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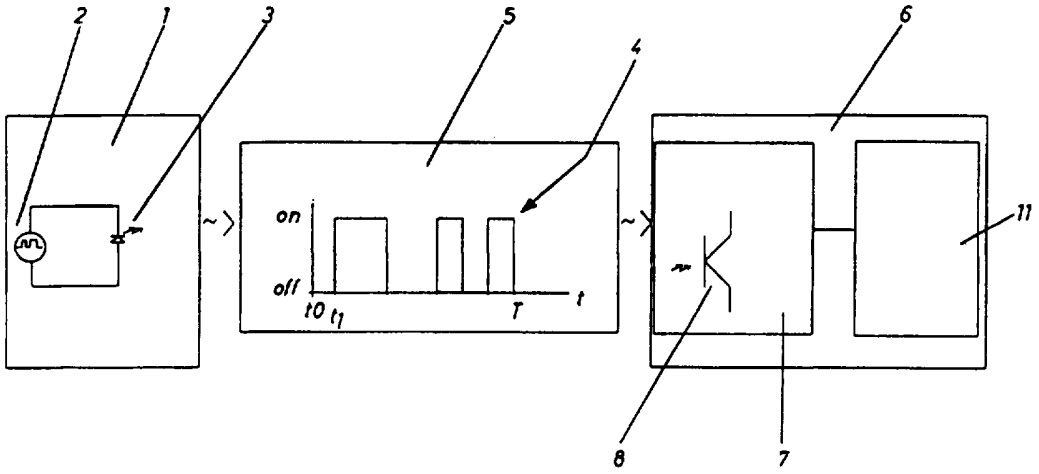

(57) Abstract

An electric power tool having means for alternatively disabling and enabling tool operation comprises a code signal receiver (7) and an electronic control means (11) supported on the tool, which control means (11) is arranged to be switched to an operable mode when a code signal (4) is received by the code signal receiver (7) and to be switched to an inoperable mode as the power supply voltage is disconnected or as a certain interval of operation has been completed, wherein the control means (11) remains in the inoperable mode until the code signal (4) is received by the code signal receiver (7).

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Electric power tool with code receiver

The invention relates to a hand-held electric power tool which comprises a device for alternatively disabling and enabling operation of the tool.

Electric power tools, for example rechargeable battery powered or mains-connected screwdrivers, are frequently used in, for example industrial assembly. Since this type of power tools are portable, they are occasionally removed from the workplace without permission and are never returned. This represents a costly loss for the owner.

The object of the invention is to ensure, in the case of a portable power tool, that the latter can only be used in an authorised workplace.

According to the invention, the above object is achieved in that the power tool comprises a receiver and an electronic control means , which is arranged to receive a code signal, in that the electronic control means switches the tool on to an operable mode upon receiving the code signal, and in that upon disconnection from the electrical supply voltage or after a certain time or operation interval, the tool returns to an inoperable mode and remains therein until the code signal is received.

A code signal transmitter is permanently installed in the vicinity of the authorized workplace.

By virtue of this device, upon disconnection from the supply voltage, i.e. by removing the accumulator in a rechargeable battery powered tool or disconnecting the mains plug in a mains-operated tool, or after a certain time or operation interval, the tool is switched into the inoperable mode and remains therein. If the tool is removed from the authorized workplace, in the case of a rechargeable battery powered tool, it can only be used until the charge runs out; in the case of a mains-operated tool, likewise it can no longer be operated; in the case of time-interval or operation-interval switching, the tool can no longer be operated after such interval has expired. This gives the owner a protection against theft, because those involved know that the tool is only usable at the workplace in connection with the code signal transmitter.

Only when the tool receives the code signal after reconnection of a battery unit in the case of a rechargeable tool, or reconnecting to the mains or after expiry of the time or operation interval, it is switched to the operable mode.

By means of different codings, groups of machines can be allocated to one of a number of working areas or code signal transmitters. Thus, the respective tools can only be used in the allotted working area. For example, in this manner it is possible to allocate screwdrivers having a specified torque setting to an assembly line (working area) at which such working operations only are to be carried out which require that particular torque setting. It is thereby ensured that in this working area,

work is always carried out a the correct torque setting. Due to the specific coding in this working area, screwdrivers which are set to a different torque or in which the output torque is not determined cannot be used, because these tools do not switch into the operable mode.

It is also possible to allocate other technical criteria to the coding. Furthermore, the coding can also be carried out according to administrative conditions; for example, in such a manner that tools belonging to one cost centre are only switched into the operable mode by the code signal within the working area of this cost centre.

Advantageous embodiments of the invention will appear from the subclaims and from the following description of an embodiment of the invention.

On the drawings:

Figure 1 shows a code signal transmitter having a transmission section and a hand-held power tool being in the vicinity thereof,

Figure 2 shows a block circuit diagram of the power tool, and

Fig 3 shows a flow chart of the electronic control means of the power tool.

A code signal transmitter 1 is installed in a stationary manner in for instance a factory. The code signal

transmitter 1 has a pulse generator 2 and an infrared transmitting diode 3. The code signal transmitter 1 periodically transmits a digital code signal 4 via a transmission section 5. In the example, the code signal begins at t0:01100101 and ends at T. t1 is the duration of one of the ones or zeros. The code signal 4 can also be coded in another way.

At least one power tool 6 is allocated to the code signal transmitter 1. This tool has a receiver 7 comprising an infrared transistor 8, which receives the code signal 4 when the power tool 6 is brought into the vicinity of the code signal transmitter 1.

Instead of the infrared transmission section 5, a radio transmission section can also be provided. It is also possible to provide a plug-in cable connection as a transmission section between the code signal transmitter 1 and the power tool 6.

In the illustrated embodiment, the power tool 6 is equipped with an exchangeable battery unit 9 (cf.Fig. 2). The charging device 10 needed for the battery unit 9 is advantageously integral with the code signal transmitter 1 (cf. Fig. 1). This makes the association between the code signal transmitter 1, the charging device 10 and the associated power tool 6 easy to monitor and simplifies the opertional coupling thereof as described above.

The receiver 7 is connected to an electronic control means 11 incorporated in the tool 6. The electronic control means 11 operates with a microprocessor. To this

is allocated a power circuit 12, by which the exchangeable battery unit 9 is connectable to a D.C. motor 13 of the tool 6. A mechanical transmission 14 is connected between the D.C. motor 13 and a drive unit 15 for the screwdriver bit, drill or other tool (not shown) (cf. Fig.2).

To the electronic control means 11 there is connected a manual switch 16, by which the motor 13 can be switched on or off via the power circuit 12 by the operator. Furthermore, the tool comprises an actuator 17, which acts on the electronic control means 11 and with which a further operational parameter can be set. For example, in the case of a screwdriver, the torque can be adjusted.

The electronic control means 11 also controls two light diodes 18, 19, which indicate the operable mode or the inoperable mode of the tool 6. The light diodes 18, 19 can also indicate other operating states, for example the state of charge of the battery unit 9 and whether a screw joint has been tightened correctly or not. An acoustic signal transmitter 20 can be provided to signal faulty tightening processes.

As an additional feature of the code signal transmission system, data concerning desired operation characteristics like torque output, angle of rotation etc. may be transferred to the power tool together with the tool operation enabling code signal. Also, a code signal emitting means may be fitted to the power tool for sending back to a stationary signal receiver the actual operation data obtained during a certain interval of

operation. These data may be stored, and an analysis of the performed operations may be carried out later on.

The *modus operandi* of the device described is substantially the following (cf. Fig. 3).

A replacement of the battery unit 9 of the tool 6 by a recharged unit, represents a reset command and a start command (a) for the microprocessor of the electronic control means 11. Upon the start command (a), initialisation of variable parameters takes place, which is indicated by the block (b). Thereafter, a probe cycle is started in which the infrared transistor is probed. If a signal is received, a bit is set to 1. If no signal is received, the bit is set to 0. This bit is then put into the first position in the receiving byte. After the time interval (t1), the cycle is repeated and the bit value is transferrred to the next position in the receiving byte. After each cycle, the receiving byte is compared with the code word stored. If these correspond, the tool is switched to its operable mode. If, accordingly, the receiving byte corresponds to the code signal 01100101, then the block (g) switches to the operable mode (cf. block h.). The tool 6 is then capable of being switched on and off by means of the manual switch 16. During the probe cycle, however, the tool cannot be switched on and off by means of the manual switch 16.

Having been switched to its operable mode via its electronic control means 11, the tool 6 may also be moved outside the range of the code signal transmitter 1. The probe cycle shown in Figure 3 is then no longer carried

out, but is initialised only when the battery unit 9 is exchanged or, in the case of a mains-operated tool, the mains plug is pulled out and plugged in again.

If in the block (g) it is established that the receiving byte does not correspond to the code - 01100101 in the example - then block (c) is returned to (cf. Fig. 3). The above-mentioned processes are repeated until the correct receiving byte comes up.

After the operable mode (h) is obtained, the probe cycle of Figure 3 is no longer carried out.

The alternative embodiments of the invention are not limited to the above described example but may be freely varied within the scope of the claims.

Accordingly, the infrared code signal transmission may be replaced by an inductive or a conductive electrical connection between the power tool itself and a code signal emitting device. This may be carried out by docking temporarily the power tool with the signal emitting device, thereby bringing an electric contact means on the power tool into a direct contact with a mating contact means on the signal emitting device.

Alternatively, the code signal receiver 7 and the control means 11 may be integrated with the replaceable battery unit 9, and the code signal emitting device is integrated with the charging device for the battery unit 9.

A further security feature for preventing unauthorized

use of the power tool is to have the code signal emitting device activated by a second code signal transferred via the mains power supply connected to the code signal emitting device.

Still another way of limiting the use of the power tool is to give the code signal certain operator definable characteristics.

Claims.

1. Electric power tool, comprising a device for alternatively disabling and enabling operation of the power tool,
characterized by a code signal receiver (7) and an electronic control means (11) supported on the power tool,
said control means (11) being arranged to be switched to an operable mode when a code signal (4) is received by said code signal receiver (7) and to be switched to an inoperable mode as the power supply voltage is discontinued or as a certain interval of operation has been completed, wherein said control means (11) remains in said inoperable mode until the code signal (4) is received by said code signal receiver (7).

2. Power tool according to claim 1, wherein said control means (11) comprises an operation cycle counter and a reference means intended to switch said control means (11) into said inoperable mode as a certain number of operation cycles have been performed, said number of operation cycles form said certain interval of operation.

3. Power tool according to claim 1 or 2, wherein said certain interval of operation is related to time.

4. Power tool according to claim 1, wherein said control means (11) continuously repeats a probe cycle (a -k) in said inoperable mode in which said code signal receiver (7) is continuously probed for the code signal each time the power tool is connected to the power supply voltage

or after said certain interval of operation has been completed, said probe cycle (a -k) checking whether the receiver (7) in fact receives said code signal (4) to thereby switch said control means into said operable mode, and in absence of said code signal maintain said control means (11) in said inoperable mode.

5. Power tool according to claim 4, wherein said probe cycle (a-k) is discontinued after a predetermined time interval if no code signal is received, whereby said control means (11) remains in said inoperable mode.

6. Power tool according to anyone of claims 1 to 5, wherein the power supply voltage is provided by a replaceable and rechargeable battery unit (9), and said code signal receiver (7) and said control means (11) are integrated with said battery unit (9).

7. Power tool according to claim 6, wherein said code signal transmitter (1) is integrated with a mains connected battery charging device (10).

8. Power tool according to anyone of claims 1 to 5, wherein the power supply voltage is provided by a replaceable and rechargeable battery unit (9), and said code signal transmitter (1) is integrated with a mains connected battery charging device (10).

9. Power tool according to anyone of claims 1 to 8, wherein said code signal transmitter (1) is connected to a mains power supply, and a second code signal is transmitted via the mains power supply to activate said

code signal transmitter (1).

10. Power tool according to anyone of claims 1 to 6, wherein the power supply voltage is provided by a mains power connection, and said code signal being transmitted via said mains power connection.

11. Power tool according to anyone of claims 1 to 6, wherein said code signal (4) is transmitted via a conductive electrical connection.

12. Power tool according to anyone of claims 1 to 6, wherein said code signal (4) is transmitted via an optical connection.

13. Power tool according to anyone of claims 1 to 6, wherein said code signal (4) is transmitted via a wireless electromagnetic connection.

14. Power tool according to anyone of claims 1-6, wherein a code signal emitting means is provided to deliver a code signal informing of operation data actually obtained during operation, and a stationary code signal receiver arranged to receive and store such data.

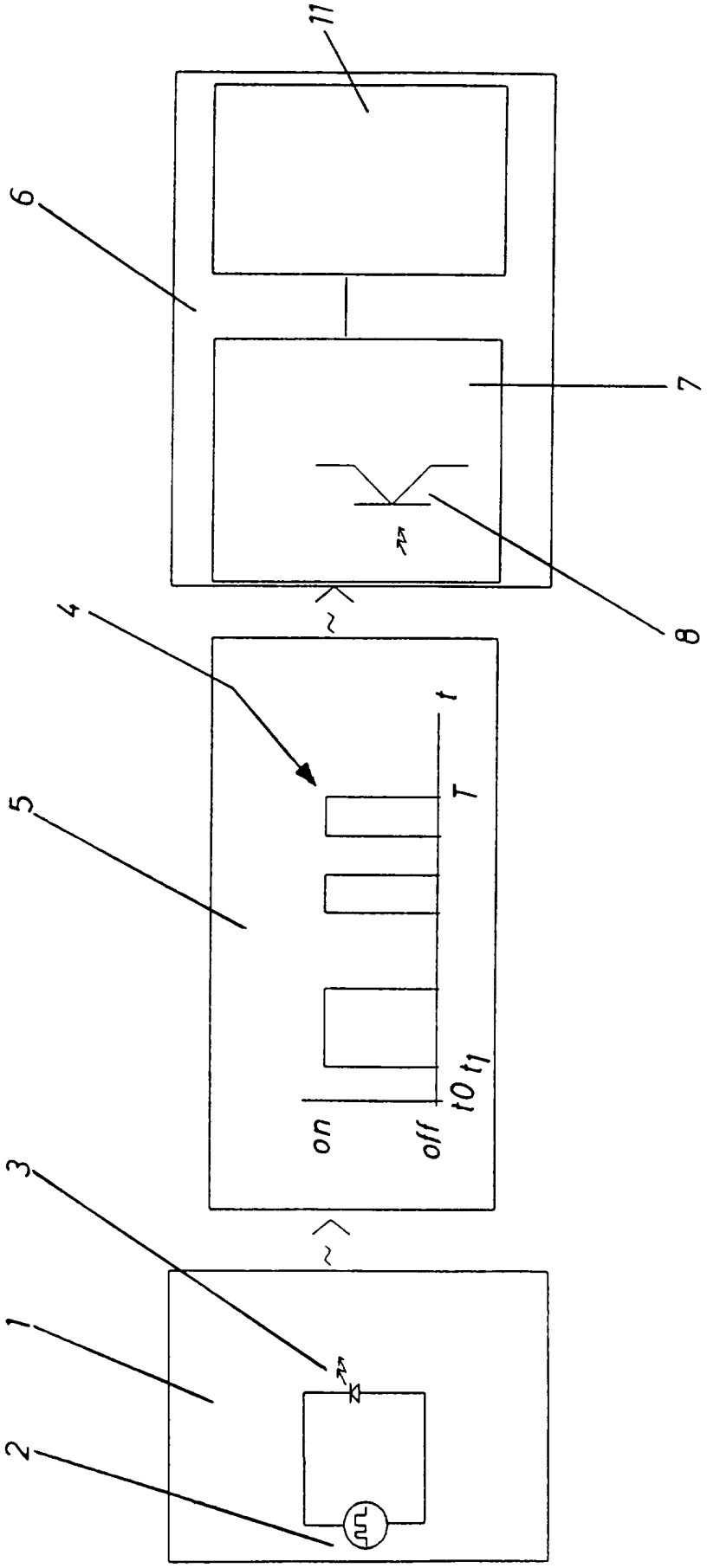


FIG 1

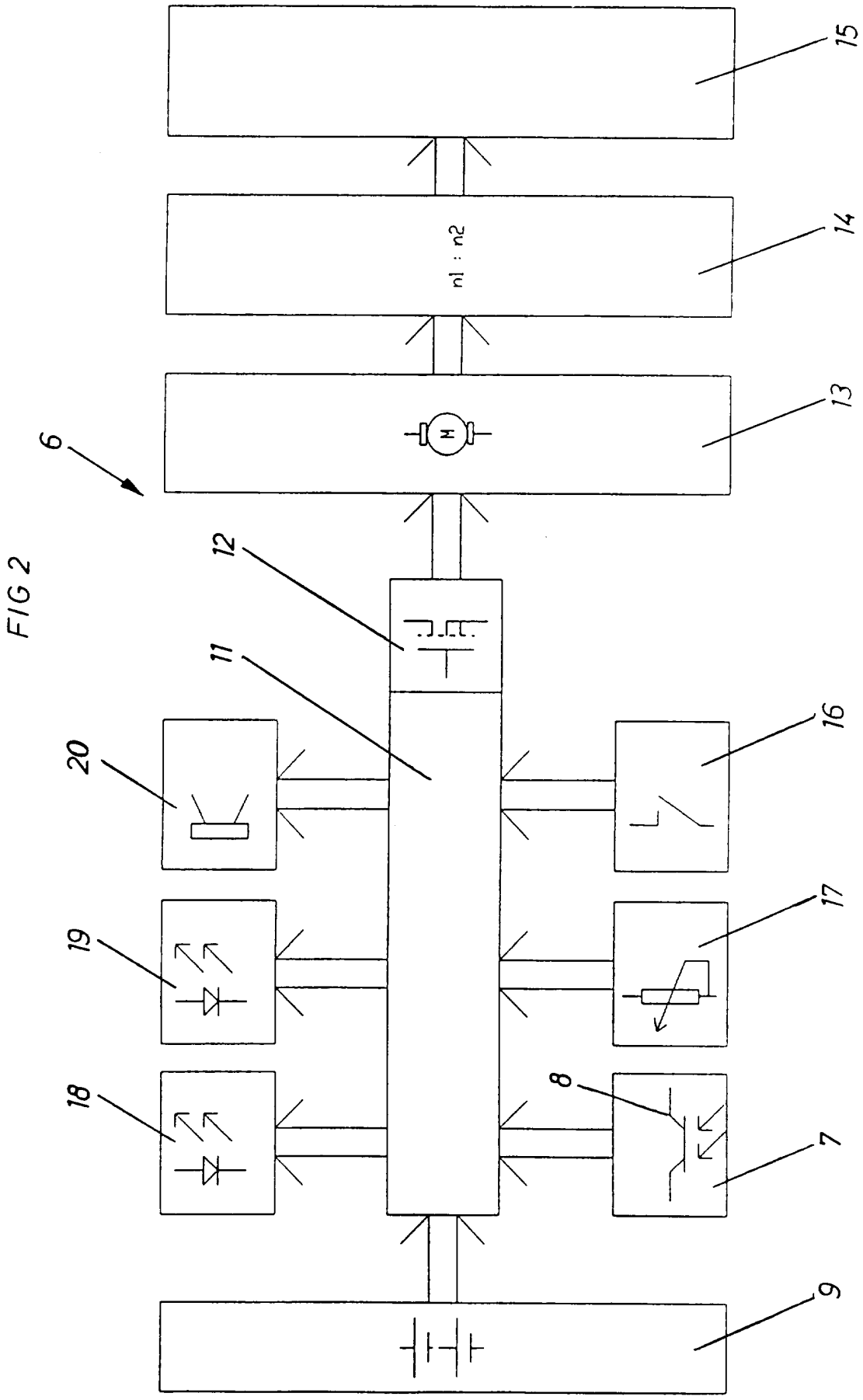
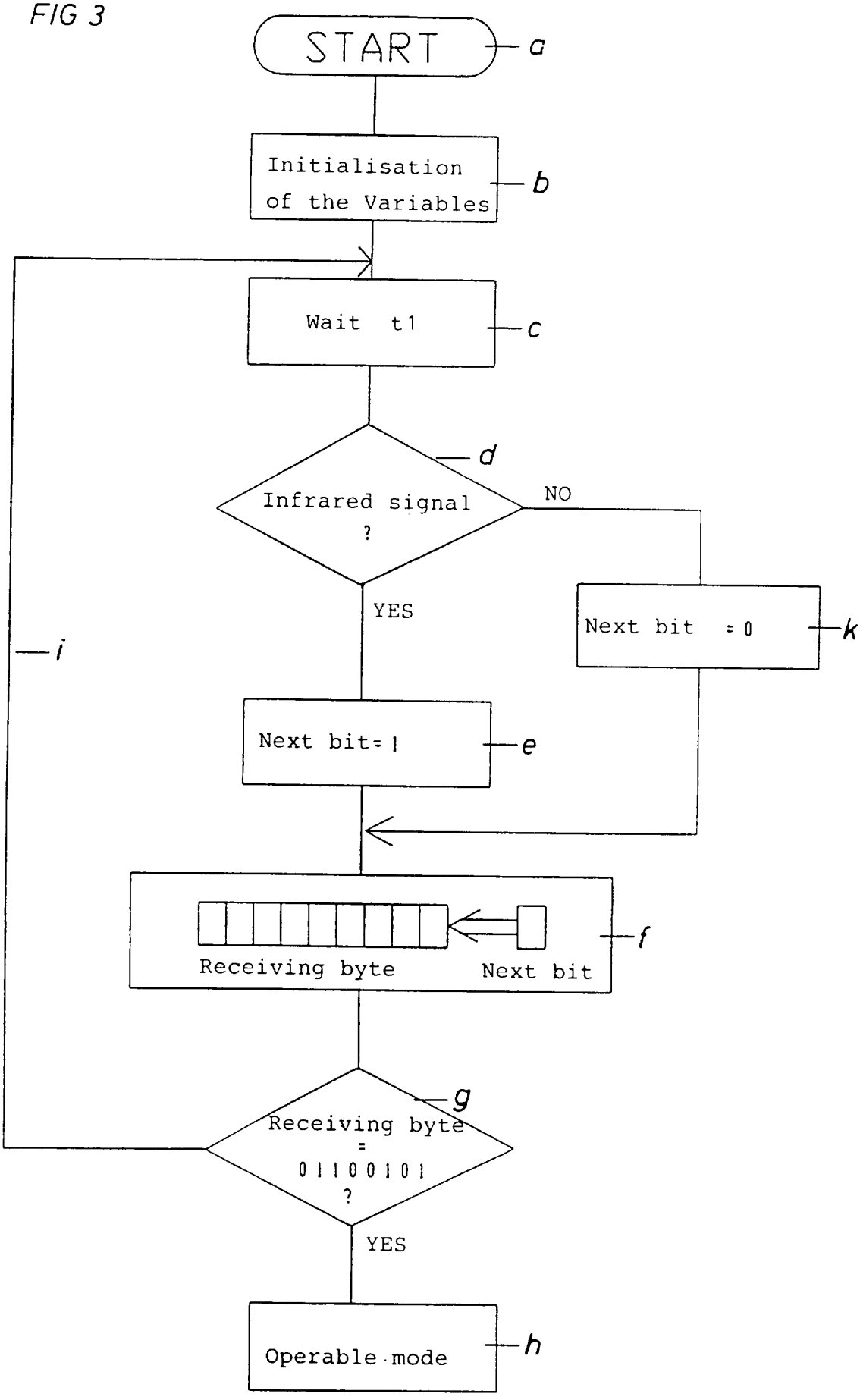


FIG 2

FIG 3


START
a
Initialisation of the Variables
b
Wait t1
c
d
Infrared signal ?
NO
YES
Next bit = 0
k
i
Next bit= 1
e
Receiving byte
Next bit
f
g
Receiving byte = 0 1 1 0 0 1 0 1 ?
YES
Operable mode
h

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 95/00932

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H02J 13/00, G08C 17/00, G08C 23/04
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)

IPC6: H02J, G08C

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9314550 A1 (EASY SHOPPING AB), 22 July 1993 (22.07.93), page 1, line 1 - page 8, line 15, figures 1-2, abstract --	1-14
X	GB 2229025 A (ELOCKTRONICS LIMITED), 12 Sept 1990 (12.09.90), page 1, line 1 - page 14, line 20, figures 1-5, abstract --	1-14
X	US 4791409 A (PHILIP L. REID), 13 December 1988 (13.12.88), column 1, line 36 - column 3, line 24, figures 1-2, abstract --	1-14

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

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4987406 A (PHILIP L. REID), 22 January 1991 (22.01.91), column 1, line 44 - column 4, line 34, figures 1-3, abstract -- --------	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

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		SE-A- 9200066	11/07/93
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