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(54) Inspection and investigation system for an object, such as a component of a rail way

(57) Object checking system comprising a memory unit containing data about the object to be checked, a data processing unit, a display unit and a data input unit, wherein said units mutually communicate through machine readable signals, such as electronic pulses, wherein the system is configured such that it shows with the display unit a complete image of the object, subdivided into fields, and subsequently, in reaction to input through the data input unit, shows with the display unit the components to be checked and belonging to a field in a predetermined manner stored in the memory and, dependent from the input through the data input unit, subsequently shows with the display unit a damage image list of a selected component, while preferably digitally operating.

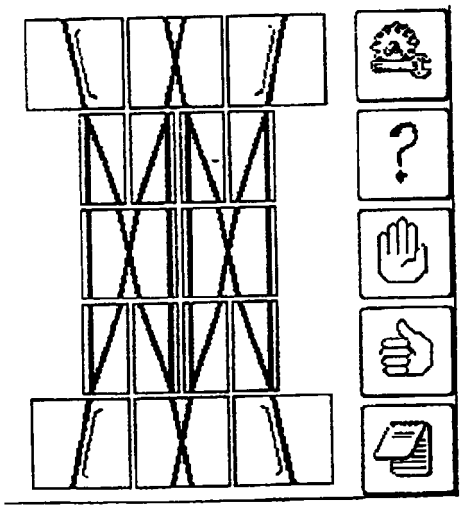

Fig. 2

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Description

[0001] The invention is concerned with an inspection and investigation system for an object, such as a component of a rail way. Particularly, the system is configured to examine the state of a moving or movable object. Preferably the system is configured to examine an object in the environment. Particularly the system is configured to examine a group of object types with similar function, the different objects of which are spread over a wide ground area, e.g. a county, each located at a fixed place.

[0002] In the following the invention is primarily illustrated by inspecting and/or investigating a component of a rail way, such as a rail way switch. However, the invention is not limited to this object type. The invention is similarly applicable to other object types, such as a robot arm or a traffic bridge or an airplane. The objects for which the system according to the invention is configured, are characterised by the high demands to their safety and reliability, for which reason they are typically checked with fixed frequency, e.g. once a week or month. Generally, frequent general checks (inspection) are alternated with intensive checks (investigation), the latter less frequent. E.g. a rail way switch is inspected each week and investigated each month. E.g. a passengers airplane is inspected prior to each flight and investigated after many flights.

[0003] In the following the term "checking" means inspecting or investigating and the term "check" means inspection or investigation, unless explicitly indicated differently.

[0004] With the present way of checking the operating person examines the object according to an individually selected sequence and reports, on the site, which aspects are insufficient in his view. On the basis of this examination the decision is made if the state of the object is sufficient to assure its reliablility and safety.

[0005] The inventors have found out after research that this way of acting leads to random examining of the state of the object. The present way of checking seems to put high demands to the skills of the operator to obtain a sufficient examining quality of the state of the checked object. It is therefor assumed that the examining quality of this way of checking is subject to strong changes.

[0006] The object of the invention is particularly to ensure that the quality of examining is at a high and hardly changing level. With the invention it is also made possible that afterwards it can be determined with a high level of certainty what the state of the object was at the moment of checking. This is relevant in connection with determining the liability, e.g. to an accident due to the insufficient state of the object.

[0007] The invention therefor relates to, as particularly indicated in the enclosed claims, an automatic system with a permanent memory unit in which data is stored about the object to be checked and with a data processing unit and with possibly a temporary or processing memory unit retrieving data from the memory on the basis of which it sends a query to the operator through a display means, which query must be answered by the operator by inputting into the system one or more data through input means, after which, preferably dependent from the given answer, the data processing unit proceeds to the next query or ends the query. Predetermined data relating to the entered answer can be stored by the data processing unit in the processing or permanent memory for later processing. The different system components, such as permanent memory unit, processing memory unit and data processing unit mutually communicate by means of machine readable signals, such as electronic pulses. The system can be e.g. a computer loaded with convenient software, e.g. with a touch screen, such that answering the query is primarily carried out by touching the screen at the desired location. An example of this is a so called Pen Based Computer (PBC), preferably of the so called palmtop type, which is easily hand held. The data input is preferably menu controlled. Each time when the computer is initiated the software, or parts thereof, is loaded into the processing memory to control the data processing unit. Controlled by the software the data processing unit retrieves data from the permanent memory, takes care of showing stored data, processing and/or memorising into the permanent memory of the input data, etc. The system specific software can be supported by a convenient general purpose operating system, such as DOS or Windows.

[0008] The computer can be of conventional type with, a.o., a CPU for complete operation of the system; a ROM memorising an operating program for controlling the processes carried out by the CPU; a RAM for memorising data during an process carried out by the CPU; a digitizer for detection of the location where the screen is touched; a LCD screen; a I/O controller to which the digitizer and the screen are connected and functioning as an interface for data input/output; and a timer to determine a time. The permanent memory can be an easily replacable diskette or similar disk shaped memorising medium or any other equivalent known to the skilled person, located in a reading unit.

[0009] Preferably, the systems contains a means for uniquely determining the location where the operator was located at the time of carrying out the check. Such means can comprise a GPS or DGPS receiver or such, from which the system can automatically determine its location. An alternative can be a reading unit for machine reading of a michine readable mark or code, e.g. a bar code reader for automatical input of a bar code. The reading unit can be designed for reading an optical, magnetical, acoustical or any other possible machine readable mark type. The object, or a body in its immediate vicinity, can be equipped withsaid mark for machine reading. In this way unique identification is possible of the object, without requiring the human inter-

ference (causing mistakes). Also, tampering is made impossible in this way and proof without doubt can be provided that the operator was indeed present near the object at the time of checking. Preferably further data are gathered at the time of this identification, such as location, date and time.

[0010] An alternative to independent unique determination that the operator was present during checking, is e.g. a masterslave system: During checking the slave system operating at the site sends a signal to a remote master system, in reatcion thereto reporting a number of relevant data, such as time of signal receipt. The slave system itself also e.g. reports a number of relevant data concerning sending of the signal, e.g. also the time. Subsequently the data reported by the master and slave systems are compared and/or combined to substract thereform the desired unique proof.

[0011] Preferably the system is configured and is operated such that the object is checked according to a predetermined sequence, for which the object is preferably subdevided in predetermined sub objects, also called fields. Within a field each of a predetermined parts is examined to its state. After examining each said parts, the system shifts towards the next field. It is preferable that the fields are defined such that within a group of objects with equivalent function, such as all types of railway switches of the public rail road of The Netherlands, or all types of tilting bridges of the public roads of The Netherlands, the different object types have at least one field in common. With this, substantial savings can be possible, such as to permanent memory space, making the data base, processing the examining results, etc. Subdivision into fiels also offers increased possibilities of digitizing the data input and processing such that a computer supported check is made possible. Apart from that, the actions to be carried out by the operator during checking are better structured.

[0012] With a view to examining the object subdivided into fields it is prefered that the software and/or the object data in the permanent memory space of the system is configured or are stored, respectively, such that the object data can be or are allocated to a predetermined field. With this, the software controls the processing unit preferably such that each time data belonging to one field are retrieved from the permanent memory until said field is finished, whereafter the data belonging to a subsequent field are retrieved. In this way the operator is forced by the software to reproducible carry out the check. The query is preferably visually carried out, e.g. by showing on a screen. As an alternative the query is audible by e.g. a mechanic voice. The answers are preferably manually input, preferably by touching the screen. As an alternative the answer is input by making a cursor move over the screen by manipulating the arrow keys or a mouse. Another alternative is that the answers are orally given and by speech recognition transferred into the digital code processable by the system.

[0013] Furthermore the system comprises preferably further information about the object, that can be retrieved by the operator at wish, e.g. for further support to decide about a damage image.

[0014] Further advantages of the system are:

- It can be used for each random object that is input in the data base;
- An object is uniformly and systematically checked;
- The information is directly reporetd in machine processable format;
- The information can be quickly processed;
- The information can be processed and made available according to desire;
- The operator can retrieve further technical information; It is possible to tamper free proof that the check is carried out, when, where and what the results of it are;
- The field structure is versatile;
- Reliable and/or quick and/or easy use, also in the open air, is possible without doubt.

[0015] In the following the invention is further illustrated by a non-limiting embodiment, referring to the enclosed drawing, showing in:

Fig. 1 a screen display of a right-hand railway switch;
Fig. 2 a screen display of an English type switch;
Fig. 3 a screen display of an input display of a first query list of a field of the switch of fig. 2;
Fig. 4 a screen display of an input display of an underlying query list of the field of fig. 3;
Fig. 5 a screen display of an input display to input a general conclusion.

[0016] Fig. 1 shows the possible subdivision into seven fields of a right-hand railway switch. This right-hand railway switch has a number of fields in common with a left-hand switch and also with an English type switch (fig. 2). E.g. the fields 6 for the nose and 5 and 7 for the check rails. The fields 1 and 2 for the left-hand and right-hand tongue and 3 and 4 for the left-hand and right-hand bow are mirror images of the corresponding fields of a left-hand switch, such that also these fields are common for a right-hand and left-hand switch. These four fields are absent with an English type switch. The English type switch (fig. 2) is in this example provided by a total of fourteen fields, a number of which is mutually identical (symmetrical or mirror symmetrical).

[0017] Each field contains general information, equal to all switch types with said field, and specific information, dependent on the switch type. E.g. the general information of field 6 for the nose contains the slit width, while the specific information learns if it is movable or fixed. The skilled person will understand how to configure the data base of the system and retrieval of the data thereof such as to combine for the specific

switch type (object type) the general information of a field with the switch specific (object specific) information of that same field.

[0018] Due to the common character of the fields and the difference between general and specific information, the required single data input in the permanent memory of the system for a plurality of objects of similar type, such as all railway switches in The Netherlands can, despite mutual differences between said types, be substantially limited. For, merely the switch specific information must be input seperately for each switch type. In this way it is possible, that of the object group stored in the permanent memory unit of the system, each object exists of X fields while in the permanent memory unit Y fields are stored, wherein each of the Y fields belongs to at least one object and wherein Y>X, particularly Y>X+2 fields.

[0019] It is assumed that the system runs on a PBC. Upon arrival at the object to be checked, the operator first ensures that the PBC reads the code, such as bar code, at or near the object, or otherwise identifies the object, e.g. by determining the position with GPS. If the operator manually inputs the identification code of the object, the system automatically adds a feature to said input, such that later on it is always possible to determine that the identification is carried out by active intervention of the operator and thus is prone to tampering. On the basis of the identification the data precessing unit retrieves the data belonging to the machine identified object from the permanent memory and provides that an image of the object, stored in the memory, is preferably completely shown on the screen, possibly in combination with menu-control commands, such as icons. Simultaneously with showing the object the display unit preferably shows the field distribution of the object.

[0020] By touching the screen at the location where the selected field of the checked object is positioned, the information belonging to said field is retrieved from the memory unit and displayed by the display unit (fig. 3). The part of the object within the field is now displayed on the screen on a much smaller scale. Simultaneously a list appears on the screen concerning the field, containing a predetermined number of technical components in said field of the object that must be examined during the check. For each component the operator can, by touching the screen at the corresponding location, indicate if it has passed (choice G) or fails (choice F) or that answering is not applicable for this component in this field (choice N). Preferably each component has the default value that it has passed, such that the operator merely needs to answer if he determines a failure. By touching the screen at the location of the arrows the operator jumps from the one to the next component on the screen.

[0021] By way of alternative the components to be checked can be indicated within the display on the screen of the part of the object within the retrieved field, such as with convenient markers, such as arrows. The list shown in fig. 3 can then be eliminated and the image of the field e.g. be at least substantially completely filling the screen. By touching the screen each time at the relevant location e.g. the query is displayed if the component is right or wrong.

[0022] When the check of a component is completed, the system returns to a prior display and the checked component is displayed recognisable as checked, for which an attributed display feature applied by the system, such as a display colour or brightness, is correspondingly adapted in the system.

[0023] If for a determined component the input concerns a failure, a next input display is automatically displayed, in which it is possible to input a damage image of said component. The operator can select between several predetermined damage image criteria, as shown. Again by touching the screen at the corresponding location the operator can input his conclusions. Only when the operator has input all answers to the query, the system automatically jumps back to a prior display. This is repeated until all components of the field have been checked. Only then the system gives permission to automatically return to a prior display, such as the complete image of the object. The field for which the check is completed is displayed such that it will be recognised as checked, for which an attributed display feature applied by the system, such as a display colour or brightness, is correspondingly adapted in the system.

[0024] The system is preferably configured such that when the check of a component is completed, it can no longer be retrieved for repeated check before the check of the complete object is completed. The same can be true for a field for which the check is completed. By this the reliability of the check is improved.

[0025] When the component to be checked is e.g. multiple, e.g. when it concerns more than one bolt with e.g. the same function, a jump is made toward a next display (not shown), in which it is possible to indicate the amount of the damage image (e.g. 100% of the bolts being broken). In relation to a multiple component it is also possible to input more answers into the damage image display, e.g. when one or a number of bolts is broken while one or a number of bolts is missing. In the damage image display the relating answer can be input for each.

[0026] A damage image display can e.g. also be applied when the damage can be present at different locations of the component. E.g. the component can contain one or more flaws, present within the one or the other distance range from a predetermined reference location. The display will then offer the possibility to select among several predetermined distance ranges.

[0027] When all fields are processed in this way, the state of the components to be checked is digitally reported. These digital data can then be statistically analysed by the system itself and after evaluation yield a conclusion. Alternatively or adding thereto the oprator

can be given the opportunity to input his conclusion (fig. 5). The statistical analysis can possibly be carried out in a host-system, for which the relevant data are transferred into e.g. a desk top PC. The system therefor includes convenient output means for data supply to an external CPU.

[0028] Intermediate ending of the check before all fields have been processed, is preferably merely possible by positive selection, to which the system forces the operator, e.g. by showing a stop display and quering again of premature ending is desired.

[0029] To end, the system can request the operator his proof, e.g. by input of a operator specific code. In this way the operator is made formally responsible, that he himself has carried out the check, and can be reminded of it lateron. One of the possibilities in this connection is e.g. to input a password or such. E.g. the data input is stored in a protected memory area that can only be written by the relevant operator.

[0030] Thus, the system ensures that the operator carries out the check in a uniform manner, wherein each time the operator can select between a limited number of predetermined damage images for each component and thus the required control of the system is as easy as possible.

Claims

1. Object checking system comprising a memory unit containing data about the object to be checked, a data processing unit, a display unit and a data input unit, wherein said units mutually communicate through machine readable signals, such as electronic pulses, wherein the system is configured such that it shows with the display unit a complete image of the object, subdivided into fields, and subsequently, in reaction to input through the data input unit, shows with the display unit the components to be checked and belonging to a field in a predetermined manner stored in the memory and, dependent from the input through the data input unit, subsequently shows with the display unit a damage image list of a selected component, while preferably digitally operating.

2. System according to claim 1, wherein during display of the display unit of either the object or the components to be checked or the damage image list, the input unit merely allows the input of predetermined data, while preferably said predetermined data is a selection between a number of predetermined selection possibilities, shown by the display unit and retrieved from the memory unit.

3. System according to claim 2, wherein among said predetermined selection possibilities at least one is related to a value, such as a ratio or dimension or a range thereof, while preferably among said predetermined selection possibilities at least one is related to the good or bad state of the relevant component.

4. System according to any of the preceeding claims, wherein the memory unit contains data about a range of objects with the same function, but mutually differing in one or more details, such as all railway switches of the public railway of The Netherlands, and preferably wherein the data are stored in the memory unit such that all information in a field that is in common for all objects belonging to said group is immediately attributed to the respective field while the for an object specific information in a field is attributed to said field through said object such that when storing into the memory unit of an added object of the same function, it is merely required to input the data which fields are applicable to said object and to input the object specific information.

5. System according to any of the preceeding claims, wherein it comprises a means for independent determination of its location while carrying out said check, such as a receiver for GPS or DGPS for determining the general position coordinates or a bar code reader to identify the object to be checked such that the location can be determined therefrom.

6. System according to any of the preceeding claims, configured as a computer that can easily be held in one hand and simultaneously operated with tough screen and preferably constructed leak water tight and impact resistant.

7. System according to any of the preceeding claims, wherein each object of the group of objects stored in the system consists of X fields while in the permanent memory unit Y fields are stored, wherein each of the Y fields belongs to at least one object and wherein Y>X, particularly Y>X+2 fields.

8. System according to any of the preceeding claims, wherein the system only gives permission to return to a prior display by the display unit when all quered input for the momentarily displayed subject is input.

9. System according to any of the preceeding claims, wherein an image shown by the display unit, the quered input of which is completed, is shown to be recognised as completed, for which a corresponding display feature, such as a colour or brightness feature of the system, is automatically adapted by the system.

10. At a fixed location in the external environment positioned, movable object, that has to be checked frequently for its reliable and safe functioning, such as

a traffic bridge or a railway switch, equipped with a machine readable code applied for independent determining the location by the system according to any of the preceeding claims.

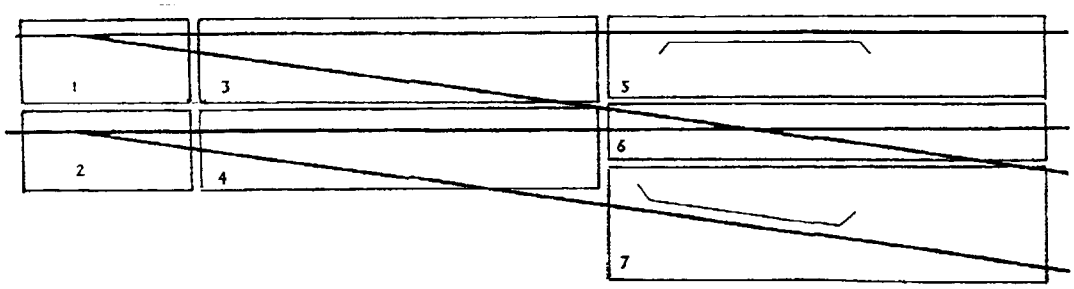

Fig. 1

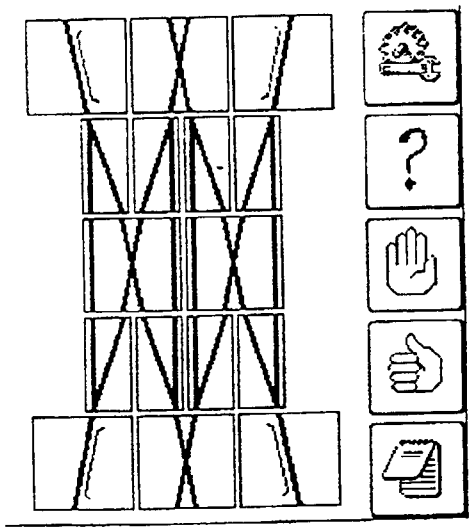

Fig. 2

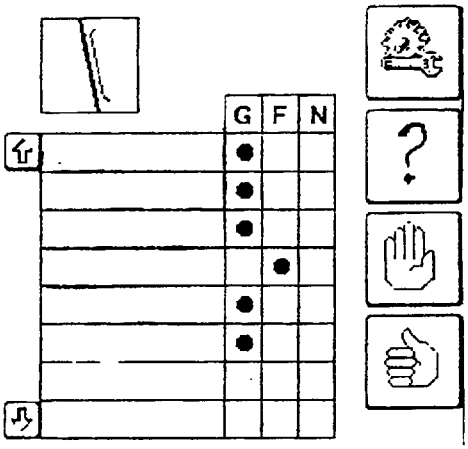

Fig. 3

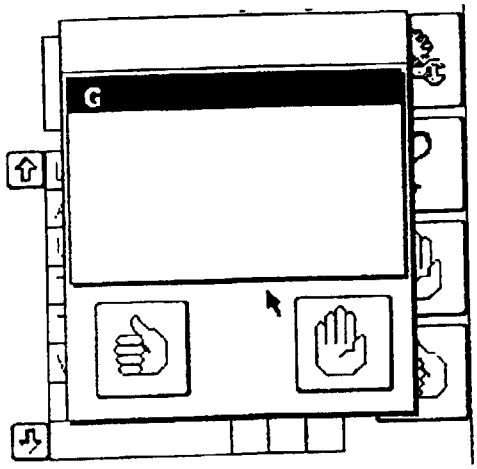

Fig. 4

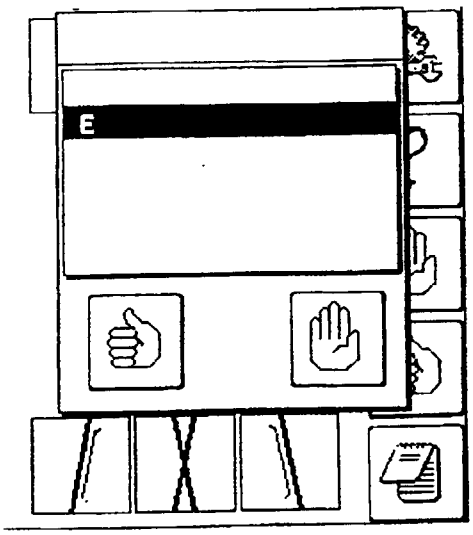

Fig. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 20 2954

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DE 41 37 742 A (MURATA MACHINERY LTD) 21 May 1992 (1992-05-21) * column 3, line 36 - column 5, line 65; figures 1-3 *	1,10	G07C3/00 B61K9/00 B61L23/04
A	DE 44 27 880 A (STADELMANN KURT) 15 February 1996 (1996-02-15) * column 6, line 58 - column 8, line 13; figures 1,2 *	1,10	
A	US 5 581 486 A (KAWAZU YUKIO ET AL) 3 December 1996 (1996-12-03) * column 3, line 28 - column 5, line 47; figures 1-5 *	1,10	
A	US 4 809 200 A (MOORE BILL V ET AL) 28 February 1989 (1989-02-28) * column 3, line 29 - column 6, line 24; figures 1-6 *	1,10	
A	WO 96 08437 A (KONE OY ;TAMMINEN AKI (FI); HUOTARI PETRI (FI); HEIKKILAE KIMMO (F) 21 March 1996 (1996-03-21) * page 4, line 24 - page 6, line 6; figures 1,2 *	1,10	TECHNICAL FIELDS SEARCHED (Int.Cl.7) G07C B61K B61L E01B B62D
A	DE 297 02 604 U (SCHALTBAU AG) 3 April 1997 (1997-04-03) * page 2, line 5 - page 3, paragraph 3 *	1,10	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 November 2000	Chlosta, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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24-11-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4137742 A	21-05-1992	JP 4180184 A	26-06-1992
		IT 1250138 B	30-03-1995
DE 4427880 A	15-02-1996	NONE	
US 5581486 A	03-12-1996	JP 6169192 A	14-06-1994
		DE 69318113 D	28-05-1998
		DE 69318113 T	03-09-1998
		EP 0600663 A	08-06-1994
US 4809200 A	28-02-1989	NONE	
WO 9608437 A	21-03-1996	FI 944294 A	17-03-1996
		AU 3389595 A	29-03-1996
DE 29702604 U	03-04-1997	NONE	

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