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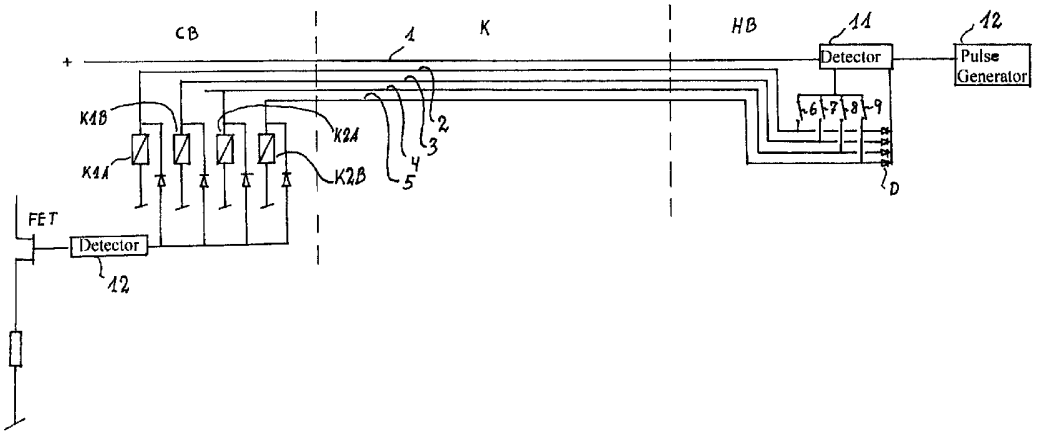
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** AN ELECTRICAL DRIVE SYSTEM



(57) **Abstract:** In actuator systems which are operated via a cabled hand control, the problem may occur that an actuator accidentally starts running because of a short-circuit of conductors in the cable. Such actuator systems are used inter alia in hospital beds where such a "self-runner" situation may be quite critical. Such situations may be prevented by arranging the system with a signal generator (12) which, in case of a current in a common conductor (1), transmits a signal through the conductors (2-5) in the hand control cable which is caught by a detector (13) at the other end of the conductors. Said system being adapted such that of one or more of predetermined conductors are short-circuited, it does not signal a control unit to activate the actuator or actuators concerned, alternatively stops it or them. A special embodiment may also allow for co-runner, i.e. where other actuators accidentally start running when an actuator is activated.

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An electrical drive system

The present invention relates to an electrical drive system comprising at least an actuator, a control unit connected to the actuator, a hand control connected to the control unit by a multi-core hand control cable with a common conductor as well as a plurality of individual conductors, said hand control comprising a plurality of function keys connected to the common conductor and to individual conductors for the control of the actuators.

Such a drive system is generally incorporated in adjustable articles of furniture, and by way of example reference is made to EP 498 111 B1 and EP 488 552 both to J. Nesbit Evans & Company Limited, which together describe a hospital bed where the mattress support as a whole may raised/lowered as well as be tilted about a transverse axis and additionally be profiled by rotation of the backrest and the legrest. The patient can operate the bed by a hand control connected to the control unit by a cable.

The hand control cable, which must necessarily be of a certain length, is liable to be damaged because it may accidentally be jammed at the movable parts in the bed. Complete cutting/tearing of the cable is annoying, of course, but involves no immediate danger to the patient, which may be the case by partial damage where some of the conductors in the cable are short-circuited. Such a type of damage is not always visible on the external sheath of the cable, but the insulation around the individual conductors may very well have been stripped. If the patient wants to adjust the backrest, then a damaged cable may e.g. cause the legrest to be activated at the same time, which may be a nuisance and at worst dangerous to the patient.

To avoid the hand control cable, research has been devoted to both infrared and partly also radio-controlled remote controls, but these have other inherent drawbacks and problems, which means that wired hand controls

are still preferred for adjustable articles of furniture.

Accordingly, the object of the invention is to provide security against misadjustment for the user of the article of furniture, if the hand control cable is torn partly across and two or more conductors are short-circuited.

According to the invention, the various situations are divided into the following categories:

1) "Self-runner" – a critical situation where other movable elements unintentionally begin moving, and which cannot be stopped once a function has been activated.

2) "Co-runner" – a non-critical situation where other movable parts, although they unintentionally begin moving, stop when the function key is released.

3) "Non-runner" – an inexpedient situation where a function cannot be activated.

When, according to the invention, the drive system is provided with a signal generator which, in case of a current in the common conductor, because of activation of a function key on the hand control, transmits a signal (signals) through conductors in the hand control cable from one end of these, as well as a detector for detecting the signal at the other end of the conductors and adapted such that if one or more of predetermined conductors are short-circuited, it omits applying a signal (signals) to the control unit to activate the actuator or actuators concerned, in the alternative stops it or them, at least self-runners may be avoided and thereby critical situations. In a further development of the invention it is also possible to avoid some of the co-runners.

An embodiment of the invention will be explained more fully below with reference to the accompanying drawing. In the drawing:

Fig. 1 shows a schematic diagram,

fig. 2 shows a survey of short-circuit constellations in the hand control cable.

The diagram shown in fig. 1 just illustrates the parts necessary for the understanding of the invention. The common parts, such as an actuators, power supply, etc., are omitted.

In the drawing CB indicates a controller, K a hand control cable, and HB a hand control. It is shown here that the control unit comprises four relays K1A, K1B; K2A, K2B which in pairs control their respective actuators. The cable comprises five conductors 1-5. The hand control comprises four function keys 6, 7, 8, 9 connected to a common conductor 1 and by individual conductors 2-5 to the respective relays.

When a function key is operated to activate an actuator, a current in the common conductor is detected by a detector 11 by means of the voltage drop across a pair of diodes. The voltage drop across the pair of diodes is so small as to be insignificant relative to the structure in general. The detector activates a pulse generator 12 which transmits pulses through the individual conductors 2-5, and the control unit includes another detector 13 to catch these signals.

Taking the previously stated division of the various situations caused by a short-circuit between the conductors in the hand control cable as a basis, "self-runner" may occur because of a short-circuit of the individual conductors 2-5 with the common conductor 1. The detector 13 in the control unit

detects if one or more of the individual conductors are short-circuited with the common conductor. The control unit is then adapted such that the motor relays K1A, K1B; K2A, K2B are not activated, whereby the power to the motors is not turned on, or if the short-circuit occurs during running, then the relays are deactivated and the power to the motors is turned off, e.g. in that a FET in the control unit (the H-bridge to the motor) is connected to the detector 13 and is allowed to be turned on only when a signal is received from the signal generator as an indication of the cable being intact.

In a further development of the invention, some of the self-runner situations may moreover be detected and thereby be avoided. This applies where the individual conductors 4 or 5 are short-circuited with the individual conductor 2 or 3. For this purpose, the individual conductors 2-5 are connected to the detector 11 via a diode D.

A short-circuit between the individual conductors 2 and 3 or 4 and 5 will draw both of the respective relays, and the non-activated actuator can thus not start.

The various situations appear from the table shown in fig. 2.

As will be appreciated, it is not a question of localizing a defect in the hand control cable, but simply a question of detecting a defect on it at the moment when it occurs and responding to the defect. Alternatively, if the defect occurred during standstill, then detecting the defect the first time the hand control is used subsequently and responding to this defect. The cable may be damaged during running with an actuator in that it gets jammed, but the cable may also be damaged when the actuators stand still, e.g. in that a pull is applied to it, it gets jammed during transport, is run over, etc.

Although the invention has been described here in connection with a bed

structure, it is evident that the invention is not restricted to this. In principle, the situation with a damaged hand control cable may occur in any structure, it might e.g. occur in a relaxer chair, a table, in an industrial application, etc.

Patent Claims

1. An electrical drive system comprising at least an actuator, a control unit (CB) connected to the actuator, a hand control (CB) connected to the control unit by a multi-core hand control cable (K) with a common conductor (1) as well as a plurality of individual conductors (2-5), said hand control comprising a plurality of function keys (6-9) connected to the common conductor and to the individual conductors for the control of the actuators, c h a r a c t e r i z e d by a signal generator (12) which, in case of a current in the common conductor (1), because of activation of a function key (6-9) on the hand control (HB), transmits a signal through conductors (2-5) in the hand control cable (K) from one end of these, as well as a detector for detecting the signal at the other end of the conductors and adapted such that if one or more of predetermined conductors are short-circuited, it omits applying a signal (signals) to the control unit to activate the actuator or actuators concerned, in the alternative stops it or them.

2. A drive system according to claim 1, c h a r a c t e r i z e d in that a current in the common detector is detected by a voltage drop across a pair of diodes (11).

3. A drive system according to claim 1 or 2, c h a r a c t e r i z e d in that the signal generator (12) is a pulse generator.

4. A drive system according to claim 2 or 3, c h a r a c t e r i z e d in that the individual conductors (2-5) are connected via a diode (D) to the detector (11).

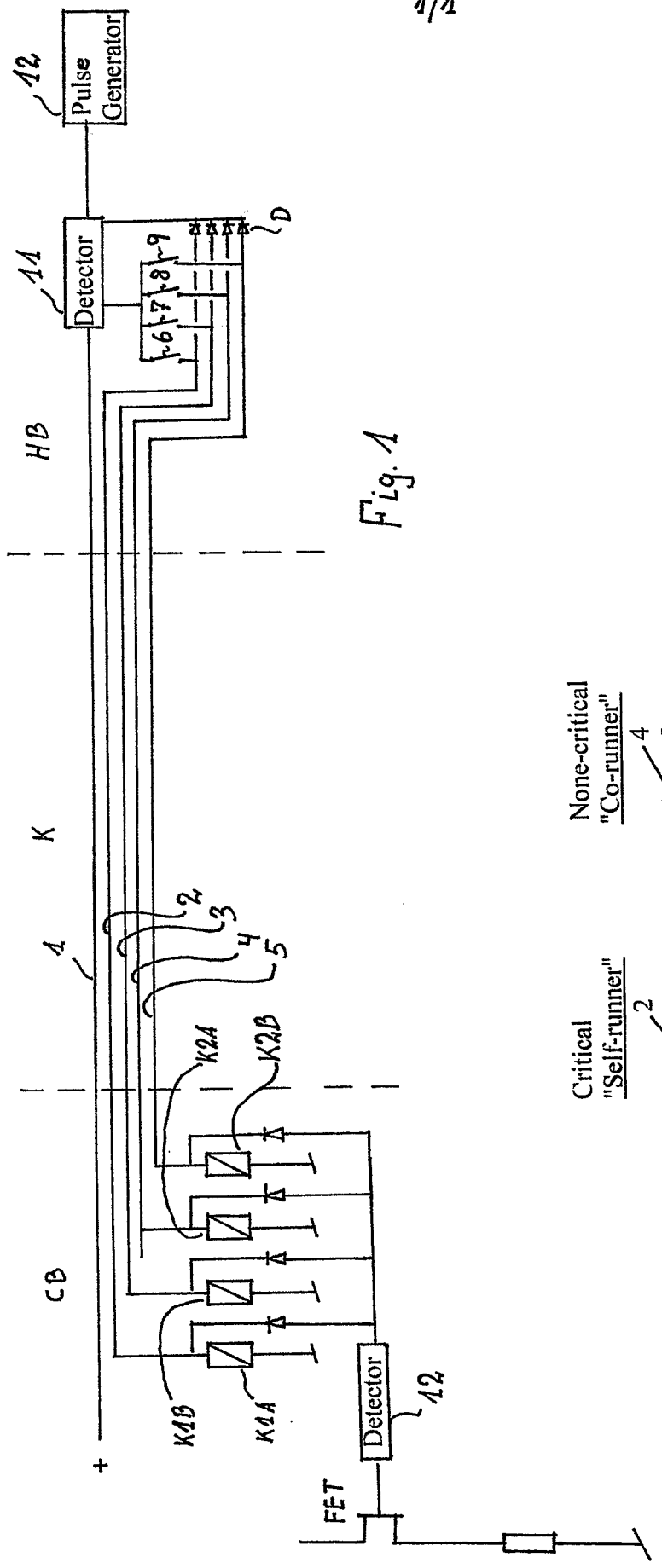
12
Pulse Generator
11
Detector
D
HB
K
CB
1
2
3
4
5
K2A
K2B
K1B
K1A
+
Detector
12
FET

Fig. 1

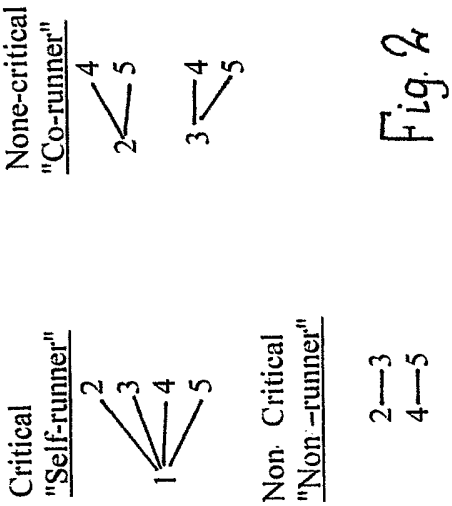
None-critical
"Co-runner"
4
2
5
3
4
5
Critical
"Self-runner"
2
3
1
4
5
Non Critical
"Non-runner"
2—3
4—5

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 2003/000710

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: A61G 7/018, G01R 31/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: A61G, G01R

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

SE,DK,FI,NO classes as above

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6008598 A (LAWRENCE E. LUFF ET AL), 28 December 1999 (28.12.1999), column 15, line 48 - column 17, line 21, abstract --	1-4
A	US 3716876 A (ARTHUR P. PETZON ET AL), 20 February 1973 (20.02.1973), figure 2, abstract --	1-4
A	WO 0070796 A1 (U.S. ELECTRONICS COMPONENTS CORP.), 23 November 2000 (23.11.2000), abstract --	1-4

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 January 2004	30 -01- 2004
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Nils Nordin/Els Telephone No. +46 8 782 25 00

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International application No.
PCT/DK 2003/000710

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 3813883 A1 (PETER LANCIER MASCHINENBAU-HAGENHüTTE GMBH & CO KG), 9 November 1989 (09.11.1989), abstract -- --------	1-4

INTERNATIONAL SEARCH REPORT
Information on patent family members

24/12/2003

International application No.
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				CA	2321297	A,C	26/08/1999
				EP	1056370	A	06/12/2000
				JP	2002503504	T	05/02/2002
				US	6396224	B	28/05/2002
				WO	9942021	A	26/08/1999
US	3716876	A	20/02/1973	DE	2224659	A	30/11/1972
WO	0070796	A1	23/11/2000	AU	5138800	A	05/12/2000
				US	6426820	B	30/07/2002
DE	3813883	A1	09/11/1989	NONE			