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(54) Title: METHOD AND APPARATUS FOR TESTING CELL PHONES

(57) Abstract: A phone holder (1) for a mobile phone testing apparatus which comprises at least a base plate (10), a rest structure (20) on the base plate (10) for supporting a mobile phone, at least one block for contacting a mobile phone's narrow side, wherein the at least one block is moveably attached to the base plate, thereby enabling adapting the position of the block to a mobile phone being supported by said rest, and clamping means for releasable fixing the at least one first block in said position can be configured for securely holding almost any mobile phone model.
Method and Apparatus for Testing Cell Phones

Field of the invention

The invention relates to a tester for testing the correct operation of a mobile phone and to a method testing the correct operation.

5 Description of the related art

Mobile phones, as well referred to as cellular phones, smart phones or more generally mobile communication devices and the like are subjected to an extensive test of preferably all functions and buttons by so called 'mobile phone testing apparatuses', briefly referred to as 'testers' after completion of the mobile phone's manufacture and before delivery to the clients. These testers typically have a housing with a phone holder as support for the mobile phone to be tested. The phone holder is particularly adapted to the respective model of mobile phone to be tested. Each time the model to be tested is changed, at least the phone holder has to be replaced by a new one being again particularly adapted to the new model.

EP 1 739 998 B1 discloses a tester for testing mobile phones. The tester has a phone holder as support for a mobile phone with a cavity being a negative mold of the mobile phone and being adapted to receive a certain type or model of mobile phone with the mobile phone's display facing upwards. The phone holder is replaceable to thereby adapt the tester to different types of mobile phones. A camera images the display and thus enables to detect defects.

KR 20060085509 discloses a phone holder for a mobile phone tester. The mobile phone is connected via an electrical connector to a computer for performing the tests. The phone holder has a base plate supporting a replaceable adapter for the mobile phone to be tested. The adapter is particularly adapted to the mobile
phone which is to be tested. Additionally, the base plate supports a height adjustable electrical connector for connecting the mobile phone to a controlling unit of the tester. The height adjustment significantly reduces the costs for the adapter, as the electrical connector is no longer part of the adapter.

US 2012/286815 discloses a phone holder for a mobile phone testing apparatus with a receiving moldboard for the mobile phone. The receiving moldboard is mounted to on top of an inspection panel and has a receptacle being particularly adapted to the type shape of a particular type of mobile phone, therefore the moldboard is product specific part. After insertion of the mobile phone into the moldboard the mobile phone is secured by two clamping blocks. The clamping blocks are elastically supported in the vertical direction to thereby exert a downward force on the upper rim of the mobile phone and thus secure the mobile phone in the moldboard. The clamping blocks each have a recess being particularly adapted to receive the upper rim of the mobile phone. Thus the rim of the secured mobile phone engages into said recesses. To release the mobile phone, the clamping blocks are lifted off and subsequently they can be pivoted around a vertical axis. Next, the mobile phone can be removed from the moldboard.

WO 2011/031904 discloses a test adapter configuration for mobile phones and the like. The test adapter comprises a common part and product specific part. The common part supports the product specific part, which is detachably mounted to the common part. The product specific part is particularly adapted to the mobile phone to be tested and so to speak an adapter to mechanically support a particular type of mobile phone and to position the corresponding probes, sensors, plugs and actuators relative to the mobile phone, which are required when testing a particular type of mobile phone.
There exists a vast variety of prior art relating to particular test routines, e.g. US 2012 0327796 A, CN 20256547 U, US 2012 212492 A, CN 102314386A to name only a few.

Summary of the invention

The invention is based on the observation that mobile phone testing has been accomplished so far in line with the production of the respective mobile phone. As each production line usually produces only a single type of mobile phone, the tester has to be set up only once for the production cycle of the respective type of mobile phone. The tester is a product specific part. This is, however, not suited for after sales testing, be it e.g. as preparatory step before repair or for purpose of quality and risk management in the second hand market.

The problem to be solved by the invention is to provide reduce the costs for after sales testing of mobile communication devices.

Only to be more illustrative, the term mobile phone is used as synonym for the more general term "mobile communication device".

Solutions of the problem are described in the independent claims. The dependent claims relate to further improvements of the invention.

The core idea of the invention is to provide a tester for mobile phones and the like that is not particularly suited for a particular type of mobile phone, but can be adjusted to receive almost any mobile phone.

A phone holder for being preferably detachably mounted to a mobile phone testing apparatus comprises preferably at least a base plate and a rest structure. The plate may be adapted to a complementary receptacle of a mobile phone testing apparatus. A rest structure is mounted to the base plate or is integrally formed on or in the base plate. The rest structure may have a preferably at least approx-
imately plane rest surface as rest for e.g. the rear side of a mobile phone. The
rest surface is thus preferably not particularly adapted to the shape of a particu-
lar mobile phone, but should be able to accommodate any kind of a typical mo-
BILE phone. To this end the rest surface may be defined by the up facing surfaces
of at least two support elements, which are preferably adjustable relative to
each other and/or to the base plate. These at least two support elements define
at least three (or more) support surfaces or points defining a triangle. The sup-
port points may be provided by up facing sides of support elements like rods or
the like which are not necessarily points, but can be areas or lines. The smaller
the surface of the up facing sides of the support elements, the better is the ac-
cessibility of the mobile phone's rear side. At least one of the support elements is
preferably adjustable relative to the base plate and can be releasable fastened,
i.e. fixed in an adjusted position. Adjustable means that the position of the re-
spective support elements can be changed and fixed in the new position, e.g. by
clamping means, enabling to releasable clamp the movable the support ele-
ments) e.g. against the base plate or support element mounted to said base
plate to obtain a frictional locking of the support element. The support structure
can thus be adapted to at least almost any kind of mobile phone or the like. The
rest structure preferably positions the mobile phone only vertically.

The phone holder has at least two blocks for contacting the mobile phone's nar-
row sides and to thereby define the mobile phone's horizontal position when the
mobile phone is inserted between said blocks. These blocks provide horizontal
stops for the mobile phones narrow sides. At least one of these blocks is movea-
BLY attached to the base plate and/or the rest structure and the position and
orientation can be adjusted horizontally. This enables to define the horizontal
position of the mobile phone by (mechanically) contacting the mobile phone's
narrow side with the blocks, i.e. the horizontal stops. In the adjusted position the
at least one block can be releasable fastened, e.g. by clamping means clamping
the block against the base plate and/or the rest structure to thereby obtain a
frictional locking of the block in its position. Thus, the position of the movable block can be adapted to any mobile phone by releasing the fastening, moving the block to a new position adapted to said new mobile phone and fasten, i.e. fix the block again. Once adjusted relative to the rest and secured in the adjusted position, the movable block enables to repeatable position a mobile phone on the rest.

The movable block thus can be brought in a so called contacting position. In other words, at least almost any mobile phone can be accommodated on said rest structure whereby at least two of the mobile phone's narrow sides can be brought in contact with said blocks. The movable block can be attached releasable relative to the base plate and/or the rest. For example, the movable block can be clamped by clamping means in said contacting position to the base plate and/or the support structure and released to be movable again. Instead of or additional to said clamping means, the at least one block may be spring loaded towards the mobile phone's narrow side, i.e. spring loaded towards the rest structure's rest surface, preferably the center of the rest surface. Such mobile phone holder can be adapted very easily, very quickly and with very low effort to securely accommodate at least almost any type of mobile phone. This enables to test almost any type of mobile phone in an accordingly equipped mobile phone testing apparatus.

Preferably, the rest structure comprises a layer of an elastic material, e.g. of rubber or silicone. The elastic material protects the surface of the mobile phone and reduces slip of the mobile phone on the rest structure. It is of particular advantage, if the rest structure comprises at least one suction cup for generating a low pressure zone between a mobile phone and the rest structure, to thereby releasably attach the mobile phone to the rest structure. The mobile phone is so to speak 'locked' in its position if the suction cup is active, i.e. if the low pressure zone is engaged). Thus, preferably the at least one suction cup has an opening
facing away from the rest towards the mobile phone such that a rim of the suction cup contacts a mobile phone being positioned on the rest. The suction cup can be integrally formed in the rest structure. The suction cup can be connected to a low pressure source, e.g. a vacuum pump. The pressure in the suction cup, or more precisely between the mobile phone and the support structure can be controlled by valves and/or a vacuum pump, these may be controlled manually or by controlling unit.

Preferably, the rest structure comprises a spacer being positioned preferably on the base plate and preferably below the layer of an elastic material. Thus, the spacer may be positioned between the base plate and the layer of elastic material. The spacer so to speak lifts the mobile phone above the base plate and thus enables access to the mobile's phone base plate facing side, e.g. to a camera opening in the rear side of a mobile phone, to a loudspeaker, control buttons and the like. In a very simple embodiment, the spacer has the form of a frame.

The rear side of the frame can be attached to the base plate and the front side of the frame may serve as rest surface and/or support said layer of an elastic material and/or at least one suction cup. Alternatively the spacer may have a box like structure. The side walls of the base may rest on the base plate and the boxes bottom may form a rest surface either for a mobile phone and/or a layer of an elastic material. In other words, the rear side of the 'box' may face away from the base plate. The bottom may have openings, to access controls or input- and other output devices, like e.g. a built in camera or a flash light, of the mobile phone via measurement devices positioned in said openings of the bottom.

Access to the mobile phone can be further enhanced, if the base plate has at least one opening for providing access to the mobile phone's base plate facing side.
It is particularly preferred, if the base plate has at least three openings, between which are at least two beams supporting the (at least one) spacer, to thereby provide even better access to the mobile phone. The advantage of three neighbor-bored openings is that they are separated by at least one beam which so to speak bridges the openings and which may provide a solid rest for e.g. the spacer. Other numbers of openings may be suited as well, as long as the stability of the rest structure is not compromised. The rest can be mounted to at least one of said beams.

If at least one finger is moveably attached to the base plate at least one measurement device can be supported by the finger and brought in a desired position relative to the mobile phone. The measurement device may be or comprise for example a microphone for testing a built-in loudspeaker and/or a loud speaker for testing built-in microphone and/or a light source for testing a built-in camera. Alternatively, the finger may as well support at least one actuator, e.g. for activation of a control button or for inserting a plug in a corresponding socket.

Preferably, the at least one finger supports a plug holder for attaching a plug to be inserted into a complementary socket of a mobile phone. The plug holder may comprise a fixed part and a movable part. The fixed part is preferably mounted to the base plate, e.g. via said finger. The fixed part and the movable part are connected by a joint, e.g. at least one bearing, preferably a linear bearing, to enable a translational movement of the movable part relative to the fixed part and thus relative to the rest structure. Alternatively or optionally, the at least one bearing may enable to pivot and/or rotate the movable part relative to the fixed part and thus relative to the support structure. The fixed part comprises means for attaching said plug. By moving the movable part relative to the fixed part, the plug can be inserted into a complementary socket (inserted position) of the mobile phone or retracted into a so-called retracted position.
Preferably, the plug holder does not comprise an actuator for moving the movable part relative to the fixed part, i.e. the movable part is preferably freely movable (only guided by the bearing) relative to the rest structure. Although the plug holder does not comprise an actuator, the plug may be inserted and retracted automatically by simply pushing the movable part and thus the plug into the desired position, e.g. by a robot being controlled by a controlling unit as explained below in more detail. The plug holder may thus be only a passive element, being much cheaper and as further advantage requiring less space on the base plate and thereby allowing better access to the mobile phone for other testing equipment like sensors, loudspeakers, flashlights and the like. However, the movable part's position and thus a corresponding plug's position can be controlled by the controlling unit, e.g. by controlling said robot, as well referred to as manipulator. Preferably the plug holder has a recess for engagement of a manipulator. For example, the movable part may comprise a recess into which the manipulator may engage for subsequently moving the movable part from a retracted position into an inserted position and/or vice versa. In at least one of the positions of the movable part, the movable part may be locked in the respective position, e.g. by a ball plunger and/or a magnet and/or friction.

The actual position of the plug can be monitored by the controller evaluating images from a camera being necessary for display testing. Thereby, the plug holder does not require separate position sensors and the accessibility of the mobile phone is further enhanced and the controlling unit however has detailed information about the positions of a plug holder's movable part and/or a plug being attached to it. A manipulator may be controlled by the controlling unit responsive to said information about the positions of a plug holder's movable part and/or the plug being attached to it.

If there are no fixed blocks and if the block surfaces are the surfaces of, e.g. vertically oriented bars, like rods or prisms, there are preferably at least five mova-
ble blocks. The movable blocks, preferably, each have a boom with a lower surface contacting the base plate. They base plate facing surface of the boom is preferably in flush contact with the base plate. The boom can be movable in a sliding manner over a plane surface of the base plate. Preferably, each boom has at least one long hole or slot into which a screw is movably inserted. The screw's distal end can be inserted into a threaded hole of the base plate or another part of the rest structure, to thereby enable releasably clamping the boom against the base plate (and/or the rest structure, respectively) and thereby fix its position and orientation.

Additionally, the boom may preferably comprise a through hole with a thread, the latter housing a set screw. The tip of the set screw points towards the base plate (and/or another part of the rest structure, respectively) and may be threaded towards the boom against its support. The set screw preferably has a sharp e.g. cone like tip at its distal end to safely position the block in a desired position by bracing the screw's tip against the base plate (and/or another part of the rest structure, respectively).

The boom preferably supports a bar, as mentioned above, in an upright position. The bar has at least one block surface extending at least approximately \( \pm 10^\circ \) orthogonal to the base plate's upper surface. Of course, the screwed connection of the booms to the base plate is only an example for any kind of releasable fastening means for fixing the positions of the blocks.

A mobile phone testing apparatus with said phone holder preferably comprises a controlling unit. The controlling unit may be connected to a camera, the camera being configured for imaging the position and/or orientation of a mobile phone supported by said rest structure. In other words the camera is connected with the controlling unit of the tester for providing images of the mobile phone and preferably at least a part of the base plate to the controlling unit. The controlling
unit is configured to determine the position and/or the orientation of the mobile phone based on said images. Thereby, inaccuracies in positioning the mobile phone on the rest structure can be detected and preferably compensated automatically by the controlling unit, for example when controlling a manipulator for operating at least one of the mobile phone's controls. It should be noted, that cameras are standard parts of mobile phone testing apparatuses, but so far only for imaging a display of a mobile phone to thereby determine faulty pixels or software problems, but not to determine the mobile phone's position and orientation. Of course the camera can be used for both, i.e. for imaging a display and as well monitoring the mobile phone's position and/or orientation.

Optionally the camera may be configured for imaging the position and/or orientation of the plug and/or plug holder. Then, the controlling unit may be configured to determine a position and/or orientation of a plug and/or a plug holder, e.g. of a mobile part of a plug holder as explained above, based on at least one image of said camera. If the plug holder has a recess for engagement of a manipulator, the recess may be used as well for detection of the mobile part's position by a controlling unit evaluating image data from said camera.

The tester is explained with reference to only one camera, but of course, the tester may comprise multiple cameras, to provide image data to the controlling unit.s

The mobile phone testing apparatus, preferably, further comprises at least one manipulator for providing inputs to the mobile phone being supported by said rest structure. The manipulator, can be e.g. a robot with at least one "finger" which can be positioned in preferably at least three axes, to thereby being able to activate control buttons being positioned at the front side and/or the narrow side the mobile phone similar to a human. The finger can be simulated by a simple stick. If the mobile phone has a touch sensitive display, it can be touched of
course as well by the manipulator, in particular the "finger" of the robot. The manipulator is preferably connected via a data line with the controlling unit for being controlled by the controlling unit. This manipulator may preferably be used (as well) for pushing a movable part of a plug holder without actuator, e.g. as explained above, into a desired position and is accordingly controlled by the controlling unit. Accordingly the controlling unit is configured to change the position and/orientation of the movable part of the plug holder and/or a plug by providing control inputs to said manipulator. For example the controlling unit can be configured to control the manipulator to engage with the movable part of the plug holder and/or the plug in the respective actual position(s), which have been acquired from said image data. Subsequently the controlling unit may control the manipulator to the movable part of the plug holder and/or the plug to a desired position.

The camera is preferably configured to image the position and/or orientation of the manipulator, e.g. the tip of a robot actuated stick. Said images are provided to the controlling unit and the controlling unit determines from these images the current position and/or orientation of the manipulator. Based on the such obtained current position and/or orientation the controlling unit may send commands to the manipulator via a data line for changing the position and/or orientation to a desired position and orientation.

The phone holder as explained enables to adapt a mobile phone testing apparatus very easily to a new type mobile phone to be tested. In a first step, one positions a mobile phone's housing of a known type on the rest structure of said phone holder in a desired position and orientation. If the rest structure comprises means for providing a low pressure zone between the rest structure and the mobile phone's housing, e.g. a suction cup or the like, one preferably attaches the mobile phone's housing to the rest structure by engaging the low pressure zone. As well the mobile phone's housing may be pressed slightly on the rest...
structure, either by hand or by a manipulator. The mobile phone’s housing may be for example an empty so to speak ‘dummy’ housing only for adjusting the phone holder to the respective model. It is particularly preferred if the housing has the same dimensions as the respective mobile phone but is at least in part transparent. Due to the transparency sensors or other measurement equipment may be positioned quickly and precisely even if they are partially or totally covered by the housing. Preferably, the dummy housing has marks indicating control buttons, camera openings, flash openings and preferably dummy socket connectors e.g. for USB cable, earphones or the like.

After the mobile phone’s housing has been positioned and orientated, the position and orientation of at least one block is adjusted to prevent the mobile phone’s housing from slipping on the rest structure. Most preferably the at least one block is adjusted to be in contact with a narrow side of the mobile phone and releasably fixed in the respective position. The number of adjustable blocks may vary depending on the form of the blocks and of course of the housing. If there are only movable blocks, there are preferably at least five of them. The blocks are preferably positioned circumferentially around the support structure for contacting the mobile phone’s respective narrow sides. Measurement devices or actuators can be positioned as required, and the mobile phone can be tested easily. After the position and/or orientation of the at least one block has been releasably fixed, the mobile phone’s housing can be removed from the phone holder. If engaged, the optional low pressure zone should be disengaged. Subsequently, further mobile phones of the same type can be positioned on the rest structure and subjected to a test. Alternatively, one may adapt the mobile phone holder to a different type of mobile phone by adjusting the blocks as explained above. A change of a model in the testing line can be accounted for by simply readjusting the blocks and, if required, the measurement devices.
As already mentioned above, the mobile phone’s housing and/or the mobile phone may be suctioned to the rest structure by generating a low pressure zone between the rest structure and the mobile phone’s housing and/or the mobile phone, to thereby fix the position of the mobile phone’s housing and/or the mobile phone on the rest structure.

The method may further comprise imaging the mobile phone with at least one camera and determining the mobile phone’s position and/or orientation on the rest structure from the image(s) obtained by said camera(s). Based on said position and/or orientation one can determine at least one position of the mobile phone’s controls and drive a manipulator to actuate at least one of said mobile phone’s controls in accordance with said previously determines position.

It is worth noting that the mobile phone holder as explained above and as well the methods for positioning a mobile phone are suited as well for other mobile communication devices, like e.g. so called tablet computers.

15 Description of Drawings

In the following the invention will be described by way of example, without limitation of the general inventive concept, on examples of embodiment with reference to the drawings.

Figure 1 shows an isometric view of mobile phone holder (without mobile phone).

Figure 2 shows the isometric view mobile phone holder (with mobile phone).

Figure 3 shows a rear view of the mobile phone holder.

Figure 4 shows mobile phone testing apparatus.
The isometric view in Fig. 1 shows a phone holder 1 with a base plate 10. The base plate 10 has an essentially plane first surface 17 with threaded holes 16 for positioning and clamping booms 31 of blocks 30 as explained below in more details. Only for convenience, the first surface 17 is as well referred to as upper surface, however it is understood by the skilled person, that the upper surface 17 is not necessary facing upwards.

A spacer 21 is mounted to the plane first surface 17 of the base plate 10. The spacer 21 has a box like structure. The narrow sides of the boxes walls are positioned on the first surface 17. The spacer's 21, i.e. boxes rear side faces away from the base plate 10. The spacer 21 may support suction cups 26 being connected via a suction tube 27 to a vacuum pump. On top of the spacer may be a layer of an elastic material 25, e.g. made of rubber, silicone, fabric or the like. The spacer 21 and the layer of an elastic material can be considered to provide a rest structure 20.

The phone holder 1 has blocks 30 for blocking a movement of a mobile phone in a plane being at least approximately parallel to the first surface 17 of the base plate 10. Each block 30 has a boom 31 being arranged on the first surface 17. As depicted, the blocks 30 are preferably each in flush contact with the base plate 10 and/or the support structure. Each boom 31 has a long hole 34 and a screw 33 extends through each long hole 34 into the thread of one of the threaded holes 16. The position and orientation of each block 30 can thus be set by first selecting a threaded hole 16, positioning the long hole 34 above the respective threaded hole 16 and slightly screwing the screw 33 into the base plate 10. Before fastening the screw 33 the block's position and orientation can still be adjusted or so to speak 'fine tuned'. Subsequently the screw may be fastened to releasably clamp and thereby fix the block 30 between the screw head (without reference numeral) and the base plate 10 by frictional locking. So to speak the screw 33 is a clamping means for releasable fixing the block 30 by frictional lock-
ing with the base plate 10. Alternatively the block 30 could be clamped against
the rest structure 20. Optionally the at least one of the booms may have a
threaded through holes accommodating a set screw 35. After clamping the
boom 31 to the base plate 10, the set screw's distal end may be so to speak
pressed against the base plate 10 by turning the set screw 35. Thereby position
and orientation of the boom 30 be additionally fixed, in particular if the screw's
distal end is a sharp tip, e.g. a cone tip.

Each block 30 has a bar 32 at a distal end of the boom 31. The bar 32 has a block
surface 321 for contacting a mobile phone's 100 narrow side.

Additional to the blocks 30, there are fingers 40 carrying measurement devices,
and/or a plug holders 60 for inserting a plug connector into a corresponding
socket of a mobile phone, a light source for testing the camera, a photodiode for
testing the camera's flash light and the like. The fingers may be similar or identi-
cal to the booms 31 of the blocks 30 and can be positioned and oriented in the
same way. The respective part of the description holds 'mutatis mutandis' as
well for the fingers 40.

Each of the plug holders 60 has a fixed part 61 being mounted on top of a fin-
ger 40 and thus to the base plate 10. The finger 40 can be omitted, but enhances
to easily adapt the plug holder's position and orientation to a mobile phone. The
fixed part 61 has a rail surface for movably supporting a movable part 62 of the
plug holder 60. The movable part 62 can be considered as slide being comple-
mentary to said rail surface. The rail surface and the slide surface are thus bear-
ing means 64 for enabling a free movement of the movable part 62 of the plug
holder 60 relative to the rest structure and/or the base plate.

Each of the movable parts 62 of the plug holder 60 has a recess for accommodat-
ing a plug 65. For fixing a plug 65 in the respective recess a retainer plate 66 may
be mounted to the respective movable part 62. The retainer plate 66 preferably
comprises a coupling bore 67. As explained below in more detail a stick 75 of a robot may be inserted into the coupling bore 67. Subsequently the stick 75 may be moved parallel to the rail surface for inserting or retracting a plug connector 65 into a corresponding socket of a mobile phone. In the figures two plug holders 60 are shown, however, it is pointed out that the phone holder may have any number of plug holders, preferably at least one plug holder 60.

In Fig. 2 the same phone holder 9 is shown as in Fig. 1, however, a mobile phone 100 has been positioned on the rest structure formed by the base plate 10, the spacer 21 with its suction cups 26 and the layer of an elastic material 25. As can be seen, the bars 32 of the blocks contact the mobile phone's 100 narrow side without hindering access to control buttons, card slots, socket connectors and the like. Even a part of the rear side of the mobile phone 100 is accessible, as the spacer's 21 orthogonal projection on the base plate 10 is smaller than the respective projection of the mobile phone 100. By though holes like 29 in the spacer 20 the accessible area can be further enhanced. Measurement devices 50 can be positioned in said openings 29 or behind of said openings 29 to access the mobile phone 100.

As best apparent from Fig. 3, showing the rear side of the mobile phone holder 1, the base plate has openings 11, 12, 13, for providing even better access to the mobile phone and the measurement devices and instruments. Between these openings 11, 12, 13 are beams 14, 15 for supporting the spacer 21.

In Figure 4 a partially mounted mobile phone testing apparatus 9, briefly 'tester' 9 is depicted. The tester has a housing 2 which is shown incompletely to provide a look inside the housing 2. Inside the housing 2 is a receptacle for the base plate 10 of the mobile phone holder 1 as explained with reference to Fig. 1 to Fig. 3. The tester 9 comprises a robot 7 for positioning a stick 75 for operating control buttons of the mobile phone 100 or control fields on a touch sensitive
display. In other words, the stick 75 simulates a user's fingers. Only as example, the robot 7 comprises a traveling bridge 71 for positioning the stick 75 in the x-z plane. An actuator 76 enables to adjust the position of the distal end of the stick in the y-direction. An (optional) force meter 77 being arranged between the actuator 76 and the stick 75 and being connected by a data line to the controlling unit enables to measure forces exerted by the robot 7 to the controls of the mobile phone 100 and to provide the forces to the controlling unit.

The traveling bridge design of the robot 7 is simple, reliable and enables to position the stick 75 with a high accuracy at comparatively low costs. However, the traveling bridge design is only a particular adapted design and any other suited robot design may be used as well.

Above the traveling bridge 71 is a camera 3 for imaging the mobile phone 100s and preferably as well the robot 7. The camera images the mobile phone 100 and at least a part of the phone holder 1 and preferably, depending on its position, as well the robot 7. The images are sent via a data line to a controlling unit that may be accommodated e.g. in the box like base 201 of the housing. The controlling unit may be configured for determining the position and orientation of the mobile phone 100 on the rest structure 20 based on said images and/or to control the robot 7 to operate the controls of the mobile phone 100 based on the said images.

For determining the position and orientation of the mobile phone, the travelling bridge 71 is preferably moved to a parking position to avoid that the mobile phone 100 is being masked by the robot. Based on the figures obtained by the camera 3 subsequently to moving the robot in said parking position the controlling unit determines the position and/or orientation of the mobile phone 100. In a next step, a test sequence can be started, including operating the controls (buttons, display etc.) of the mobile phone 100. For operating the controls, the con-
trolling unit may determine the current position of the stick 75 based on images of said camera 75 and adjust the position of the stick 75 to a desired position.

Different from what is depicted the camera or an additional camera may as well be mounted to the robot to better image the display of the mobile phone, e.g. for activating controls being displayed on a touch sensitive screen. Alternatively at least one mirror may be used to provide the required perspective and/or the tester may comprise at least two cameras.
List of reference numerals

1  phone holder
2  housing
201 box like base of housing 2

3  camera
7  robot
71 traveling bridge
75 stick
76 actuator / preferably linear actuator

10  force meter / force sensor
9  mobile phone testing apparatus / tester
10  base plate
11  opening
12  opening

15  opening
14  beam
15  beam
16 threaded holes
20 rest structure

20  spacer
25 layer of elastic material
26 suction cup
29 opening in spacer 21

25  block
31 boom
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Claims

1. A phone holder (1) for a mobile phone testing apparatus comprising at least:
   - a base plate (10)
   - a rest structure (20) on the base plate (10) for supporting a mobile phone (100) and thereby position the mobile phone (100) vertically, characterized in that the phone holder further comprises at least one block (30) being movably attached to the base plate (10) and/or the rest structure (20) for contacting a mobile phone's narrow side thereby defining the mobile phone's horizontal position on said rest structure (20), and clamping means (33) for releasable fixing the at least one first block (30) in said position relative to at least one of the rest structure (20) and the base plate (10).

2. The phone holder of claim 1 characterized in that the clamping means releasable fix the at least one block (30) to the base plate (10) by pressing said block (30) against the base plate (10) or the rest structure (20) to thereby obtain a frictional locking of the block relative to the base plate (10) or the rest structure, respectively.

3. The phone holder of claim 1 or 2 characterized in that the rest structure (20) comprises a layer of an elastic material (25) with at least one suction cup (26) having an opening facing away from the rest, for
attaching a mobile phone (100) being positioned on the layer of elastic material (25) to the rest structure (20) by reducing the pressure in the at least one suction cup (26).

4. The phone holder of claim 3

characterized in that

the rest structure (20) comprises a spacer (21), being positioned between the base plate (10) and the layer of an elastic material (25).

5. The phone holder (1) of one of the preceding claims,

characterized in that

the base plate (10) has at least one opening (11, 12, 13) for providing access to the mobile phone's base plate facing side, when the mobile is supported by the rest structure (20).

6. The phone holder (1) of claim 5,

characterized in that

the base plate (10) has at least two openings (11, 12, 13) between which is at least one beam (14, 15) supporting the spacer (21).

7. The phone holder (1) of one of the preceding claims,

characterized in that

at least one finger (40) is moveably attached to the base plate (10), where in said finger (40) supports at least one measurement device (50) and/or at least one actuator (60) and/or at least one plug holder.
8. The phone holder (1) of one of the preceding claims, characterized in that the phone holder (1) comprises at least one plug holder (60), the plug holder (60) comprising:

- a fixed part (61), being mounted to the base plate (10) and/or the rest structure (20) and

- a movable part (62), comprising means for attaching a plug connector (65) for being inserted into a complementary socket of the mobile phone (100),

- wherein the fixed part (61) and the movable part (62) are connected by a bearing (64) enabling a free movement of the movable part (62) relative to the rest structure (20).

9. A mobile phone testing apparatus (9), characterized in that it comprises

- a phone holder (1) of any one of the preceding claims,

- at least one camera (3) being configured for monitoring the position and/or orientation of a mobile phone (100) supported by said rest structure (20); wherein the camera (3) is connected with a controlling unit of the tester for providing images of the mobile phone (100) and preferably at least a part of the base plate (10) to the controlling unit.

10. The mobile phone testing apparatus of claim 9, characterized in that it comprises at least one manipulator for providing inputs to a mobile phone being supported by said rest structure, the position and/or orienta-
tion of the manipulator is imaged by said camera and in that the controlling unit is configured to determine the current position and/or orientation of the manipulator from the images provided by said at least one camera.

11. The mobile phone testing apparatus of claim 10 characterized in that
the controlling units is configured for controlling the position and/orientation of the manipulator by driving it from said current position to a desired position.

12. A method for testing a mobile phone, comprising:
- positioning a mobile phone's housing a known type on a rest structure of a phone holder in a desired position,
- adjusting the positions and/or orientation of at least one block to be in contact with a narrow side of the housing,
- adjusting the positions and/or orientation of at least one block to be in contact with a narrow side of the housing,
- removing the housing from the rest structure,
- positioning a mobile phone of the same type on the rest structure such that its narrow facing side is in contact with the at least one block,
- perform at least one function test of the mobile phone.

13. The method of claim 12, characterized in that,
the mobile phone's housing (101) and/or the mobile phone (100) are/is suctioned to the rest structure by generating a low pressure zone between the rest structure (20) and the mobile phone's housing (101) and/or the
mobile phone (100), to thereby fix the position of the mobile phone's housing (101) and/or the mobile phone (100) on the rest structure (20).

14. The method of claim 12 or 13, characterized in that:
the method further comprises
- imaging the mobile phone (100) with a camera (3), and determining the mobile phone's position and/or orientation on the rest structure (20),
- based on said position and/or orientation, determine the position of the mobile phone's controls,
- drive a manipulator (7) to actuate at least one of said mobile phone's controls.

15. The method of claim 14, characterized in that:
the method further comprises imaging the position of a plug holder's movable part (62) and/or a plug (65) by a camera (3),
- determining the movable part's (62) and/or plug's (65) actual position based on said imaging,
- driving the manipulator (7) to push the movable part (62) from the actual position to a desired position.

16. The method of claim 15, characterized in that:
the method further comprises inserting a stick (75) of the manipulator (7) into a coupling bore (67) of the movable part (67) of the plug holder (60) and subsequently pushing the movable part by moving the stick (75).
## INTERNATIONAL SEARCH REPORT

**PCT/IB2014/002201**

### A. CLASSIFICATION OF SUBJECT MATTER

**INV.** H04M1/24

According to International Patent Classification (IPC), or to both a national classification and IPC.

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W G01R H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

- EPO-Internal, WPI Data

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 2012/286815 AI (CHEN CHIAN-JUNG [TW] ET AL) 15 November 2012 (2012-11-15) paragraphs [0019] - [0029]; figures 2-5</td>
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<td>US 6752 391 BI (EUKER RICHARD T [US]) 22 June 2004 (2004-06-22) col umn 1, lines 40-52 col umn 3, line 43 - col umn 4, line 31 col umn 5, line 39 - col umn 6, line 26 figures 1,2,10-13</td>
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**X** Further documents are listed in the continuation of Box C.

**X** See patent family annex.

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*"Z"* document member of the same patent family

Date of the actual completion of the international search: 22 January 2015

Date of mailing of the international search report: 30/01/2015

Name and mailing address of the ISA:
European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040; Fax. (+31-70) 340-3016

Authorized officer: de Biolley, Luc

Form PCT/ISA/210 (second sheet) (April 2005)
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