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- (73) Patenthaver: **VERMOP Salmon GmbH, Zeppelinstrasse 24, 82205 Gilching, Tyskland**
- (72) Opfinder: **Salmon, Dirk, Zeppelinstr. 24, 82205 Gilching, Tyskland**
- (74) Fuldmægtig i Danmark: **Plougmann Vingtoft A/S, Rued Langgaards Vej 8, 2300 København S, Danmark**
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Cleaning system with motion and position detection

Field of the invention

The invention relates to a cleaning system with motion and position detection.

State of the art

In the field of professional cleaning, questions of logistics, scheduling and property monitoring, but also low-cost training of cleaning personnel, are becoming more and more important. Thus, in a cleaning team there must be an overview of where which cleaner is located and, in the case of work to be carried out immediately, a decision on which cleaner will be entrusted with a certain task at short notice must be taken. For this it is necessary to have knowledge of the whereabouts of the individual cleaners. This is conventionally determined using preset schedules from which, on looking through the schedules, it can be established which cleaner is located in which part of the building at a certain time.

A further problem lies in that certain cleaning tools must be moved in a certain manner in order to be able to obtain the best possible cleaning effect. As an example of this, a mop which must be guided in a certain loop-like motion in order to obtain the best possible cleaning effect may be mentioned. Here too there is a need for a supervisor who not only monitors the logistics and scheduling, but also takes care that the cleaning work as such is carried out efficiently.

There is a need for optimising complex cleaning tasks in particular on larger properties using a large number of cleaners.

A cleaning system with a position detection system is known from DE 10 2010 060 347 A. The automatically movable cleaning tool for floor cleaning described in this is a suction and/or sweeping robot which has a sensor for measuring a distance from an object and compares a predefined distance with the distance measured by the sensor.

US 2006/140703 A1 describes a cleaning system which shows the closest state of the art.

Subject of the invention

It is the object of the invention to optimise a cleaning system to the effect that complex cleaning processes can be carried out more efficiently. This object is achieved by a cleaning system having the characteristics of claim 1. Preferred embodiments follow from the remaining claims.

According to the invention, a cleaning system with motion and/or position detection is characterised in that it comprises an evaluating device in at least one cleaning utensil. The at least one cleaning utensil has at least one motion sensor mechanism as well as a data transfer module, wherein the motion sensor mechanism detects the motion of the cleaning utensil and the data transfer module is suitable for transmitting data wirelessly to the evaluating unit, preferably by a near field communication (NFC) transmission method or by Bluetooth.

By means of the motion sensor mechanism the motion of the cleaning utensil is detected. From the motion of the cleaning utensil, the position of the cleaning utensil can be determined, but also, within the framework of training, the correct motion sequence when operating the cleaning utensil can be studied. By means of a data transfer module, the data generated by the motion sensor mechanism can be wirelessly transmitted to the evaluating device, where these various evaluations can be delivered.

The data transfer module can use any common technology and any common standard for wireless data transmission. Simply as examples, Bluetooth Low Energy and Bluetooth ANT+ may be mentioned. Here, wireless communication can take place using a wireless communication protocol such as IEEE 802.11-compliant wireless local network protocol, a mobile communication protocol such as WiMAX, LTE or other ITU-R-compatible protocol, a short-wave radio communication protocol such as near field communication (NFC) or a wireless process control protocol such as WirelessHART, to mention just the commonest examples.

The cleaning utensil here can be a manually operated cleaning tool, e.g. a mop, while the evaluating device is located in the associated cleaning trolley. But in the same way it is equally possible for the cleaning utensil with the motion sensor mechanism to be a cleaning trolley and for the evaluating device to be stationary and located e.g. in a building to be cleaned.

According to a preferred embodiment of the invention, the motion sensor mechanism comprises inertia sensors and gyroscopes. By means of initial sensors and gyroscopes of this kind, the motion and orientation of the cleaning utensil can be detected and a position can be calculated from the data recorded and transmitted to the evaluating device.

Here, it is preferred that the motion sensor mechanism comprises three inertia sensors which are arranged orthogonally to each other and oriented on the three spatial axes, and also three gyroscopes which are arranged orthogonally to each other and also oriented on the three spatial axes. Due to the predefined positioning of the inertia sensors and gyroscopes orthogonally to each other, a complex motion sequence of the cleaning utensil can be calculated with a precision which is high enough to be able to detect the desired information on the position of the cleaning utensil, but also for training purposes the desired information on the motion sequence of the cleaning utensil.

According to a preferred embodiment, the cleaning utensil is a cleaning trolley and the motion sensor mechanism comprises a pulse generator as well as a direction-of-rotation sensor in a rotatable wheel of the cleaning trolley. The use of a pulse generator as well as a direction-of-rotation sensor in a rotatable wheel is a very simple way of being able to follow the position of the cleaning trolley. Here, the distance covered is detected by means of the pulse generator in the rotatable wheel, and the direction of motion taken within a timed interval is detected by means of the direction-of-rotation sensor in the rotatable wheel.

Furthermore, the cleaning system further comprises a position detecting device, preferably a GPS sensor (global positioning system). The use of a GPS sensor can be used to correct evaluation errors which occur when calculating the position of the cleaning utensil from the data provided by the at least one motion sensor mechanism, and add up over a longer time. By means of a GPS sensor, at predetermined intervals a comparison can be made between the position determined by means of the GPS sensor and the position calculated on the basis of the motion sensor mechanism.

Furthermore, the motion sensor mechanism comprises a sensor for magnetic field strength. This serves to carry out terminal-based radio positioning, e.g. by Wi-Fi. For this, the evaluating unit has a map with field strengths and positions of radio transmitters, e.g. Wi-Fi access points, and then calculates, from the currently measured magnetic field strengths which the sensor for magnetic field strength provided on the cleaning utensil detects and delivers via the data transfer module to the evaluating device, a position which can likewise be compared with the position which is calculated on the basis of the data delivered by the motion sensor mechanism.

For this, the position detecting device comprises a server-based radio positioning system which detects the field strengths and, by mapping of the positions of radio transmitters and their field strengths, which is filed in a memory of the evaluating device, calculates the position of the cleaning utensil.

An alternative lies in that the cleaning utensils communicate with each other and with the evaluating device via a mobile telephone network. For this, the cleaning utensils can be provided with SIM cards, which allows data transfer without delay. The cleaning utensils equipped with a SIM card can send the data to a cloud from which data can be retrieved and passed on by means of predefined access rights.

According to a preferred embodiment of the invention, the cleaning utensil has at least two spaced-apart motion sensor mechanisms which are mounted at such positions of the cleaning utensil that, when the cleaning utensil is used properly, display different, characteristic motion sequences of the cleaning utensil. If the cleaning utensil is a mop holder which is held on a handle by the cleaner and guided in a loop over the surface to be cleaned, for example a first motion sensor mechanism can be arranged at the top of the handle, while the second motion sensor mechanism is arranged on the mop holder at a point close to the

mop cover. If the motion sequences which are obtained with the first motion sensor mechanism as well as the second motion sensor mechanism and transmitted from the data transfer module to the evaluating device are now analysed in the evaluating device, the motion sequence determined by computer as a result can be compared with an ideal motion sequence filed in the memory of the evaluating device. Within the framework of training, the motion sequence can be analysed and improved. This of course applies in the same way to other cleaning tools as well, e.g. guiding a squeegee when cleaning large window surfaces which optimally likewise follow a complex motion sequence.

According to an embodiment of the invention, the evaluating device is stationary. By means of a stationary evaluating device, the logistics, scheduling and property monitoring can be carried out from a central position. Thus for numerous cleaning utensils which are each assigned to different cleaners, the position of the individual cleaners in a property can be detected and displayed in real time. In the case of cleaning tasks to be done at short notice, the scheduling can easily be altered and the cleaner who, from the spatial point of view, is best suited to taking over a certain task, can be informed. Furthermore, the cleaning work done can be proved to a client by the fact that the surface area actually covered is detected.

According to a preferred embodiment, a receiving module is provided on the cleaning utensil and suitable for receiving data from the evaluating unit. In this way e.g. feedback can be given to the respective cleaner, within the framework of checking the correct motion too, wherein preferably an output interface is provided on the cleaning utensil in order to allow an optical and/or acoustic signal output.

A further preferred embodiment of the invention lies in that the data transfer module as well as an authentication unit cooperating with the data transfer module is additionally suitable for communicating with one or more access control devices for authentication of the cleaning utensil. In this way the targeted access to hygienic areas can be regulated and controlled. For example, in the case of certain hygienic areas, by refusal of access it is possible to prevent a cleaning utensil not intended for cleaning a certain hygienic area from being taken into the hygienic area.

Brief description of the drawings

Below, the invention is described purely by way of example with reference to a few practical examples with reference to drawings in which

Figure 1 shows schematically a cleaning trolley as well as a wiping system, between which data are transmitted;

Figure 2 shows schematically the handle of a cleaning tool for indicating possible positions for motion sensors;

Figure 3 shows schematically the joint region of a mop holder; and

Figure 4 shows the networking of a plurality of cleaning utensils.

Ways of carrying out the invention

In Figure 1 a cleaning trolley 10 and a mop holder 12 are shown schematically. The mop holder 12 in this embodiment is meant only as an example, and in the same way it can be any other cleaning tool which communicates with an evaluating unit 20 arranged on the cleaning trolley 10.

The mop holder 12 has three motion sensor mechanisms 14, 16 and 18 which are arranged at a suitable location. In the practical example of Figure 1, this is the hand grip 22 in which the motion sensor mechanism 14 is embedded, the handle 24 in which the motion sensor mechanism 16 is located, and the wiper plate 26 on or in the motion sensor mechanism 18. Each motion sensor mechanism 14, 16 and 18 is suitable for detecting the local status of motion of the mop holder 12. In the practical example of Figure 1, each individual motion sensor mechanism 14, 16 and 18 comprises three orthogonally arranged inertia sensors which are oriented on the three spatial axes as well as three gyroscopes which are arranged orthogonally to each other and likewise oriented on the three spatial axes. Furthermore, either each individual motion sensor mechanism 14, 16, 18 is assigned a data transfer module 30 or, as shown schematically in Figure 1, in the region of the handle 24 is provided a central data transfer module 30 by means of which the data obtained from the motion sensor mechanisms 14, 16, 18 are transmitted to the evaluating unit 20 in the cleaning trolley 10. For receiving the data sent by the data transfer module 30, on the cleaning trolley 10 is provided a communication module 28 which is in data communication with the evaluating unit 20. Furthermore, the evaluating unit 20 can be assigned a data memory 32, preferably in the form of a memory chip.

In the embodiment according to Figure 1 the mop holder 12 can also receive data. For this, a schematically shown receiving module 36 which is connected to a signal generator 38 which can output an acoustic and/or optical signal is provided.

Data exchange between the evaluating unit 20 in the cleaning trolley 10 and the mop holder 12 can use all conventional technologies for wireless data transmission. On account of the usual proximity between the cleaning trolley 10 and the mop holder 12, however, data transmission technologies with a low energy density are particularly suitable. Examples of such data transmission protocols are short-wave radio communication protocols such as near field communication (NFC) or Bluetooth, in particular Bluetooth Low Energy and Bluetooth ANT+.

The configuration as shown in Figure 1 is particularly suitable for training in the motion sequence when using the mop holder 12. For this, an ideal reference motion is filed in the data memory 32 which is in data exchange with the evaluating unit 20. If the mop holder 12 is now actuated, typical motion patterns which follow different patterns depending on the position of the motion sensor mechanisms 14, 16, 18 arise. These data provided on the motion sensors assigned to the motion sensor mechanisms are transmitted wirelessly from the data transfer module 30 to the communication module 28 and delivered to the evaluating unit 20 which processes the transmitted motion data using a suitable software program and compares them with the reference data for the motion sequence filed in the data memory 32. Depending on the nominal deviation determined between the actual motion and the reference motion and with respect to the tolerated deviation which is predetermined here, via the communication module 28 a feedback signal is sent to the receiving module 36 in the mop holder 12, which is suitably outputted for the user via the signal generator 38. Thus for example an acoustic signal can be outputted when the motion sequence deviates from the ideal motion sequence beyond a predetermined tolerance deviation.

Both in the cleaning trolley 10 and in the mop holder 12 can be provided suitable energy sources such as accumulators with which the electronic components, but also a possible signal generator, are supplied with energy. In the case of the cleaning trolley 10, one of the wheels 42 can be assigned a dynamo 14 which supplies the electronic components of the cleaning trolley with energy. But in the case of the mop holder 12, the energy needed can also be generated in a conventional manner by the motion of the handle itself and buffered in an accumulator.

In the embodiment according to Figure 1, the motion sensor mechanisms 14, 16 and 18 are located both in the handle and on or in the wiper plate 26. But in order to be able to detect the desired motion sequence of the mop holder or other cleaning utensil, two or more motion sensor mechanisms of a cleaning utensil can be arranged in the handle 24 only. This has the advantage that a handle of this kind, which is expensive on account of the electronic components located in it, can be coupled to different cleaning heads, wherein via a suitable identification interface 44 which communicates with a passive component, preferably an RFID chip on the cleaning head, the type of cleaning head can be detected. The identification interface 44 forwards this information to the data transfer module 30 in the handle (see Figure 1), so that the evaluating unit 20 on the cleaning trolley 10 receives the information as to which cleaning head the handle 24 is coupled to at the time.

The embodiment shown in Figure 3 is different in that, unlike the embodiments according to Figures 1 and 2, the motion sensor mechanism 18 is assigned to the universal joint 46 between the handle and the wiper plate 26. In this case angle sensors which detect the respective angle states in the universal joint 46 continuously or in a short time sequence and deliver them to the data transfer module 30 can be used.

In the embodiment shown in Figure 4, the evaluating unit 20 is stationary, e.g. arranged in a building complex to be cleaned. The cleaning utensils in this case are a plurality of cleaning trolleys 10a, 10b, 10c, but also a mop holder 12a. Between a communication module 28 assigned to the evaluating unit 20 and corresponding data transfer modules 30 in all of the cleaning utensils 10a, 10b, 10c, 12a there is data communication. In larger building complexes, a radio communication protocol such as near field communication or Bluetooth is no longer suitable for this, but preferably the WLAN (wireless local area network) which already exists in larger buildings is used for data exchange.

The individual cleaning utensils 10a, 10b, 10c and 12a can, as in the manner described with reference to Figure 1, be equipped each with at least one motion sensor mechanism which, in the case of the embodiment according to Figure 4, serves to determine the position of the individual cleaning utensils in a building complex. The data from one or more accelerometers and from one or more gyroscopes which receive data from a magnetometer therefore serve to determine the position and hence orientation of the mobile cleaning utensils 10a, 10b, 10c and 12a. The data obtained in this case are delivered to the evaluation unit 20 which can file these data in a memory and suitably display them in real time on a monitor 48. Thus for example the positions of the individual cleaning utensils 10a, 10b, 10c and 12a within a building can be identified on a floor plan in order to be able to detect the current positions of individual cleaners.

In the case of the cleaning trolleys 10a, 10b and 10c, the positions can also be determined from the distances which the cleaning trolleys cover. For this it is possible to assign to one of the wheels 42 of the cleaning trolley a motion detection device 50 which can detect the distance covered by means of a pulse generator 54 and the direction of travel by means of an angle-of-rotation detector 56.

Furthermore, one or more additional position detection devices which are assigned to the cleaning utensils can be provided. This can involve a sensor 58a which, by means of the global positioning system (GPS), detects the position of the cleaning trolley 10a in a building, or a sensor 58b for determining the position and field strength of radio transmitters. In the case of a sensor which detects the position and field strength of radio transmitters in a building complex, there must be a map of the positions and field strengths of radio transmitters existing at different locations in the building for comparison of the data detected. The position detection device 58 has been described simply with reference to two special examples 58a, 58b, but any position detection devices can be used. Location beacons installed in rooms such as RFID tags, small Bluetooth or infrared transmitters as well as QR codes which can be detected by means of a mobile reader on the cleaning utensil are known, to mention just a few other possibilities for position detection devices.

Position detection of the cleaning utensils serves first and foremost to improve the logistics and scheduling in the case of complex cleaning tasks. Via a central location, for example a workplace on the evaluating unit 20, it is possible to determine at any time which cleaner is located precisely where in the building and,

in the event that a certain task is to be taken over at short notice within the framework of facility management, can be informed and entrusted with this task. But furthermore for a cleaning business it can be proved to the client that the cleaning work has actually been done. In order to be able to perform such property monitoring, as shown in the practical example of Figure 4, not only are the cleaning trolleys 10a, 10b and 10c linked to the evaluating unit 20, but also the mop holder 12a of which the motion sequence in this case serves not only for training in motion, but also for property monitoring in order to prove to the client which surface has actually been cleaned.

But networking between the mop holder 12a as the cleaning utensil and the stationary evaluating unit 20 also serves to be able to check whether the cleaning utensil which has just been used is also the right one. Thus e.g. a different cleaning tool must be moved over a surface covered with a carpet, than over a tiled floor. Also it can be checked whether the mop fitted on the mop holder 12a is suitable for the respective floor covering.

Another possible use of the networked cleaning system consists of being able to grant authorised access to certain areas of the building. Thus in the field of health or in factories for food production it is normal to define certain hygienic areas, or access is possible in certain local areas of industrial plants only when the cleaner is wearing certain protective clothing or e.g. carries a dosimeter on his or her person. By means of the networked cleaning system, specially equipped cleaning utensils which have exclusive authorisation for access to certain sensitive areas can therefore be defined.

Patentkrav

1. Rengøringsystem med bevægelses- og positionsbestemmelse, **kendetegnet ved at** rengøringssystemet omfatter:

- 5 - en evalueringsindretning (20); og
- mindst ét rengøringsredskab (12; 10a, 10b, 10c, 12a), der har mindst én bevægelsessensormekanisme (14, 16, 18), samt
- et dataoverføringsmodul (30), hvor
- bevægelsessensormekanismen (14, 16, 18) detekterer bevægelsen af
- 10 rengøringsredskabet (12; 10a, 10b, 10c, 12a); og
- dataoverføringsmodulet (30) er egnet til at sende data trådløst til evalueringsindretningen (20), fortrinsvis med en Near Field Communication (NFC) -transmissionsfremgangsmåde eller med Bluetooth, hvor
- en positionsbestemmelsesindretning (58) omfatter et serverbaseret
- 15 radiopositioneringssystem;

kendetegnet ved at

- bevægelsessensormekanismen yderligere omfatter en sensor til magnetisk feltstyrke (58b); og
- hvor det serverbaserede radiopositioneringssystem detekterer feltstyrkerne af
- 20 radiosendere og, ved at mappe positionerne af radiosendere og deres feltstyrker, der er gemt i en hukommelse, beregner positionen af rengøringsredskabet (10a, 10b, 10c, 12a).

- 2.** Rengøringsystem ifølge krav 1, **kendetegnet ved at**
- 25 bevægelsessensormekanismen (14, 16, 18) omfatter inertisensorer og gyroskoper.

3. Rengøringsystem ifølge krav 1 eller 2, **kendetegnet ved at** bevægelsessensormekanismen (14, 16, 18) omfatter:

tre inertisensorer, der er anbragt ortogonalt på hinanden og orienteret på de tre rumakser; og også

5 tre gyroskoper, der er anbragt ortogonalt på hinanden og orienteret på de tre rumakser.

4. Rengøringsystem ifølge krav 1, **kendetegnet ved at** rengøringsredskabet (12, 10a, 10b, 10c, 10d, 12a) er en rengøringsvogn; og

10 bevægelsessensormekanismen omfatter en impulsgenerator (54) samt en drejeretningssensor (56) i et roterbart hjul (42) af rengøringsvognen (10a, 10b, 10c).

5. Rengøringsystem ifølge et hvilket som helst af de foregående krav, yderligere
15 omfattende en positionsbestemmelsesindretning (58), fortrinsvis en GPS-sensor (58a).

6. Rengøringsystem ifølge et hvilket som helst af de foregående krav, **kendetegnet ved at** rengøringsredskabet (24) har mindst to med afstand
20 anbragte bevægelsessensormekanismer (14, 16, 18), der er monteret ved sådanne positioner af rengøringsredskabet (12) og, når rengøringsredskabet (12) er anvendt korrekt, afbilder forskellige bevægelsessekvenser af rengøringsredskabet (12).

25 **7.** Rengøringsystem ifølge krav 1, **kendetegnet ved at** evalueringsindretningen er stationær.

8. Rengøringsystem ifølge et hvilket som helst af de foregående krav, yderligere omfattende et modtagelsesmodul (36) på rengøringsredskabet til at modtage data
30 fra evalueringenheden (20).

9. Rengøringsystem ifølge krav 8, yderligere omfattende et outputinterface (38) på rengøringsredskabet til et optisk og/eller akustisk signaloutput.

10. Rengøringsystem ifølge et hvilket som helst af de foregående krav,
5 **kendetegnet ved at** dataoverføringsmodulet (30) er yderligere designet til at kommunikere med en eller flere adgangskontrolindretninger til autentifikation af rengøringsredskabet.

11. Netværksbaseret rengøringsystem med et rengøringsystem ifølge et hvilket
10 som helst af de foregående krav, en flerhed af rengøringsredskaber (10a, 10b, 10c, 12a) og en evalueringsindretning (20), der er stationær.

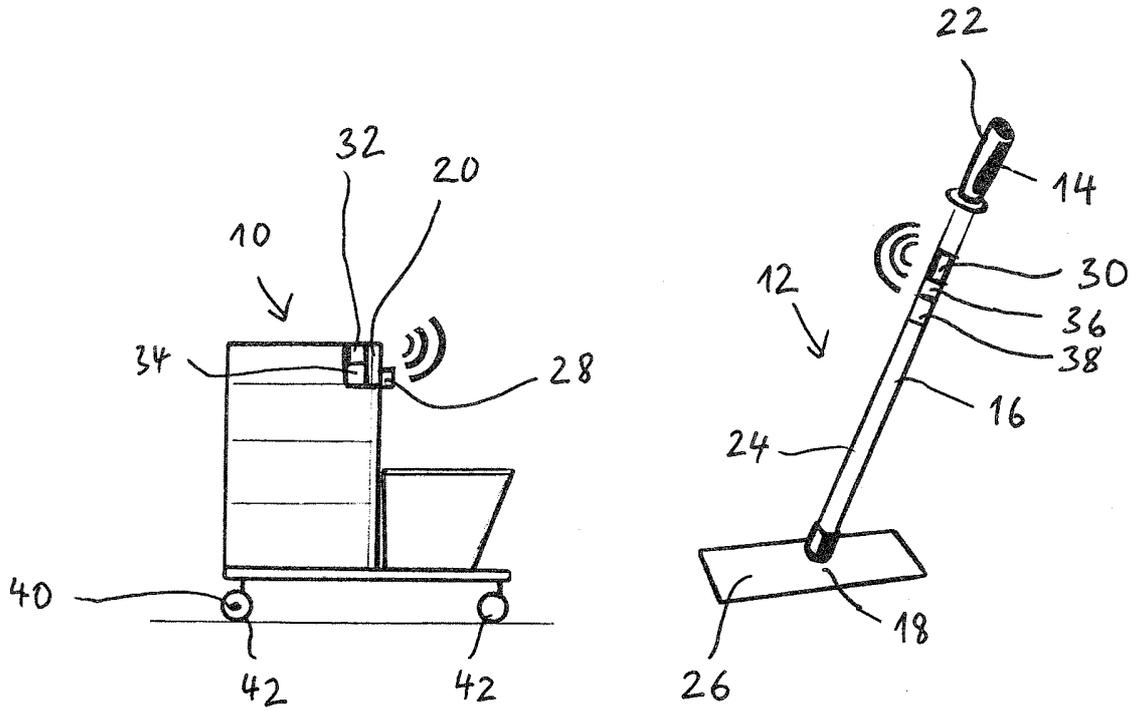


Fig. 1

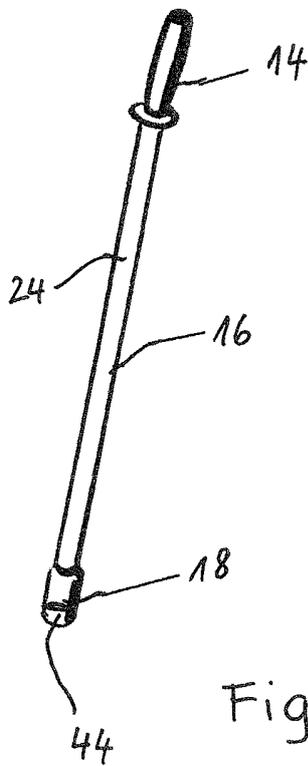


Fig. 2

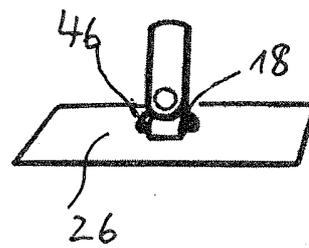


Fig. 3

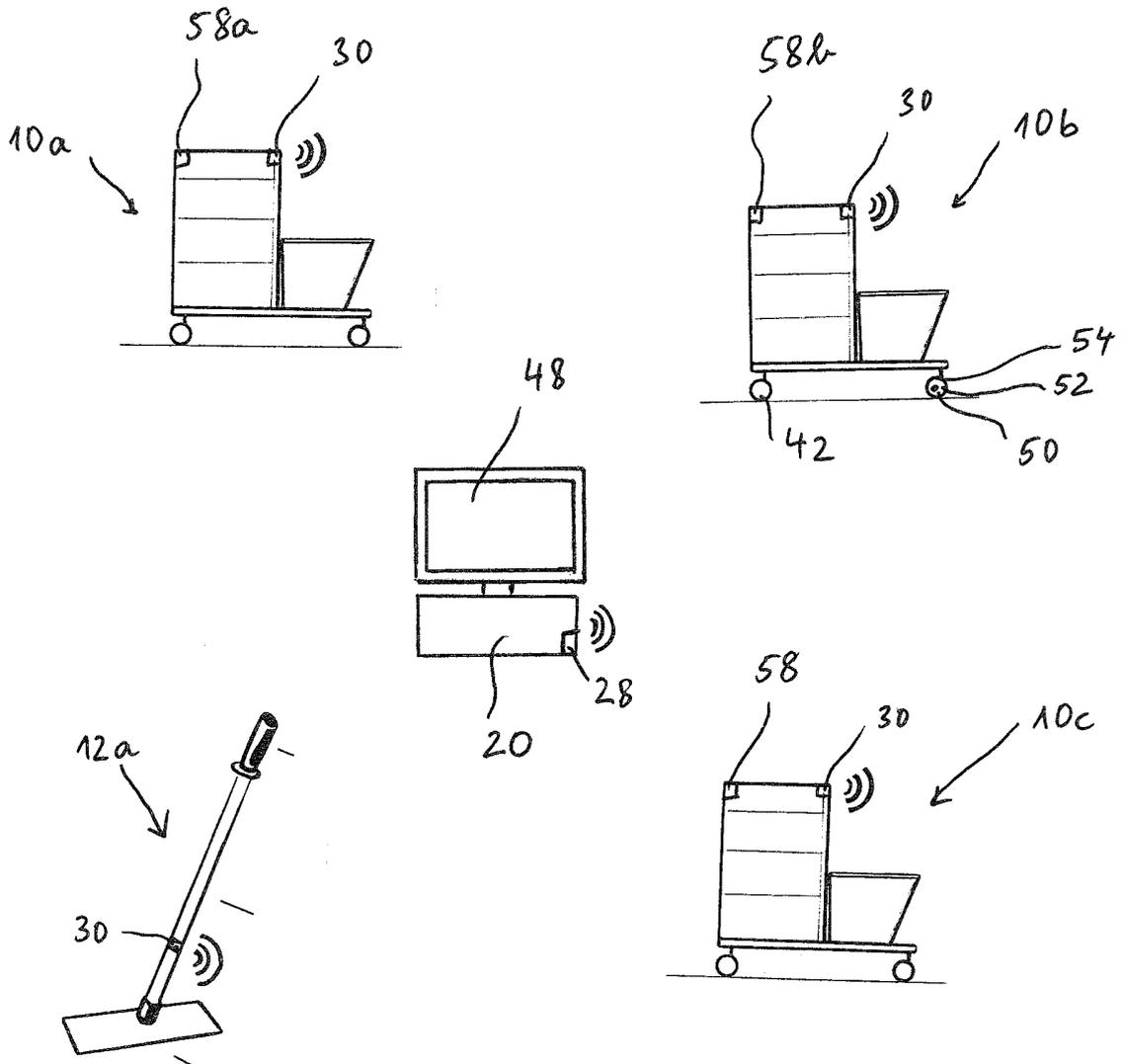


Fig. 4