A joystick arrangement 1 includes a base unit 3 and a moveable handle 2. The handle 2 may be detachably fixed to the base unit 3 with a bayonet connection. In order to simplify mounting of the handle 2, there are no electrical connections in the coupling. The handle includes an electrical circuit 15, which is able to send and receive data wirelessly. The energy supply for the circuit 15 comes from a power receiver 16, which receives energy via a wireless transmission path 20 (fig.2). A high frequency between 100 kHz and 20 MHz may be used. A 'Bluetooth' technology may also be used. The handle 2 may be operated while not connected to the base 3. The joystick may be used to control a work machine such as a digger or a fork lift.
Joystick arrangement

This invention concerns a joystick arrangement with a base unit and a movable handle unit including at least one electrical function element which has an energy supply connection and forms an end point of a wireless signal transmission path.

Such a joystick arrangement is known from US 6,550,562 B2. Via three wires, the electrical function element is connected to a control device in the base unit. The three wires comprise voltage, ground and a serial data transmission wire. The data transmission can also be wireless.

Such joystick arrangements are frequently used for controlling hydraulic machines. By moving the handle unit, which can also be called a hand lever, hydraulic motors, for example piston-cylinder units, are activated in a desired direction, the displacement of the handle unit in relation to the base unit additionally also being able to influence the speed at which the motor works. The motors, for example, serve to move an arm on a digger, to lift the load arm of a fork lift or to drive the machine, if this is a self-propelled driven machine.

Furthermore, such a handle unit has additional function elements in the form of buttons, switches, wheels etc., with which the operator can control further functions. While the displacement of the handle unit in relation to the base unit can usually be detected by a sensor arrangement which is integrated in the base unit, these
signals from the additional function element or elements have to be transmitted to an evaluation system.

When mounting a joystick arrangement, it is necessary, even when a wireless signal transmission path is being used, to ensure that the electrical function element is supplied with the required electrical energy. For this purpose, it is necessary to provide an electrical wire link before mounting, which should then be invisible as far as is possible, when the handle unit is mounted on the base unit. The installer thus requires some skill to perform the mounting.

The invention is based on the problem of simplifying the mounting.

The present invention provides a joystick arrangement comprising a base unit and a movable handle unit which includes at least one electrical function element, which element has an energy supply connection and forms an end point of a wireless signal transmission path, wherein the energy supply connection is connected to a power receiver located in the handle unit, which power receiver can be supplied with energy over a wireless power transmission path.

With a joystick arrangement as mentioned in the introduction, the above-mentioned problem is solved in that the energy supply connection is connected to the power receiver located in the handle unit, which power receiver can be supplied with energy over the wireless power transmission path.
With this construction, no electrical wires are required at all to create a connection between the base unit and the electrical function element. It is sufficient to mount the handle unit mechanically on the base unit, that is, to connect it to the base unit or otherwise locate it near the base unit. The energy, for example electrical energy, which is required for the operation of the function element, is transmitted wirelessly so that electrical leads or wires are not required. Within certain limits, wireless energy transmission is possible without problems. Particularly, when the electrical energy consumption of the electrical function element is limited, such an energy transmission can be realized wirelessly without great effort.

It is preferred that the energy transmission path comprises a high frequency field. With a high frequency field, electrical energy can be transmitted over certain distances with relatively good efficiency. The term "high frequency field" is here used in a rather wide sense. It extends from approximately 100 KHz to 20 MHz. The higher the frequency is, the more power can be transmitted. The energy can also be transmitted with light; also a "Bluetooth" technique is conceivable.

Energy can also be transmitted in other ways, for example acoustically or by pressure. In this case, provision is made for energy conversion into electrical energy in the handle unit.

Preferably, a power transmitter is located in the base unit. In this way, the power transmission path is automatically kept short, that is, the spatial distance
between the power transmitter and the power receiver remains small. Particularly at higher frequencies, this construction keeps the risk of interference, which could break through to the environment, small. Further, the efficiency of the power transmission is increased.

 Preferably, the power receiver has an energy storage means, for example a battery or a capacitor. In a manner of speaking, the battery or the capacitor serves as energy buffer for periods in which the power transmission over the wireless power transmission path is disrupted, that is the electrical power cannot be transmitted with the required intensity. During normal operation, the battery can be permanently on charge, so that it is ensured that the required electrical power is constantly available.

 Preferably, the electrical function element is connected to a circuit in the handle unit which has a non-volatile, programmable memory. In this memory, data can thus be stored, which is not then lost during a malfunction or a failure of the electrical power transmission. For example, specific operating parameters can be stored in the memory, which parameters are tailored to the individual machine. When the machine is turned off, the power transmitter will also no longer transmit. However, the operation parameters will be maintained. This memory can also be used for simplifying mounting. In a manufacturing step prior to final mounting, the handle unit can be supplied with the required parameters, or with programs, which are favourable for control of the machine. When, then, the handle unit is then mounted on the base unit, the programs or data for operation of the machine are available right away. An update can easily be made by replacing the
handle unit with another handle unit with new data or programs.

Preferably, the signal transmission path forms a second end point, which is connected to a bus interface. Thus, it is possible to connect the electrical function element directly to a bus, for example a CAN-bus, which is located on the machine. This is particularly advantageous if the machine is a self-propelled driven machine, as the use of a CAN-bus is common in vehicles. Thus, by means of the joystick it is possible to act upon practically the complete system of the vehicle or the machine.

Preferably, the handle unit is detachably connected to the base unit. The connection can, for example, be realized by means of a snap-on or a catch connection. Alternatively, some kind of bayonet connection is possible. If required, easily activated auxiliary connecting parts can be used, for example a hinged member or a union nut. If the handle unit is detachably connected to the base unit, a number of advantages occur, which will be described below.

For example, the base unit is connected selectively to one of several handle units, which have different external forms. Users often want a handle unit with special buttons, scroll buttons, adjustment wheels, switches or the like, a special arrangement of these operating elements or the like. This is easily realized with the detachable connection of the handle unit on the base unit. In each case, the signal and energy transmission can be of the same form, namely wireless. In order to be able to accommodate the wishes of the user, it is sufficient
merely to use a handle unit having the appropriate external form.

It is also advantageous, if the base unit is selectively connectible to one of several handle units, in each of which the respective electrical function element has a different characteristic. For example, in connection with the actuation of an actuation arrangement which releases or controls the electrical function element, different response times or different ramp functions or other different responses can be built in. The user can then have a handle element specifically adapted to him/her which meets his/her requirements.

It is particularly advantageous, if driver-specific data are stored in at least one handle element, said data being automatically transferable to the base unit when mounting the handle unit on the base unit. These driver-specific data can be, for example, the response times or functions mentioned above. Additionally, however, seat positions or similar positions on the vehicle can be stored in the handle unit. Each driver then has his own handle unit. When the driver mounts his handle unit on the base unit, the vehicle or the driven work machine is automatically adjusted in accordance with his programmed settings, for example, the seat position can be set correctly, the chair back inclination of the seat can be set accordingly, the position of the driving mirrors can be set, etc. Additional measures are not required. It is sufficient for the driver to mount his handle unit on the base unit.

It is also advantageous for at least one electrical function element to have an anti-theft function which can
be deactivated only when a handle unit is mounted. If the machine is, for example, a tractor, the driver can take the handle unit with him/her when leaving the tractor, thus ensuring that the tractor is protected against theft.

For example, a starter immobilizer can be activated, so that the engine of the tractor can no longer be started.

It is also advantageous for the base unit to be detachably mounted on a vehicle or a driven work machine. A remote control can then be realized in a simple manner. The base unit merely has to be detached from the machine or the vehicle. The operator can then position himself/herself away from the machine and then possibly has a better view of the functions to be performed by the machine.

Preferably, at least one additional base unit is provided, and the handle unit communicates selectively with one of the base units. In this case, the vehicle or the driven machine can be controlled from different locations. For example, provision can be made for the machine to be stopped when the handle unit is removed from a base unit. The machine can then only be operated again when the handle unit communicates with another base unit. Provision can even be made for the handle element to initiate other responses, depending on the location of the base unit. For example, the posture of the operator can be taken into consideration. In a sitting position, an operator will manipulate the handle unit differently from when he/she is standing, for example.

It is also advantageous for the handle unit to have a display. Such a display can, for example, be a liquid crystal display (LCD display). In this display, the
provision also of buttons or touch-sensitive areas is conceivable, which buttons or areas can then be reconfigured by the user to different functions, as is, for example, known from mobile phones. It is also possible to provide light in the function elements, for example, buttons or switches, so that the light is turned on, when a button or a switch is actuated.

Preferably, the function element can be configured via the signal transmission path. The function element can then, for example, be adapted to different vehicles or driven work machines, in which connection it is of possible to take into account previously stored user-specific settings.

A joystick arrangement constructed in accordance with the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic view of the joystick arrangement; and

Fig. 2 is a block schematic diagram of the joystick arrangement.

Referring to the accompanying drawings, a joystick arrangement 1 has a handle unit 2, which is detachably fixed on a base unit 3. For this purpose, the base unit 3 has a mounting plate 4 which is supported on a housing 6 by means of a ball joint so that the handle unit 2 can be displaced by pivoting from the position shown by solid lines into, for example, the position shown by broken lines. Displacement in one direction in space is shown,
but, in fact, the handle unit 2 can be displaced in
arbitrary directions in relation to the housing 6.

The mounting plate has a mounting opening 7, into which
the handle unit 2 can be inserted. Distributed around the
mounting opening 7 are several radially extending recesses
which can be engaged by radial pins, not shown, on the
handle unit 2 when the handle unit 2 is mounted. After
inserting the handle unit 2 into the mounting plate 4, the
handle unit 2 must be turned, for example by 45°, in
relation to the mounting plate 4 to ensure secure fixing.
Thus, the handle unit 2 is detachably fixed on the base
unit 3, here with a kind of bayonet connection. Other
types of mounting, for example with a union nut or the
like, are possible.

Although not illustrated in the drawings, the mechanical
fixing between the handle unit and the base unit can even
be omitted. The handle unit is then movable freely in
space. This is comparable with a computer mouse, although
a mouse is, however, movable only in two dimensions. The
opportunity of moving the handle unit freely in space
gives a further convenience feature. The only requirement
is that the handle unit and the basis unit are able to
communicate with each other.

By pivotal displacement in relation to the housing 6, the
handle unit 2 controls a number of functions of a
hydraulic machine (not shown in the drawings). The
machine can be provided with several drives. Displacement
of the handle unit 2 in relation to the housing 6 in one
direction actuates a drive in one direction or the other,
depending of the displacement direction. The degree of
displacement is a measure of the degree to which the drive is activated, for example a measure of the extension movement of a piston-cylinder arrangement or a measure of the speed at which a rotary motor is operated. As the handle unit 2 can be displaced in several directions in relation to the housing 6, it is also possible to control more than one motor, for example two motors.

The handle unit 2 has a number of additional control elements, namely two buttons 9, 10, two switches 11, 12, an adjustment wheel 14 and a light emitting diode 13. The arrangement shown here is merely an example. Different users will have quite different requirements. The above-mentioned control elements 9 to 14 are connected to an electrical function element 15, which can, for example, be in the form of an integrated circuit. The function element is connected to an antenna 16, which is able to derive energy from a high frequency field. The high frequency field, which is explained further below, works in the region from 100 KHz to approximately 20 MHz. Preferred frequencies are, for example, 125 KHz or 13 MHz. Although not illustrated in the drawings, the function element 15 can have an A/D converter, a microprocessor, a RAM, an EEPROM, a ROM, oscillators, timers and counters.

A multiplexer is also possible if several control elements 9 to 14 are connected to the function element 15. The function element 15 can be, for example, a module of the type MLX10111 of the Melexis Microelectronic Systems, Concord NH, USA.

Although not illustrated in the drawings, the handle unit can also have a display, for example an LCD display. This display may be provided with touch-sensitive areas by
means of which the user can enter different functions or which he can reconfigure to different functions. The use of the handle unit thus becomes very versatile.

As can be seen from Fig. 2, the function element can furthermore have a battery 17, so that brief interruption of the power transmission by means of the high frequency field can be buffered.

The function element 15 is switchable. In one case, the high frequency field can be operated at 13 MHz, in the other case at 125 KHz. In each case, it is ensured that the required electrical power can be transmitted.

The electrical power is provided by a power transmitter 18, which is located in the housing 6. The power transmitter 18 is connected to an antenna 19. The antenna 19 can instead be integrated in the power transmitter 18. Via the antenna 19, the power transmitter emits the high frequency field which is used to transfer the electrical power to the function element 15.

The power transmitter 18 can be, for example, a module of the type MLX90121 of Melexis Microelectronic Systems.

As is seen from Fig. 2, a wireless transmission path 20 is provided between the function element 15 and the power transmitter 18. Via this path 20, not only is the electrical power transferred which is required for driving the function element 15, but the transmission path 20 is also used to transfer the signals generated by the function element 9 to 14 to the housing 6. For this purpose, the power transmitter 18 also has a data
receiving arrangement. The function element 15 is able to send and receive data.

Instead of a relatively high frequency electrical field, the required energy can also be transferred in a different manner, for example by means of light. For this purpose, light emitting diodes and corresponding light receivers, for example light-sensitive transistors, are then used. Energy transfer in an acoustic manner or at a low-frequency is also possible. Also a "Bluetooth" technology can be used, so that in principle a larger distance between the handle unit 2 and the base unit 3 is acceptable. Bluetooth works in the Gigahertz range.

In any case, some sort of security should be built into the communication between the handle unit 2 and the base unit 3, so that the reliability of detecting a "false" signal is 100 percent. Such a signal might trigger an error situation. The security can be ensured by using hardware. However, it is also possible to ensure it by means of software.

When such a non-electrical transmission path is available, it is of course possible not only to transfer the energy, but also the signals, via this transmission path. As necessary, an energy converter is then required, which converts the non-electrical signals into electrical signals and vice versa.

The power receiver 18 is connected via a serial bus 21 to a bus interface 22, which in turn is connected to a CAN-bus 23. When the joystick arrangement 1 is mounted on a vehicle, it gives direct access to the CAN bus and thus to
practically all modules of the vehicle which are connected to the CAN bus.

For the sake of completeness it is mentioned that the housing 6 has an energy supply 24, which, for example, supplies the power transmitter 18.

As appears from Fig. 1, it is not only the handle unit 2 that is detachable from the base unit 3. Also the base unit 3 is detachably mounted on a frame 25, the frame 25 being, for example, part of a vehicle. When the base unit 3 together with the handle unit 2 is removed from the frame 25, it is possible, in a manner of speaking, to remote-control the vehicle or machine to be controlled.

Safety levers 26 serve the purpose of fixing the base unit in the frame 25. Plug-in connections, not shown, ensure that the energy supply 24 and the CAN-bus 23 are connected to the base unit 3, when the base unit 3 is inserted in the frame 25.

The embodiment shown provides a number of advantages.

Even when the handle unit 2 is not detachably mounted on the base unit 3, mounting is substantially easier, as no electrical connections have to be established.

However, additional advantages are involved when the handle unit 2 is detachably mounted on the base unit 3. For example, several handle units 2 can be provided, which are provided with different arrangements of control elements 9 to 14. Many users want a handle unit with special buttons or switches or a special arrangement of
the buttons, and with the concepts described here, this is possible in a simple and cost effective manner.

Using the handle unit, it is possible to communicate with the whole machine via the CAN-bus. Particularly when used in a vehicle, there are many possibilities. Finally, not only is it possible to act upon the operation of hydraulic motors, but also, for example, upon the fuel injection into a diesel engine driving a pump, which is provided for the supply of hydraulic loads. The range of application of the joystick arrangement is thus extended.

If the handle unit 2 can be dismounted from the base unit 3, then the handle unit 2 can be taken with the operator when he/she leaves a self-propelled driven work machine, the driven machine then being protected against theft (starter immobilizer, for example) and locked. On returning to the driven machine, the handle unit 2 is inserted in the base unit 3 again, and the machine is ready to work.

Each user can be provided with his/her own special handle unit 2, in which his/her specific data are stored, for example, seat position, driving mirror position, speed profile and the like. If, the driver or operator now inserts the handle unit 2 into the base unit 3, the machine is automatically loaded with his/her desired settings.

It is also possible to provide at least one additional base unit on the vehicle or on the driven machine from the outset. The handle unit 2 can then removed from the first base unit 3 and be fixed on or connected to the additional
base unit 3. It can be envisaged here that the overall system blocks the base unit 3 at the same time as the handle unit is removed so that undesired actuation is not possible at all, even if undesired actuation is attempted at the base unit. When the handle unit is then mounted in the other base unit, specific settings can also exist here.

In connection with software updates, the manufacturer can, for example, deliver a new handle unit 2. When mounted in the base unit 3, a software update then takes place, which update can easily be in respect of the whole machine or the whole vehicle, respectively, since a connection from the handle unit 2 to the CAN-bus of the machine or the vehicle exists via the wireless transmission path 20.

An upload to the handle unit 2 is also possible, so that a certain function element on the handle unit 2 can be provided with a new function via the transmission path 20.
1. Joystick arrangement comprising a base unit and a movable handle unit which includes at least one electrical function element, which element has an energy supply connection and forms an end point of a wireless signal transmission path, wherein the energy supply connection is connected to a power receiver located in the handle unit, which power receiver can be supplied with energy over a wireless power transmission path.

2. Arrangement according to claim 1, wherein the power transmission path comprises a high frequency field.

3. Arrangement according to claim 1 or 2, wherein a power transmitter is located in the base unit.

4. Arrangement according to any one of claims 1 to 3, wherein the power receiver includes energy storage means.

5. Arrangement according to any one of claims 1 to 4, wherein the electrical function element is connected to a circuit in the handle unit which has a non-volatile, programmable memory.

6. Arrangement according to any one of claims 1 to 5, wherein the signal transmission path forms a second end point which is connected to a bus interface.
7. Arrangement according to any one of claims 1 to 6, wherein the handle unit is detachably connected to the base unit.

8. Arrangement according to claim 7, wherein the base unit is selectively connectible to one of several handle units of different external form.

9. Arrangement according to claim 7 or 8, wherein the base unit is selectively connectible to one of several handle units, in each of which the respective electrical function element has a different characteristic.

10. Arrangement according to claim 8 or 9, wherein driver-specific data are stored in at least one handle element, said data being automatically transferable to the base unit when mounting the handle unit on the base unit.

11. Arrangement according to any one of claims 7 to 10, wherein at least one electrical function element has an anti-theft function, which can be deactivated only when the handle unit is mounted.

12. Arrangement according to any one of claims 1 to 11, wherein the base unit is detachably mounted on a vehicle or a driven machine.

13. Arrangement according to any one of claims 1 to 12, wherein at least one additional base unit is provided, and the handle unit communicates selectively with one of the base units.
14. Arrangement according to any one of claims 1 to 13, wherein the handle unit includes a display.

15. Arrangement according to any one of claims 1 to 14, wherein the function element can be configured by way of the signal transmission path.

16. A joystick arrangement substantially as herein described with reference to, and as illustrated by, the accompanying drawings.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

<table>
<thead>
<tr>
<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td></td>
<td>EP 1283535 A1 (H2Eye Intl.) see fig.6</td>
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Categories:

- **X** Document indicating lack of novelty or inventive step
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- **A** Document indicating technological background and/or state of the art.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC\(^X\):

- F2Y; G4A

Worldwide search of patent documents classified in the following areas of the IPC\(^{07}\):

- E02F; G06F; H01F

The following online and other databases have been used in the preparation of this search report:

Online databases: EPODOC, OPTICS, WPI