supporting block 2, and the expansion flange 452 has a first side being in contact with the first end portion of the receptacle pipe 44 and a second side being in contact with the first side of the spring 46. The pin main body 411 of the pin unit 41 is inserted in the holder body 451.
- [46] Alternatively, the spring holder 45 may be omitted. In this case, the spring 46 may be supported being in contact with the expansion flange provided in the first end portion of the receptacle pipe 44.
- [47] The spring 46 is inserted in the pin main body 411 and interposed between the pin head 412 and the expansion flange 452 of the spring holder 45. The spring 46 is compressed as the subject-to-be-tested 5 presses the tip during the test, and restored as the pressure is released.
- [48] Below, the operations of the test probe 4 are as follows.
- [49] As shown in FIG. 2, when the test terminal 51 of the subject-to-be-tested 5 is pressed for the test while being in contact with the tip provided in the pin head 412 of the pin unit 41, the spring 46 is compressed and the pin unit 41 and the terminal unit 42

connected by the connection unit 43 are moved sliding downward within the receptacle pipe 44.

- [50] Then, when the pin head 412 of the pin unit 41 is released from the pressure, the spring 46 is restored and the pin unit 41 and the terminal unit 42 coupled to each other are moved sliding upward within the receptacle pipe 44.
- [51] When a specific test probe is damaged during the test, the engagement portion 434 of the engagement accommodating portion 431 and the locking portion 423 of the engagement extending portion 422 are separated from each other by pulling the pin unit 41 upward so that the skirt portion 433 of the engagement accommodating portion 431 can be transformed outward in the radial direction. Then, a new pin unit is inserted in the receptacle pipe 44 so that the engagement accommodating portion of the pin unit can be fastened to the engagement extending portion 422 of the terminal unit 42.
- [52] Below, a method of assembling the test probe 4 will be described with reference to FIG. 6.
- [53] 1) The spring 46 and the spring holder 45 are sequentially inserted in the pin main body 411 of the pin unit 41, and then the first side of the connection unit 43 is put on and secured to the first coupling end 413.
- [54] 2) The connection unit 43 coupled to the pin main body 411 of the pin unit 41 is inserted through the first side of the receptacle pipe 44. In this case, a portion of the pin main body 411 and the holder body 451 of the spring holder 45 are inserted in the receptacle pipe 44.
- [55] 3) The engagement extending portion 422 of the terminal unit 42 is inserted through the second side of the receptacle pipe 44. In this case, the engagement extending portion 422 is inserted in the engagement accommodating portion 431 of the connection unit 43 so that the locking portion 423 and the engagement portion 434 can be fastened to each other.
- [56] FIG. 7 is a view showing a test probe 6 according to a second embodiment of the disclosure.
- [57] Referring to FIG. 7, the test probe 6 includes a pin unit 61, a terminal unit 62, a receptacle pipe 64, and a spring 66. Below, descriptions about the terminal unit 62, the receptacle pipe 64 and the spring 66 will be omitted because they are similar to the terminal unit 42, the receptacle pipe 44 and the spring 46 shown in FIG. 4.
- [58] The pin unit 61 includes a pipe body 611, and a pin head 612.
- [59] The pipe body 611 is shaped like a tube and includes an engagement accommodating portion 611b at a first side thereof.
- [60] Like the engagement accommodating portion 431 shown in FIG. 5, the engagement accommodating portion 611b includes four slits cut in the longitudinal direction, four skirt portions 611c formed by four slits, and an engagement portion 611d provided at

the end of each skirt portion 611c and decreased in diameter along the longitudinal direction. The opening formed by the four engagement portions 611d and allowing the engagement extending portion 622 of the terminal unit 62 to pass therethrough may have a diameter equal to or smaller than the outer diameter of a locking portion 623 of the terminal unit 62.

- [61] The pin head 612 includes a head portion 612a, and a third coupling end 612b extending toward the opposite side of the head portion 612a.
- [62] The head portion 612a includes at least one sharp tip to come into contact with the test terminal 51 of the subject-to-be-tested 5, for example, the secondary battery.
- [63] The third coupling end 612b may be inserted into an end portion of the pipe body 611 by, for example, forcible fitting, or may be inserted and secured by deforming the pipe body 611 inwards through rolling or dimpling. The third coupling end 612b may be formed to extend near the engagement accommodating portion 611b.
- [64] FIG. 8 is a view showing an engagement extending portion 713 and an engagement accommodating portion 721 of a test probe 7 according to a third embodiment of the disclosure.
- [65] Referring to FIG. 8, the test probe 7 includes the engagement extending portion 713 provided in the pin unit 71, and the engagement accommodating portion 721 provided in the terminal unit 72.
- [66] The engagement extending portion 713 includes a locking portion 714 with which an engagement portion 724 of the engagement accommodating portion 721 engages. The locking portion 714 is recessed along the circumferential direction of the engagement extending portion 713.
- [67] The engagement accommodating portion 721 is shaped like a cylinder and accommodates the engagement extending portion 713 therein. The engagement accommodating portion 721 includes four skirt portions 723 formed by, for example, four slits 722 cut in the longitudinal direction, and four engagement portions 724 decreased in diameter along the end of the skirt portion 723.
- [68] Alternatively, the terminal unit may be shaped like a rod, the connection unit as shown in FIG. 5 may be coupled to the terminal unit, and the engagement accommodating portion may be provided in the connection unit.
- [69] Alternatively, the terminal unit may include a tubular pipe body, and the engagement accommodating portion may be formed at a first end portion of the tubular pipe body.
- [70] FIG. 9 is a view showing an engagement extending portion 822 and an engagement accommodating portion 831 of a test probe 8 according to a fourth embodiment of the disclosure.
- [71] Referring to FIG. 9, the test probe 8 includes the engagement extending portion 822 provided in a terminal unit 82, and an engagement accommodating portion 831

provided in a connection unit 83. The connection unit 83 is shaped like a cylinder of which the first side is coupled to the first end portion of a pin unit 81. The pin unit 81 and the connection unit 83 are coupled based on the engagement between a first recessed portion 814 of the pin unit 81 and a first protruding portion 835 of the connection unit 83.

- [72] The engagement extending portion 822 includes a locking portion 823 with which an engagement portion 834 of the engagement accommodating portion 831 engages. The locking portion 823 is recessed along the circumferential direction of the engagement extending portion 822.
- [73] The engagement accommodating portion 831 is shaped like a cylinder and accommodates the engagement extending portion 822 therein. The engagement accommodating portion 831 includes four skirt portions 833 formed by, for example, four slits 832 cut in the longitudinal direction, and four engagement portions 834 radially protruding inwards along the circumferential direction of the skirt portions 833. The engagement portion 834 is formed as pressed by rolling.
- [74] FIG. 10 is a view showing an engagement extending portion 922 and an engagement accommodating portion 931 of a test probe 9 according to a fifth embodiment of the disclosure. Descriptions about similar parts between the engagement extending portion 922 and the engagement accommodating portion 931 of the test probe 9 and the engagement extending portion 822 and the engagement accommodating portion 831 of the test probe 8 shown in FIG. 9 will be omitted to avoid the repetitive descriptions.
- [75] Referring to FIG. 10, the engagement accommodating portion 931 includes four skirt portions 933 formed by, for example, four slits 932 cut in the longitudinal direction, and four engagement portions 934 radially protruding inward from the skirt portions 933. The engagement portion 934 may be formed to protrude having a hemispherical shape as pressed by dimpling or punching.
- [76] FIG. 11 is an exploded perspective view of an engagement extending portion 1022 and an engagement accommodating portion 1031 of a test probe 10 according to a sixth embodiment of the disclosure, and FIG. 12 is a cross-sectional view showing a state that the engagement extending portion 1022 and the engagement accommodating portion 1031 of the test probe 10 shown in FIG. 11 are assembled. Descriptions about similar parts between the engagement extending portion 1022 and the engagement accommodating portion 1031 of the test probe 10 and the engagement extending portion 822 and the engagement accommodating portion 831 of the test probe 8 shown in FIG. 9 will be omitted to avoid the repetitive descriptions.
- [77] Referring to FIG. 11, the engagement accommodating portion 1031 is shaped like a cylinder and accommodates the engagement extending portion 1022 therein. The engagement accommodating portion 1031 includes four elastic bars 1033 formed by,

for example, four closed slots 1032 cut in the longitudinal direction, four engagement portions 1034 radially protruding inwards along the circumferential direction of the elastic bar 1033, and a flange 1036 provided at an end portion thereof. The engagement portion 1034 is formed as pressed by rolling.

- [78] Referring to FIG. 12, the engagement portion 1034 of the engagement accommodating portion 1031 is separated from a locking portion 1023 of the engagement extending portion 1022 by pulling a pin unit 101 to deform the elastic bar 1033. In this case, the elastic bar 1033 is radially deformed outwards within a space between the flange 1036 and a connection unit body 1037.
- [79] FIG. 13 is a view showing an engagement extending portion 1121 and an engagement accommodating portion 1131 of a test probe 11 according to a seventh embodiment of the disclosure.
- [80] Referring to FIG. 13, the test probe 11 includes the engagement extending portion 1121 provided in a terminal unit 112, and the engagement accommodating portion 1131 provided in a connection unit 113. The connection unit 113 is shaped like a cylinder, a first side of which is coupled to a first end portion of a pin unit 111. The pin unit 111 and the connection unit 113 may be coupled based on engagement between a first recessed portion 1114 of the pin unit 111 and a first protruding portion 1135 of the connection unit 113.
- [81] The engagement extending portion 1121 includes a locking portion 1124 with which an engagement portion 1134 of the engagement accommodating portion 1131 engages to prevent separation in the longitudinal direction. The locking portion 1124 is recessed along the circumferential direction of the engagement extending portion 1121.
- [82] The engagement extending portion 1121 includes four engagement extending bars 1123 formed to extent in the longitudinal direction by the cutting portions 1122. The engagement extending bar 1123 is elastically transformable in a radial direction.
- [83] The engagement accommodating portion 1131 is shaped like a cylinder and accommodates the engagement extending portion 1121 therein. The engagement accommodating portion 1131 includes a circular engagement portion 1134 decreased in diameter toward a lengthwise central axis.
- [84] FIG. 14 is a view showing an engagement extending portion 1211 and an engagement accommodating portion 1221 of a test probe 12 according to an eighth embodiment of the disclosure.
- [85] Referring to FIG. 14, the test probe 12 includes the engagement extending portion 1211 provided in a first end portion of a pin unit 121, and the engagement accommodating portion 1221 provided in a terminal unit 122.
- [86] The engagement extending portion 1211 includes a locking portion 1214 with which an engagement portion 1224 of the engagement accommodating portion 1221

engage to prevent separation in the longitudinal direction. The locking portion 1214 is recessed along the circumferential direction of the engagement extending portion 1211.

[87] The engagement extending portion 1211 includes four engagement extending bars 1213 formed to extend in the longitudinal direction by cutting portions 1212. The engagement extending bars 1213 are elastically transformable in the radial direction.

[88] The engagement accommodating portion 1221 is shaped like a cylinder and accommodates the engagement extending portion 1211 therein. The engagement accommodating portion 1221 includes a circular engagement portion 1224 decreased in diameter toward a lengthwise central axis.

[89] Although a few embodiments of the disclosure have been illustrated and described above, the disclosure is not limited to the foregoing specific embodiments. Various modifications can be made in the embodiments by those skilled in the art without departing from the scope of the disclosure as claimed in Claims, and these modified embodiments should not be understood separately from the technical spirits or prospects of the disclosure.

Claims

- [Claim 1] A test probe comprising:
a pin unit; and
a terminal unit connected to the pin unit along a longitudinal direction, wherein
one of the pin unit and the terminal unit comprises an engagement extending portion extending along the longitudinal direction, and comprising a plurality of cutting portions formed along the longitudinal direction to be elastically transformable in a radial direction, and a locking portion recessed in the radial direction, and
the other one of the pin unit and the terminal unit comprises an engagement accommodating portion comprising an engagement portion engaging with the locking portion to prevent the engagement extending portion from separating in the longitudinal direction, and accommodating the engagement extending portion along the longitudinal direction.
- [Claim 2] The test probe of claim 1, wherein the engagement portion comprises an end portion decreased in diameter toward a lengthwise central axis.
- [Claim 3] The test probe of claim 1, wherein the engagement portion comprises a hemispherical protruding portion formed by dimpling to protrude toward an inside of the engagement accommodating portion.
- [Claim 4] The test probe of claim 1, wherein the engagement portion comprises a protruding portion formed by rolling to protrude inward along a circumferential direction of the engagement accommodating portion.
- [Claim 5] The test probe of claim 1, wherein the engagement extending portion comprises a plurality of engagement extending bars separated in the longitudinal direction by the cutting portions.
- [Claim 6] A test device for testing electrical characteristics of a subject-to-be-tested, comprising:
a test probe according to any one of claims 1 to 5;
a probe supporting block accommodating and supporting the test probe so that the test probe can move elastically and stretchably in an accommodating direction; and

a test circuit board provided under the probe supporting block and transmitting a signal to the test probe.