DESCRIPTION

«SYSTEM AND METHOD FOR THE DIMENSION CHECKING OF MECHANICAL PIECES»

Technical Field

The invention relates to a system for checking the position and/or the dimensions of mechanical pieces, including a checking probe with detecting devices, power supply devices, a logic unit, memory devices adapted for storing the value of at least one operation parameter of the checking probe, and a remote transceiver unit for the wireless transmission and reception of signals, and a base transceiver unit for the wireless transmission and reception of signals to and from the remote transceiver unit.

The invention also relates to a method for selecting the value of at least one operation parameter in a system for checking the position and/or the dimensions of mechanical pieces including a checking probe with a logic unit, memory devices, and a remote transceiver unit for the wireless transmission and reception of signals, a base transceiver unit for the wireless transmission and reception of signals to and from the remote transceiver unit, a display device, and a manually-operated control device connected with said base transceiver unit.

Background Art

There are known checking systems and methods, for example in numerical control machine tools, for determining the position and/or the dimensions of machined workpieces by means of a contact detecting probe mounted in the machine that, in the course of a checking cycle, displaces with respect to the workpiece, touches the surfaces to be checked and responds to contact by wirelessly transmitting

signals to a base station, typically located at a certain distance from the probe. The base station is in turn connected, by means of an interface device, to the numerical control unit that, by processing other signals indicative of the spatial position of the probe, obtains information about the position of the workpiece surfaces.

The contact detecting probe can include electric batteries for the power supply of contact detecting circuits and devices for the wireless transmission that can occur, for example, by emitting electromagnetic signals of optical, or radio-frequency, type. As the probe is utilized just for short time intervals during the machining cycle of the associated machine tool, the associated detecting circuits and transmission devices are normally kept in a low power consumption "stand-by" state and powered-up only when there is the need to perform a checking cycle to optimize the life of the batteries. The probe activation, i.e. the switching from the "stand-by" state to the full powered-up state can take place by means of suitable switching devices located on the probe. These switching devices can be of the mechanical (microswitch) type, or remotely activated by means of activation signals, wirelessly transmitted from the base station. When the checking cycle ends, the probe circuits return to the low power consumption "stand-by" state either upon the wireless transmission of a suitable de-activation signal or, as an alternative, upon elapse of a predetermined time period. This time period can be calculated since the last useful signal transmitted from the probe in the course of the formerly mentioned cycle. In the event activation is implemented by means of a microswitch, de-activation is obviously implemented in a mechanical way.

Should there be a plurality of probes operating in a same working area, as frequently occurs, there can be foreseen a cycle for the selective activation of a selected probe, a cycle that foresees at first the activation of a plurality of probes and thereafter the selection further to a two-way

exchange of identification and confirmation signals between the probes and the base station. Such a selective activation cycle is disclosed, for example, in U.S. patent No. US-A-6115647.

In general, each probe is characterized by the value assumed by some parameters as, for example, those relating to the transmission frequency (more particularly in the case of radio-frequency transmission), to the activation mode (implemented in a mechanical way or by means of a wireless signal), to the signal that enables the identification of the probe (in the case of selective activation), to the operation/switching off time, and other parameters.

In the known systems, the values of the various parameters are defined and stored in the probe by programming devices with manually-operated switches ("dip-switches"), typically programmed at the time of installation of the probe in the associated machine.

The previously mentioned patent No. US-A-6115647 illustrates and describes a similar device (more particularly, with reference to the reference number 29 in figure 2 and to the description in column 3, lines 57-61 and in column 4, lines 12-15).

This programming method is subject to some drawbacks. For example, should it be necessary to program many parameters, the number of manually-operated switches correspondingly increases and so problems in terms of layout dimensions are presented. These problems become quite significant also in consideration of the fact that market requirements call for ever smaller dimensions and frequently the operation for programming the switches, performed in a workshop environment, might accidentally dirty the switches and the nearby electronics.

In some systems including, for example, connections for the wireless transmission of signals of the optical type, there may be the need to program just one parameter, more specifically the interval of time whereafter the probe

automatically switches off. In a similar case, the "dip-switch" located on the probe need not be provided and the time parameter can be programmed and stored in the probe in a "self-learning" phase. The "self-learning" phase includes the manually-operated activation of the probe in a specific way (for example by keeping the stylus deflected for a specified amount of time, or by mounting the battery with inverted polarity or in other ways that enable to differentiate the self-learning mode from the normal working mode), the subsequent de-activation, implemented in an analogous or reverse way or by a remote control transmitted from the base station, subsequently to a time interval either corresponding to the time that it is desirable to set as the switching off time, or in a known relationship (for example a multiple or a submultiple) with respect to said time, and the storing in the probe of the time interval, prior to suitable rounding off. This simple programming method is difficult or impossible to implement when it is necessary to set the values of more than one parameter or when such values are of other nature than a time interval.

Disclosure of the Invention

Object of the present invention is to provide a system in which the typical values of the operation parameters characteristic of each probe can be modified in a simple, reliable and wireless controlled way, without burdening the system with special circuits.

A further object of the invention is to provide a method applicable to the system for modifying, by means of a wireless control, the values of the operation parameters, that is equally simple and reliable.

These and other objects are achieved by a system according to claim 1 and a method according to claim 15.

Brief Description of the Drawings

The invention is hereinafter described in detail with reference to the enclosed sheets of drawings, given by way of non limiting example only, wherein

figure 1 shows, in simplified form, a checking system according to the present invention with a checking probe installed in a machine tool;

figure 2 is a block diagram of the circuits associated with the checking probe of figure 1; and

figure 3 is a flow chart showing a phase of operation of the system according to the invention.

Best Mode for Carrying Out the Invention

Figure 1 illustrates, in simplified form, a system for detecting linear dimensions of a piece **1** in a machine tool, for example a machining center, identified in the figure by reference number **2**, where piece **1** is machined. The system includes a computer numerical control **3**, for superintending the operation of the machine tool **2**, and a detecting apparatus including a checking probe **4**. The latter, for example a contact detecting probe, has a support and reference portion **5**, coupled to the slides of the machine tool **2**, a feeler **6** and an arm **7** carrying the feeler **6** and movable with respect to the support portion **5**. Moreover, probe **4** includes detecting devices, for example a microswitch **13**, power supply devices **12** including a battery and a remote transceiver unit **8** for wirelessly and remotely transmitting and receiving signals to and from a base transceiver unit **10**, or base station, preferably stationary, remote from probe **4**. The remote transceiver unit **(8)** and the base transceiver unit **(10)** define a single wireless two-way communication link **14**, for example for a radio-frequency transmission, or for the transmission of information by means of optical, acoustic or other signals. The base transceiver unit **10** is electrically connected, by means of a cable **9**, to an interface unit **11** that is in turn

connected to the computer numerical control **3**. The base transceiver unit **10** serves to transmit - for example by radio-frequency - coded signals to the remote transceiver unit **8** of the probe **4** for activating and for de-activating probe **4** in response to a request coming from the computer numerical controller **3** through the interface unit **11**, and to receive coded signals coming from remote unit **8** of probe **4** and also transmitted, for example, by radio-frequency. The received coded signals may indicate the spatial position of feeler **6** with respect to support portion **5**, the level of charge of the battery of probe **4**, the identity of the probe **4** in the event of a selective activation cycle according to the formerly mentioned patent No. US-A-6115647, or other information. The terms activation/de-activation mean the switching of the power supply of probe **4** from/to an "inactivity" (or "stand-by") state in which just some low power consumption sections of the remote transceiver unit **8** are powered, to/from a "full" powered state of unit **8** and of the other units of the probe **4**.

According to the present invention, the wireless two-way communication link **14** can also be used in a different phase of the probe operation, as hereinafter described.

A manually-operated control device - that in the illustrated example is integrated in interface unit **11**, connected to the base transceiver unit **10**, but that can be separately implemented, and connected to the base station **10** or to another base transceiver unit, manually-operated control device and base unit housed, for example, in a same casing - includes two keys, specifically ("select") key **20** and ("enter") key **21**. An indicator device or display **22**, for example with three figures with seven segments each, is also connected to the base transceiver unit **10**.

In the illustrated example, the display **22** is integrated in the manually-operated control device and thus in the interface unit **11**. Other indicator devices (for example, LED) can be included in the interface unit **11** for providing

other visual indications (power supply of the interface unit **11**, power supply and state of the probe **4**, error, ...).

Figure 2 is a block diagram of the circuits of probe **4**. The remote transceiver unit **8** includes a wireless communication device **30**, more specifically one or more antennas in case of radio-frequency transmission. In the case of optical or acoustic transmissions, block **30** can represent optoelectronic devices as LEDs and photodiodes or ultrasonic transducers, respectively. It is also possible to implement mixed systems in which, for example, the activation of the probe occurs in an optical way and the transmission of the state of probe **4** occurs by radio-frequency. However, in this case there must obviously be present both optoelectronic devices and the antenna, and consequently this implies a more complex hardware and a rise of costs. Should all the signals be of the radio-frequency type, is it often possible to utilize a single antenna for both receiving and transmitting, thanks to its reciprocity features.

Function blocks **31** and **32** represent receiver circuits and transmitter circuits, respectively, both connected to the communication device **30**.

The power supply devices **12** include the formerly mentioned battery **(33)** and power supply circuits **24**, while monitoring and conditioning circuits **35** include the detecting device (microswitch) **13**.

Logic circuits are present in a unit **36** that is connected to the receiver circuit **31**, to the transmitter circuit **32**, to the power supply circuit **24** and to the monitoring and conditioning circuit **35**. Unit **36** ("logic unit") includes memory devices with a temporary register **37** and a non-volatile memory **38** electrically modifiable, for example of the EEPROM type, in which there are memorized, among other things, the values of some operation parameters of the system (transmission frequency, activation/de-activation mode, etc.) that are characteristic of each single probe **4**.

The logic unit **36** provides and contains a coded sequence of selectable values of the operation parameters of the probe **4**. The values of the former sequence are transmitted to the base station **10** by means of the wireless communication link **14** in the course of the programming phase that will be hereinafter described.

When probe **4** is in the "stand-by" condition, the only circuits that are permanently powered by battery **33** are the receiver circuits **31**.

On receipt of a signal, the communication device (antenna) **30** sends a weak signal to the receiver circuits **31**, the latter process the weak signal, more specifically strongly amplify and detect it. If the received signals has characteristics compatible with the useful one, the receiver circuits **31** enable the power supply of the logic unit **36** and send the detected signal to the logic unit **36** for subsequent processings. Once the logic unit **36** activates, it manages its power supply and the power supply of the monitoring and conditioning circuits **35** and of the transmitter circuits, for example in the manner described in the formerly mentioned patent No. US-A-6115647.

Probe **4** can be in one of four different conditions:

- not fully powered. The probe can be powered by mechanical switching devices (for example, a microswitch, implemented and operated in a different way with respect to the previously mentioned microswitch **13**);
- partially powered, in "stand-by" condition;
- fully powered, in working condition;
- almost fully powered (i.e. with the exclusion of the monitoring and conditioning circuits **35**) in programming condition.

The operation of the system shown in figure **1** when switching from working conditions to "inactivity" conditions (not powered or partially powered) takes place in per se known ways and, partly, already previously described.

Briefly, further to contact occurring between feeler **6** and the surface of a piece **1** to be checked, microswitch **13** detects displacements of the arm **7** and generates detection signals that are processed and transmitted from the remote unit **8** to the base transceiver unit **10** by means of the remote communication link **14**. Before the normal operation starts (and when it ends), activation (and de-activation) signals for fully powering the circuits of the probe **4** (and for causing the return to a "stand-by" state) are transmitted by the wireless communication link **14**, from the base unit **10** to the remote transceiver unit **8**, on the basis of signals generated by interface unit **11**. Activation can occur on reception of a single signal, or on an exchange of a plurality of signals, for example as described in the formerly mentioned patent No. US-A-6115647.

The following description refers to a procedure according to the invention that regards the programming phase, in other words the phase by which it is possible to select the value of one or more operation parameters that characterize the specific probe **4** and its associated interface unit **11**, as the transmission channel (more particularly in the case of radio-frequency transmission), the activation mode (mechanic or by means of a wireless signal), the signal that enables the identification of the probe (in the case of selective activation), the operation/switching off time, and/or other parameters. From the herein just cited examples, it is obvious that the term "value" should not necessarily be intended as an immediately significant number (which is the case of the radio-frequency transmission channel, or the switching off time), but also, for example, as a figure that identifies the selection made among a type of setting as an alternative to other types (as in the case of the activation mode).

It is possible to set the fully powered probe **4** in the programming condition by operating key **21** of the manually-operated control device (i.e. interface unit **11**, in the illustrated example) and so transmitting from the latter

control device a signal **P1** with preset frequency and duration time. Subsequently, information regarding the values of the various parameters stored in the non-volatile memory **38** of probe **4** is displayed in sequence on the display **22** and, by operating the keys **20** and **21**, it is possible to control the sending of control signals from the base transceiver unit **10** by means of the wireless communication link **14**.

In practice, the former control signals are used for sending the following controls:

C1 updates (increases) the value of the current parameter (for example the current transmission channel, in the case of radio-frequency system) starting from the value stored in the non-volatile memory **38**. Furthermore, the value of the current parameter is sent in a continuous way by the remote transceiver unit **8** to the base unit **10** and displayed on the display **22**.

C2 acquires (confirms) the displayed value.

Logic blocks of the flow chart of figure 3, which refers to a method for programming the probe **4** according to the invention, mean as follows:

block **40** - start of the programming phase;

block **42** - sending of signal **P1** from the base station **10** to the remote unit **8** by means of the wireless communication link **14** by pressing key **21** for a time period lasting longer than a minimum time period;

block **44** - copying in the temporary register **37** of the data currently present in the non-volatile memory **38**;

block **46** - transmission - from the remote unit **8** and by means of the wireless communication link **14** - of signals indicative of the value of a parameter currently present in the temporary register **37**, for example the number of the radio-frequency transmission channel currently set;

block **48** - display on the display **22** of information regarding the nature of the parameter and the current value;

block **50** - visual check, by the operator, of the nature

of the parameter and the correspondence between the associated value and the desired value, by observation of display **22**;

block **52** - sending of a control signal, that corresponds to control **C1**, from the base station **10** to the remote unit **8** by means of the wireless communication link **14**, by pressing key **20**;

block **54** - increase in the temporary register **37** of the value of the parameter under consideration, according to the sequence coded in logic unit **36**;

block **56** - sending of a control signal, that corresponds to control **C2**, from the base station **10** to the remote unit **8** by means of the wireless communication link **14**, by pressing key **21**;

block **58** - verification about the fact that the values of all the programmable parameters have been checked;

block **60** - stepping on, in the temporary register **37**, to the subsequent parameter to be checked;

block **62** - transmission - from remote unit **8** and by means of the wireless communication link **14** - of signals indicative of the option, that is currently present in logic unit **36**, regarding the storing of the whole of the selections made;

block **64** - display on the display **22** of indications regarding the option relative to the storage of the whole of the selections made;

block **66** - verification about the confirmation of the visualized option;

block **68** - sending of a control signal, that corresponds to control **C1**, from the base station **10** to the remote unit **8**, by means of the wireless communication link **14**, by pressing key **20**;

block **70** - modification, in logic unit **36**, of the option relative to the storage of the selections made, according to the sequence coded in logic unit **36**;

block **72** - sending of a control signal, that corresponds to control **C2**, from the base station **10** to the remote unit

8, by means of the wireless communication link **14**, by pressing key **21**;

block **74** - verification about the intention to store the selections made;

block **76** - updating of the contents of the non-volatile memory **38** with the values of register **37**;

block **78** - sending a signal **P2** with preset frequency and duration time from the base station **10** to the remote unit **8**, by means of the wireless communication link **14**, by pressing key **21** for a time period lasting longer than a minimum predetermined time period;

block **80** - end of the programming phase.

In practice the programming of the probe **4** takes place as follows.

Once the programming phase has started (block **42**), the current contents of the non-volatile memory **38** are shifted into the temporary register **37** (block **44**) and the display **22** displays (block **48**), on the basis of indicative response signals provided by the logic unit **36** and transmitted from the remote transceiver unit **8** (block **46**), information regarding the first parameter to be considered and the associated currently set value, i.e. present in the non-volatile memory **38**. In order to modify the value, key **20** is pressed (block **52**) thereby causing the base station **10** to send control signals for giving the updating control **C1**, thereafter the value of the parameter under consideration is increased (block **54**). In practice, the subsequent value that can be selected, in the sequence coded in logic unit **36** for the parameter under consideration, becomes the current selectable value and is displayed on the display **22** (block **48**) on the basis of indicative signals transmitted from the remote unit **8** (block **46**). When the operator who carries out the programming makes certain (block **50**), by watching the indication appearing on the display **22**, that the current selectable value of the parameter under consideration is the desired one, he confirms the selected value, that remains temporarily stored in register **37** of

the logic unit **36**. This is done by pressing key **21** and thus causing the manually-operated control device (i.e. interface unit **11** in the described example) to generate a control signal that corresponds to control **C2** (block **56**) and its associated transmission from the base unit **10**. If not all the parameters have been checked (block **58**) in the course of this programming phase, indications regarding the subsequent parameter (block **60**) and its associated current value are transmitted from the remote unit **8** (block **46**) and displayed on the display **22** (block **48**). When the checking of all the parameters has been completed, it is possible for the operator to re-check and possibly even modify the value of one or more of them. More particularly, remote unit **8** transmits (block **62**) and the display **22** displays (block **64**) a value indicative of said option; this value can be modified (block **70**) by pressing key **20** for sending control signals that give the control **C1** (block **68**). Once the desired option has been displayed, selection is confirmed by pressing key **21** (block **72**), either (block **74**, choice "no") for reconsidering and in case modifying the value of one or more parameters, or (block **74**, choice "yes") for confirming the selections made. In this second case, the data temporarily saved in register **37** are stored in the non-volatile memory **38** (block **76**). Thus the programming phase ends by sending from the base station **10** a signal **P2** that has suitable frequency and duration time (block **78**), similar to the signal **P1** for starting the programming. As an alternative, it is possible to automatically exit from the programming phase after a specific time interval elapses and neither key **20** nor key **21** has been pressed.

According to another generally preferred alternative, there is the possibility that, after the saving in the non-volatile memory (block **76**), the values of the just stored parameters be proposed again for performing further possible modifications (block **46**) and that the programming

phase can be interrupted by sending the signal **P2** (block **78**) at any time in the course of the procedure.

As already discussed, the control signals transmitted from the base unit **10** contain very simple information (controls **C1**, **C2**) that can be transmitted in an extremely reliable way even in a system in which the wireless transmission link from the base station **10** to the probe **4** has in some way limited performance - owing to technical reasons and/or involved costs - and is unsuitable for the transmission of signals with great information contents. This feature of the invention is particularly advantageous especially in a system as the one herein described and illustrated in which the receiver of the remote unit **8** actually has some limitations, as a consequence of both the limited space available and the fact that, for optimizing the life of battery **33**, it is necessary to minimize the power consumption of the receiver circuits **31** in the remote unit **8**, which are the only circuits that are permanently powered. For example, in the case of transmission by radio-frequency, it is not possible to utilize a typical superheterodyne receiver, but a radio-frequency tuned amplifier followed by a diode amplitude detector and by a low frequency amplifier is generally used. As an alternative, it is possible to use a super-reactive receiver, that however gives rise to problems regarding critical behavior, aliasing, etc. Even the use, in the radio-frequency amplifier, of band-pass filters employing surface acoustic wave devices does not provide sufficiently narrow bandwidths for preventing the reception of interference signals on nearby frequencies, more particularly signals emitted by other probes belonging to other similar systems in operation in the surrounding area. Furthermore, it is practically inevitable to make use of the amplitude modulation instead of the frequency modulation, in consideration of both the difficulties in implementing a frequency demodulator in a non-superheterodyne scheme, and the need to avoid

demodulating the signals transmitted by other similar probes, that are modulated in frequency. Moreover, the modulating signal cannot consist of coded pulses, because the low power consumption receiver would distort their duration too much, according to the intensity of the received signal, and could even add "tails" of parasitic pulses at the end of each real pulse. This situation occurs even in systems with optical or acoustic transmission. Therefore, it is practically compulsory to use, as a modulating signal, quite long trains of pulses the repetition frequency of which represents the basic information. In fact, it is sufficient to make sure that the receiver circuits 31 do not output integral multiple frequencies (harmonics) of the modulating frequencies for guaranteeing that the frequency of the signal remains unaltered. Therefore, in practice the radio-frequency carrier is amplitude modulated by a signal, the exact frequency thereof is significant.

In the case of optical transmissions, the transmitter LEDs are directly driven by the trains with defined frequency and can be intended as amplitude modulators of an electromagnetic wave with a frequency that corresponds to the wavelength of the emitted light; the receiver photodiodes can be intended as amplitude quadratic detectors, because they provide a current that is proportional to the incident optical power density, that is in turn proportional to the square of the associated electric field.

There is another limitation which is due to the fact that the transmissions by means of the single two-way wireless communication link **14** must never occur simultaneously in both ways, in order to prevent the receivers of the base unit or base station **10** and of the remote unit **8** from being "blinded" by their associated transmitters.

Thus it is important, for the reliability of the system, that the transmissions necessarily carried out for programming purposes have simple information contents, in

addition to being short and rather spaced out with respect to each other. It should be realized that, by virtue of these latter characteristics, it is possible to utilize, for the signals transmitted to the probe **4**, the same radio-frequency channel utilized for the selective activation according to the formerly mentioned patent No. US-A-6115647. In fact, the method therein disclosed enables to implement the activation and to tolerate short interferences on the activation channel, and vice versa the possible (rare) interference caused by the activation procedure of a nearby system that simultaneously occurs to the pressing of one of the keys **20** or **21** can lead, in the worst case, to the missed reception of the associated signal by probe **4**. In any case, the system allows the operator to immediately realize, by watching the display **22**, that there has occurred the missed reception and immediately press again the key (**20** or **21**) without this rare circumstance causing appreciable inconveniences.

The simplicity of the system according to the invention also regards the operations performed by logic unit **36**. Thus, the probe has no complex processing devices, like microprocessors, or other special hardware for the programming phase, but just memory units associated with the logic unit **36**. On the other hand, the previously outlined generally limited performance of the system for wireless transmission towards probe **4** would not allow the reliable sending of instructions for a possible microprocessor, without making the system more complex and utilizing a distinct channel dedicated to the programming.

When the programming of probe **4** has been completed, it is necessary to get into programming mode for programming the interface unit **11**, more specifically for programming, for example, the reception channel, that must obviously coincide with the one that has just been programmed on probe **4**. Programming of the interface unit **11** can occur by pressing keys **20** and **21**, according to a sequential procedure that is not herein disclosed in detail but is

analogous to the one for the probe. The transmission channel and other parameters, already programmed as previously described for probe **4**, can also be directly communicated to interface **11** by transmitting the information from the remote unit **8** to the base station **10**. It should be realized that in this case a signal with more complex information contents can be transmitted in a reliable way owing to the fact that the receiver devices of the base station **10** - which are of a known type - are not subjected to the same limitations as those of the corresponding devices of the remote unit **8**.

An additional feature of the system according to the invention regards a recovery procedure that enables to manage even the condition in which the transmission channel set in probe **4** is not known, or there are corrupted data on the non-volatile memory **38**. This procedure consists in placing in a specific condition ("recovery programming") first the manually-operated control device (more particularly the interface unit **11**), by pressing again its keys **20** and **21**, and then probe **4**. As far as the probe **4** is concerned, a possible way for activating the "recovery programming" condition is that of removing the battery **33** and re-inserting it in a particular configuration, for example with the movable arm **7** deflected and the microswitch **13** consequently activated (open, if it is closed in the probe rest condition). Another possible way for activating the "recovery programming" condition can be that of inserting the battery **33** with inverted polarity.

Once the "recovery programming" condition has been activated, probe **4** starts an activation procedure on a specific service channel, that cannot be utilized for the normal operation, with nominal frequency equal to the activation frequency (therefore, in this case the wireless communication link **14** is conducted, for both ways, on the same radio-frequency channel). As the manually-operated control device **(11)** is also in the "recovery programming" mode, this activation procedure leads the probe **4** to the

working condition on the service channel instead of the programmed channel. At this point it is possible to step on to the programming phase according to the foregoing description.

Other feasible variants can be applied to the checking system and to the associated method according to the invention, for example, regarding the programming sequence, and/or the choice to program the interface unit **11** before the probe **4**. Systems according to the invention can be implemented according to various other embodiments, the latter including a plurality of base stations **10** connected to the same interface unit **11** (for extending the working range and/or overcoming problems relating to excessive attenuation of the signal) and/or to the manually-operated control device, in other terms the physical integration of the base transceiver unit **10** in the interface unit **11**. The number of keys (**20**, **21**) on the panel of the interface unit **11** and/or the activation sequence of these keys can differ with respect to those herein described as an example.

As previously mentioned in various parts of the description, the preferred embodiment of the invention foresees that the base unit **10** and the remote transceiver unit **8** be of the radio-frequency type and consequently define a single two-way channel **14** with radio-frequency transmission. Systems with a single two-way channel of other type (optical, acoustic, …) also fall within the scope of the invention, just as systems with a plurality of channels that however, as discussed above, are less advantageous.

As previously mentioned in the herein illustrated and described preferred embodiment, the manually-operated control device is physically integrated in the interface unit **11** and substantially coincident with the latter. However it is possible, according to the invention, that the former manually-operated control device be implemented as a distinct unit, for example with its own casing, its own keys (**20** and **21**) and display (**22**). Furthermore, said

distinct unit can be connected to the base station **10** or to a separate transceiver unit housed in its own casing and achieve a portable device.

Furthermore, alternative embodiments foresee that the display unit **22** be separate from the manually-operated control device and be integrated, for example, in the base station **10** or in the probe **4**. In this latter case, the transmission of signals indicative of the parameters and of the associated values to be displayed is simplified as the display unit **22** is directly connected to the logic unit **36**. Systems in which the detecting device includes components that differ from the microswitch **13**, for example transducers that provide continuous signals of the digital or analogue type, also fall within the scope of the invention.

CLAIMS:

1. A system for checking the position and/or the dimensions of mechanical pieces, including

- a checking probe **(4)** with
  - detecting devices **(13)**,
  - power supply devices **(12)**,
  - a logic unit **(36)**,
  - memory devices **(37,38)** adapted for storing the value of at least one operation parameter of the checking probe **(4)**, and
  - a remote transceiver unit **(8)** for the wireless transmission and reception of signals, and
- a base transceiver unit **(10)** for the wireless transmission and reception of signals to and from said remote transceiver unit **(8)**,

characterized in that the logic unit **(36)** of the checking probe **(4)** is adapted for selecting the value of said at least one operation parameter between two or more selectable values, in response to the controls **(C1,C2)** received by means of the remote transceiver unit **(8)**,

the logic unit **(36)** being adapted to provide, in response to the received controls **(C1,C2)**, signals indicative of said at least one parameter and of a current selectable value,

the system including

- a display device **(22)** adapted for displaying, on the basis of said indicative signals, information regarding said at least one parameter and said associated current selectable value, and
- a manually-operated control device **(11)**, connected to the base transceiver unit **(10)** and adapted for generating, upon an operator's manual control on the basis of information in the display device **(22)**, control signals corresponding to said controls **(C1,C2)**, and for transmitting said control signals by means of the base transceiver unit **(10)**.

2. The system according to claim 1, wherein said display device **(22)** is connected to the base transceiver unit **(10)**, said indicative signals being wirelessly transmitted from the remote unit **(8)** to the base transceiver unit **(10)**.

3. The system according to claim 2, wherein the manually-operated control device **(11)** includes said display device **(22)**.

4. The system according to one of the preceding claims, including an interface unit **(11)**, connected to said base transceiver unit **(10)**, that includes said manually-operated control device **(11)**.

5. The system according to claim 4, wherein said remote unit **(8)** and said base transceiver unit **(10)** define a single wireless two-way communication link **(14)**.

6. The system according to claim 5, wherein the remote transceiver unit **(8)** is adapted for transmitting by means of said single wireless two-way communication link **(14)** detection signals generated in the probe **(4)** by the detecting devices **(13)**.

7. The system according to claim 5 or claim 6, wherein the base transceiver unit **(10)** is adapted for transmitting by means of said single wireless two-way communication link **(14)** signals for activating the probe **(4)** on the basis of signals generated in the interface unit **(11)**.

8. The system according to one of the preceding claims, wherein said remote unit **(8)** and said base transceiver unit **(10)** are of the radio-frequency type.

9. The system according to claim 8, wherein each of said base unit **(10)** and said remote transceiver unit **(8)**

includes an antenna **(30)**.

10. The system according to claim 8 or claim 9, wherein said at least one operation parameter of the checking probe **(4)** is the transmission frequency of the remote transceiver unit **(8)**.

11. The system according to one of the preceding claims, wherein said memory devices include a temporary register **(37)** and a non-volatile memory **(38)**.

12. The system according to one of the preceding claims, wherein said manually-operated control device **(11)** includes at least a key **(20,21)** and is adapted for generating said control signals in response to manual activation of said at least one key by the operator.

13. The system according to one of the preceding claims, wherein said manually-operated control device **(11)** includes two keys **(20,21)** and is adapted for generating said control signals in response to manual activation of said two keys **(20,21)** by the operator.

14. The system according to one of the preceding claims, for the checking of mechanical pieces in a machine tool **(2)**, wherein the checking probe is a contact detecting probe **(4)** and the detecting devices include a microswitch **(13)**.

15. A method for selecting the value of at least an operation parameter in a system for checking the position and/or the dimensions of mechanical pieces including a checking probe **(4)** with a logic unit **(36)**, memory devices **(37,38)**, and a remote transceiver unit **(8)** for the wireless transmission and reception of signals, a base transceiver unit **(10)** for the wireless transmission and reception of signals to and from said remote transceiver unit **(8)**, a

display device **(22)**, and a manually-operated control device **(11)** connected to said base transceiver unit **(10)**, the method including the following steps

- generation in the logic unit **(36)**, and transmission **(46)** to the display device **(22)** of signals indicative of said at least one operation parameter and of an associated current selectable value,
- display **(48)** in the display device **(22)**, on the basis of said indicative signals, of information regarding said at least one parameter and associated current selectable value, and
- generation **(52,56)**, in the manually-operated control device **(11)** in response to a control manually provided by an operator on the basis of information displayed on the display device **(22)**, of control signals corresponding to the updating control **(C1)** or the confirmation control **(C2)** of the current selectable value, and the transmission of said control signals from the base unit **(10)** to the remote transceiver unit **(8)**.

16. The method according to claim 15, in a system in which said display device **(22)** is connected to the base transceiver unit **(10)**, wherein said transmission **(46)** of the indicative signals occurs wirelessly, from the remote unit **(8)** to the base transceiver unit **(10)**.

17. The method according to claim 15 or claim 16, for selecting the value of two or more operation parameters of a system in which said memory devices **(37,38)** include a temporary register **(37)**, the method including the storing in said temporary register **(37)** of the current selectable value of each of said two or more operation parameters, as a consequence of the generation **(56)**, in the manually-operated control device **(11)**, of control signals corresponding to the confirmation controls **(C2)**.

18. The method according to claim 17, in a system in which said memory devices **(37,38)** further include a non volatile memory **(38)**, the method including the following further steps

- generation **(72)**, in the manually-operated control device **(11)** in response to a control manually provided by an operator, of control signals corresponding to confirmation controls **(C2)** of the selections made, and transmission of said control signals from the base unit **(10)** to the remote transceiver unit **(8)**, and
- storage **(76)** in the non-volatile memory **(38)** of the values selected and stored in said temporary register **(37)**.

19. The method according to claim 18, in a system in which said remote unit **(8)** and said base transceiver unit **(10)** are of the radio-frequency type, where one of said two or more operation parameters of the system is the transmission and reception frequency of the remote transceiver unit **(8)**.