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Control panel for use in a construction engine

05 The invention relates to a control panel for use in
a construction engine.

10 In conventional construction engines like drilling units,
pile hammers and the like the working unit is arranged
on a vehicle, generally a caterpillar vehicle of the
type used for excavators. In the operator's cabin of
the construction engine a variety of control levers
is provided to control movement of the vehicle as well
as various functions of the working unit.

15 An operator's place of the type explained above comprises
a plurality of control levers, which is unfavourable
in view of clearness and ease of operation.

20 Generally it would be possible to design such an operator's
place in a more clear manner, if the technology of stored-
program control systems was used for control of the
various servomotors. In such a structure it would be
sufficient to just provide at the the operator's place
an input unit of the type usually used in connection with
25 stored-program control systems, i.e. a monitor and a
plurality of input keys or analog input means. A further
advantage obtained by such design of the operator's place
would be that the number of lines, which must be arranged
in the operator's cabin, can be reduced to a small number
30 of electrical lines. There is no need to arrange bulky
hydraulic lines in the operator's cabin. Use of a screen
would also allow to output various error messages and
eventually to give hints for remedy of the errors encoun-
tered to the operator in a clear manner.

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However, the usual monitors and the usual input means like keyboards or touch-panel-control means are not very well adapted for use in construction engines. Use of conventional keyboards does not allow for rapid control of loads without visual contact to the keyboard. However, such visual contact cannot be provided in construction engines, since the operator must visually control the work executed by the construction engine in continuous manner. For these reasons, touch-panel-input means cannot be used for those working functions of the engine, which must be controlled in normal working.

The object of the present invention thus is to provide a control terminal for use in a construction engine, which on one hand flexibly adapts to different control jobs and allows to control a large number of different functions using a small number of control elements, only, and which on the other hand is of such design, that it can be operated without visual control.

In accordance with the present invention this object is solved by a control panel for use in a construction engine comprising the features enumerated in claim 1.

In the control panel in accordance with the present invention a plurality of control elements is arranged at different locations on a monitor housing. These locations are determined in fixed manner and differ as to their location, which can be easily recognized by a user thus allowing blind control of the control panel. For carrying out special tasks special functions differing from the standard-functions can be associated to the different control elements by the control unit connected to the control panel. In such case appropriate information showing which function is associated to which control

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element is displayed on the screen.

Advantageous further improvements of the invention are defined in subclaims.

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The further improvements of the invention in accordance with claims 2 to 6 are advantageous in view of even more clear tactile backfeed and identification of the control element to be presently actuated by the operator.

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In a control panel in accordance with claim 7 to 9 an additional acoustic information is output indicating to the operator, which of the control elements the operator he is just about to move.

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The further improvement of claim 10 facilitates recognizing the control function associated to each of the control elements.

20 The further improvement of the invention in accordance with claim 11 is advantageous in that an even larger number of control function is available, which need be used seldom, only. This advantage is achieved without a need of the control elements associated to basic control
25 functions having to be be reprogrammed by the control unit connected to the control panel.

The further improvement of claim 12 is advantageous in view of ease and ergonomy of use of the control panel.

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The invention will be explained in more detail by way of preferred embodiments thereof shown in the drawings.
In the drawings

35 Figure 1: is a top view of a control panel for use

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in a construction engine as well as a block diagram of a control unit cooperating with the control panel and controlling various servomotors of the construction engine;

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Figure 2: is a side view of the control panel shown in figure 1;

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Figures 3 to 5: are similar views as figure 1, however, showing modified control panels; and

Figure 6: is a block diagram of the control unit shown in figure 1.

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In figure 1 a control panel is generally shown at 10. The control panel 10 is used for controlling various movements of the moveable base of a construction engine and for controlling working functions of the construction engine, e.g. the functions of a drilling unit carried by

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an excavator or a pile hammer carried by an excavator. The control panel 10 is connected to a control unit 14 by means of a data cable 12. The control unit 14 controls a plurality of different loads of the construction engine. By way of example for such loads a 4/3 solenoid valve (four way/three position solenoid valve) 16 is shown, which selectively connects the fluid ports of a hydromotor 18 to a pressure line 20 and a return line 22 to cause the hydromotor 18 to rotate in one of two directions of movement, respectively.

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The control panel 10 comprises a housing generally shown at 24 and including a bottom wall 26, a back wall 28, side walls 30, 32, a desk-shaped inclined top wall portion 34 as well as a lateral stepped top wall portion 36.

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The upper region of the top wall portion 34 carries a screen 38, which actually may be a LCD display, a STN display or a TFT display.

- 05 The lower region of the top wall portion 36 carries two keys 40-1, 40-2, which cooperate with position sensors not shown in figure 1 in detail, e.g. microswitches 84.

- 10 On the horizontal portions of the stepped top wall portions 36 there are pairs of adjacent keys 40-3, 40-4, 40-5 and 40-6, 40-7 and 40-8 as well as 40-9 and 40-10.

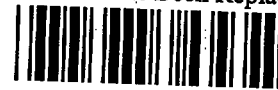
- 15 A proximity sensor 42 only schematically shown in the drawings is associated to each of the keys 40, which will respond to a finger being put onto the respective key.

- 20 The position sensors cooperating with the keys 40 and the proximity sensors 42 as well as a driver circuit 44 controlling the screen 38 are connected to the control unit 14 by the data cable 12. Typically the control unit 14 will output graphic or alphanumeric information in a left hand portion 46 of the screen. This information informs the operator on the actual working conditions and, eventually, on errors that have occurred as well as
- 25 possible remedies for these errors. Furthermore, the control unit 14 controls soft key areas 48 defined on the screen 38. In the embodiment shown in the drawings, the function associated to the keys 40-3 to 40-8 is displayed in aligned soft key areas 48. As to the keys 40-1, 40-2,
- 30 40-9 and 40-10, for explanation purposes, they are supposed as being permanently associated to the same control functions, which allows to explain the function of these keys by permanent information carried by the top wall portions 34, 36.

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The screen 38 further comprises touch-panel-areas 50 and 52, which in accordance with information output on the screen are used for controlling special functions of the construction engine, which are needed in exceptional cases, only.

The housing 24 of the screen is connected to a fixed wall portion 64 of the operator's cabin of the construction engine, which apart from wall portion 64 is not shown in the drawings, by means of three universal joints 54, 56, 58 and mounting arms 60, 62. The universal joints may either comprise a friction brake or manually controlled brakes so that each operator can position the control panel 10 in a individual way so that he has maximum comfort in actuating the various control elements.

A key-operated switch 66 is mounted in the side wall 32, which is connected to the control unit 14 by means of the data cable 12 the same way as the position sensors associated to the keys and the screen 38. The key-operated switch 66 is used in connection with inputting special control command signals into the control unit, when the when the control unit 14 in exceptional cases must be caused to perform special functions, i.e. to deactivate a locked state of the control unit, which the control unit automatically entered after an emergency stop or due to a grave error occurring, or to temporarily override a permanent blocking condition established in connection with particularly dangerous works.

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The design of the top wall of the housing 24 described above enables the user to recognize different keys in a tactile way so that blind operation of the control panel 10 by the operator will not result in his fingers inadvertently moving from one key to another key.

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For additional security an acoustic signal is produced shortly before touching a key or in the very first phase of contacting a key, which signal is individually associated to the function of this key. This will now be explained in more detail referring to figure 6 in connection with one of the keys:

As may be seen from figure 6, a contactless proximity sensor 42 is connected to one input of a special plural AND-gate 68. The latter has plurality of data inputs, each of which by means of a multiconductor data line 70 is connected to one of the output terminals of a tone control signal generator 72. An input terminal of the latter is connected with one of the interfaces of a processor 74 controlling operation of the control unit 14 in accordance with a predetermined program. Particularly, the processor 74 defines, which of the working functions of the construction engine is associated to which of the keys 40 at a given moment. Together with establishing the correspondence between a working function and a key the processors 74 causes the tone signal generator 72 to provide at that one of its output terminals, which corresponds to the working function of interest (the tone signal control generator has exactly one output terminal for each of the keys) a specific digital tone control signal. This digital tone control signal is fed to the control terminal of a controllable digital tone signal generator 76, when the AND-gate 68 associated to the key of interest is switched through or ON by the signal output from the proximity sensor 42, which actually occurs upon a finger approaching the surface of the key. The digital tone signal generator 76 may be a digitally controllable frequency generator, which in accordance with different digital control signal received will provide tones of

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different pitch or combinations of tones of different pitch and/or different tone colour and/or different rhythm. Alternatively, the tone signal generator 76 may be formed by a large read only memory (ROM) having a plurality of memory areas which can be selectively activated by the tone control signal and store different spoken messages in digital form.

The tone signal produced by the tone signal generator 76 is amplified by an amplifier 78 and will then drive a loudspeaker 80, which may be arranged on the control panel 10 or may be mounted at the ceiling of the operator's cabin. Additionally, the tone signal can be supplied to an earphone not shown in the drawings, which is carried by the operator of the construction engine via a line 82.

As may be seen from figure 6, too, the processor 74 furthermore controls an eventual soft key area 48 associated to the key of interest. One of the inputs of the processor 74 is connected to a switch 84 (i.e. the position sensor referred to above) associated to the key of interest and being closed upon pushing the key. Upon this key becoming closed the processor 74 will start a routine for performing the function associated to the key of interest, e.g. establishing one of the operating positions of the solenoid valve 16 of figure 1.

As to the input of control commands, the control unit shown in figure 6 operates as follows:

Upon a finger tip coming close to one of the keys 40 the AND-gate 68 is switched ON and the digital signal provided at the associated one of the output terminals of the tone control signal generator 72 and being repre-

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sentative of the working function of the construction engine, which is associated to the respective key, will be fed to the control input terminal of the tone signal generator 76. The operator will now hear an acoustic
05 signal indicative of the respective key function. The meaning of the various acoustic signals will be known to the operator after a short training phase. From such a signal the operator may recognize without visually controlling the position of the finger, if the working
10 function, which will be caused upon further movement of the finger (then triggering the key) is the really desired one.

If desired, instead of the contactless proximity sensor
15 42 a further switch 86 may be provided as shown in broken lines, which will be actuated within a first portion of the key's stroke, wherein the switch 84 will still remain in its open state.

20 In the embodiment shown in figure 1 and 2 tactile recognition of the different keys of the control panels 10 is facilitated by the step-shaped geometry of the top wall portion 36. In the embodiment shown in figure 3, wherein functionally equivalent components are identified
25 by the same reference numerals, the different keys 40 differ by very distinctly different spatial locations, at which they are provided on the front side and rear side of the housing 24, respectively. More particularly, for each of the edges of the lower face of the bottom
30 wall 26 two keys are provided only, which due to their clear spatial separation can be easily discerned. The same holds for keys, which are arranged along different edges of the lower side of the top wall.

35 For easier operation of the keys arranged on the lower

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surface of the back wall by the index finger of the operator the housing 24 is provided with a circumferential flange 88 forming a support for the thumb of the operator's hand.

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In this embodiment of the housing those of the keys 40, which are situated at the rear side of the housing, may be additionally discerned by designing the different keys with rest position restoring forces of different size. For example, one can generally adopt a design such that the keys succeeding along an edge and thus also the keys being adjacent to a corner of the housing respond to actuating forces of different size.

15 The control panel 10 shown in figure 4 essentially corresponds to one of figure 1, however, the two keys forming a key pair are arranged on different sides of the desk-shaped top wall portion 34, i.e. the housing is formed with two mirror image stepped top wall portions 36.

20

Referring to figure 5 a further way of allowing safe and easy tactile discerning of different control elements will now be explained, which is discerning of the control elements by means of different operating directions.

25

In connection with the control panel of figure 5, components which have already been described above, are again identified by the same reference numerals and will not be explained again in detail.

30

In the control panel of figure 5 two of the keys have been replaced by two rotatable control wheels 40-3 and 40-4, which are journaled for rotation with respect to two axis, which in figure 5 extend in horizontal direction.

35 The control wheels 40-3-4 cooperate with rotary encoders,

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which instead of a switch 84 are connected to an associated one of the input terminals of the processor 74. Further keys have been replaced by operating levers 40-5 and 40-6, which can be pivoted about axis, which in figure 05 5 extend in a direction being perpendicular to the plane of the drawings. The control levers 40-5 and 40-6 cooperate with rotary encoders, which are arranged in the interior of the housing 24 and are not shown in the drawings.

10 Furthermore, the lower surface of the housing 24 again carries keys 40-7 and 40-8, which can be actuated from the rear of the housing by pushing the keys towards the front side of the housing. Actuating of the keys 40-1 and 40-2 being situated below the screen 38 is 15 effected in inverse direction, i.e. in a direction extending from the front side to the rear side of the housing.

The front wall of the housing 24 also carries slidable 20 control elements 40-9 and 40-10, which can be moved in lateral direction.

Thus all the control elements to be actuated by one hand of the operator have different operating directions, 25 which fact allows to easily discern the different control elements in a tactile way.

In addition the control elements are of clearly different size and geometry, which can easily be monitored in 30 a tactile way.

A common feature of the control panels described above resides in the fact that they allow to control a large number of different working functions of a construction 35 engine in a safe way and without visual control of the

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actuation of the control elements. Yet the control panel has small overall dimension and does not affect the view of the operator to the site, where the actual work is carried out by the construction engine.

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Within the operator's cabin only electric cables need be arranged, i.e. the cable 12. Hydraulic lines may extend from a valve assembly arranged adjacent to the control unit 14 to the various hydraulic working devices

10 and motors. Thus the structure of the construction engine and service thereof is simplified, since the control unit and the valve block can be arranged at locations, which are well accessible.

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Claims

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1. A control panel for use in a construction engine,
05 which is connectable to a control unit (14) controlling the working functions of the construction engine, comprising a screen (38) as well as a housing (24) carrying the latter and comprising control elements (40) cooperating with associated control signal generators (84), character-
10 rized in that the control elements (40) are arranged on the housing (24) carrying said screen (38) at locations being discernable in tactile manner.
2. The control panel as in claim 1, characterized
15 in that the control elements (40) or subgroups of control elements are arranged on different walls (26, 28, 30, 32) of the housing (24).
3. The control panel as in claim 2, characterized
20 in that at least a fraction of the control elements (40) is arranged on a stepped wall portion (34) of the housing (24)
4. The control panel as in one of claims 1 to 3, characterized
25 in that at least some of the control elements, preferably adjacent operating elements (40), differ as to their actuating direction.
5. The control panel as in one of claims 1 to 4, characterized
30 in that at least some of the operating elements, preferably adjacent operating elements (40), differ as to their dimensions.
6. The control panel as in one of claims 1 to 5, characterized
35 in that at least some of the control elements,

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preferably adjacent control elements (40), differ as to the resistance to be overcome for actuating of the control element.

05 7. The control panel as in one of claims 1 to 6, characterized in that proximity sensors (42) are associated to the control elements (40), which within an actuating cycle of the associated control element provide an output signal before the control signal generator (84) associated
10 to the respective control element (40) will respond to the actuating movement.

8. The control panel as in claim 7, characterized in that the proximity sensors are formed by switches
15 (86) or contactless sensors (42), particularly optical sensors.

9. The control panel as in claim 7 or 8, characterized by a controllable tone signal generator (76), the
20 character of the tone signal output from said tone signal generator (76) being controlled by the signals output from the proximity sensors (42).

10. The control panel as in one of claim 1 to 9, characterized in that the screen (38) includes soft key
25 areas (48) associated to one of the control elements (40), respectively.

11. The control panel as in one of claims 1 to 10,
30 characterized in that the screen (38) comprises touch-panel actuating areas (50, 52).

12. The control panel as in one of claims 1 to 11, characterized in that the housing (24) is carried
35 by a fixed portion (64) of a vehicle by means of an adjustable (54 to 58) linkage (60, 62).