

Modular furniture system

Reference to related documents

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This document claims priority of Swiss Patent Application No. 0198/19, filed February 15, 2019, the entire contents of which are hereby incorporated by reference.

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Field of the Invention

The invention relates to a modular furniture system according to claim 1.

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Background

Furniture systems with movable furniture modules are known. For example, modular rolling shelves have been developed as so-called compactus systems for storing files. In this case, several modules are arranged one behind the other. To access the files of a module, the modules are manually shifted until an access space is created between the module of interest and the neighboring module. This concept was further applied to residential units, where furniture modules are preconfigured and by moving the individual modules, different interstitial spaces can be created to serve one purpose or the other, e.g. a living room or a bedroom. Due to convenience, solutions have been developed in which the furniture modules can be moved electrically.

Such modular furniture systems have been developed with an eye to saving space, or making the best use of a room. One challenge here is to adapt the furniture system to different room configurations or room layout.

Description of the invention

The objective of the invention is to provide an improved modular furniture system.

5 The objective is reached with a modular furniture system having at least two furniture modules electrically and independently movable in a room. Each furniture module comprises its own motor controlled by a control computer of the furniture system. For the modular
10 furniture system, an electric linear drive is provided with a first drive element attached to a wall of the room and a second drive element attached to each furniture module. The first drive element cooperates with the second drive element so that each furniture module is
15 individually movable by means of the linear drive in cooperation with its own motor. The modular furniture system further comprises a rail system for supporting the furniture modules, which is arranged on a wall of the room. When a furniture module is moved, a support element
20 of the furniture module rests on the rail system.

The present system has the advantage that the furniture modules are guided on the wall side. Therefore, there is no need for guide grooves in the floor in order to move the furniture modules in a guided manner, which
25 reduces the assembly effort.

Brief description of the drawings

Further embodiments, advantages and
30 applications of the invention are shown in the dependent claims and in the following description based on the figures. The figures show:

Fig. 1 a schematic perspective view of the furniture system according to the invention, and

35 Fig. 2 a schematic circuit diagram of the furniture system according to the invention from Fig. 1.

Ways of carrying out the invention

Fig. 1 represents a perspective view of a furniture system 1 according to the invention. The modular furniture system 1 has several furniture modules 2, which
5 can be moved electrically and independently of one another in a room, of which only one module 2 is shown in the figure for reasons of clarity. Another module 2 would be arranged on the support base or substructure 16a, but it is not shown in order to make the rear arranged elements
10 of the module visible. In the present context, the term "rear" means toward the wall 15a.

As mentioned, each furniture module 2 comprises its own motor 8 controlled by a control computer 10 of the furniture system 1. An electric linear drive is
15 provided for the modular furniture system 1, comprising a first drive element 3a fixed along the wall 15a of the room and a second drive element 3b fixed to each furniture module 2. It is noted that in the present document, the linear drive is understood as the drive train and the
20 motor is understood as the driving force. The first drive element 3a cooperates with the second drive element 3b so that each furniture module 2 is individually movable by means of the linear drive in cooperation with its own motor 8. For controlling a speed of each furniture module
25 2, the control computer comprises a motor controller 12 and a first encoder 9 coupled to the motor 8 for regulating a speed of the motor 8. The motor controller 12 is electrically connected to the first encoder 9, which is preferably an encoder with two Hall sensors. The motor
30 controller 12 complies with the certification for standard IEC 60335-1 as applicable on the filing date of this application. The motor controller 12 further has interfaces for encoders with two Hall sensors.

In a preferred embodiment, the first drive
35 element 3a is a toothed rack 3a and the second drive element 3b is a pinion 3b that engages the toothed rack 3a. Preferably, involute gearing is used, since it is

quiet, robust and easy to manufacture. To move the furniture module 2, the pinion 3b is coupled to the motor.

In another embodiment, not shown, the linear drive may be a spindle drive with a spindle mounted along
5 the wall.

In yet another alternative, not shown, the linear drive may be a direct drive.

A gear unit 7 is provided between the linear drive and the motor 8. Preferably, a planetary gear is
10 used here, since this has the advantage of being quiet, which is particularly important for use in an inhabited room where gear noise is considered disturbing. However, a direct drive can also be applied so that no gearbox is necessary. Furthermore, a mechanical force limiter, in
15 particular a torque limiter, in particular a slip clutch, is interposed between the linear drive and the motor 8. The mechanical force limiter is designed in such a way that it disconnects the connection between motor 8 and linear drive as soon as a predefined torque is applied.
20 This safety clutch takes into account the fact that, for example, a user is located between two adjacent modules 2 while they are being moved towards each other. As soon as a module encounters an obstacle, the slipping clutch comes into play, separating the motor 8 from the linear drive.
25 Here, the force limit at which the clutch is to be released can be set mechanically. In any case, a value is set here at which no serious injury to the operator can occur and which complies with the applicable safety regulations. The control computer 10 is designed in such a
30 way that it compares the speed of the motor 8 with the position signal of the second encoder continuously or at predefined time intervals and checks whether a deviation is above a predefined threshold value, in order to detect a disconnection of the connection between the linear drive
35 and the motor 8 by means of the mechanical force limiter 6. If the position has not changed or has changed only slightly and the motor continues to rotate (at idle), this

may be interpreted by the control computer 10 as a decoupling of the motor 8 from the linear drive. As a reaction, the control computer can switch off the motor 8 and store the standstill position provided by the position
5 detection.

The position detection is performed with a system for absolute path measurement. For this purpose, a cable tension sensor system is provided for each module in the modular furniture system 1, which comprises a cable
10 attached to a fixed reference point. It further comprises, on each furniture module 2, a cable tension sensor cooperating with the cable and having a second encoder for outputting a position signal resulting from the unwinding or winding of the cable during the movement of the module
15 2.

The acceleration is adjustable within certain limits; the limits on the choice of acceleration are given by the release torque of the slipping clutch, i.e. the acceleration torque must be less than the trigger torque
20 of the slipping clutch. In case the slipping clutch is triggered due to an obstacle, a low linear acceleration is performed when the module is next started up until a displacement of the module 2 is detected by means of the position sensor (engagement of the slipping clutch).

When braking a module 2, a distinction is made between a normal braking process and an emergency braking process. The control computer 10 makes this distinction based on certain signals it receives. If an emergency stop has been initiated by the user, the module 2 will be
25 braked many times faster than during a normal stopping process while the module 2 is displaced. In the case of this emergency braking profile, braking is initiated after the emergency stop condition has been detected, and the module must come to a stop within a short distance.
30 Therefore, active braking is preferred in this case. In normal braking, braking is initiated immediately after detection of an appropriate condition, with linear braking

to 0 cm/s. Of course, the acceleration and braking values are adjustable and can be adapted according to the distances to be travelled by the module 2 and according to the module weight.

5 Furthermore, a rail system 4a is provided for supporting the furniture modules 2, which is arranged on a wall of the room. When a furniture module 2 is moved, a support element 4b of the furniture module 2 rests on the rail system 4a.

10 A safety distance is always provided between the modules. On the one hand, this ensures that e.g. fingers cannot be trapped, which might not be detectable as an obstacle by the slipping clutch due to the low counterforce. On the other hand, this prevents two
15 adjacent modules from colliding and possibly damaging each other.

 The rail 4a of the rail system is preferably designed as a linear rolling bearing and is arranged essentially parallel to the room floor 15b. In particular,
20 it is a linear recirculating ball bearing. This embodiment is advantageous because it permits easier sliding of the support element 4a and is comparatively quiet. Since the furniture module 2, which is supported on the rail by means of the support element 4b, is heavy, the furniture
25 module 2 is additionally supported on the support pad 16a, which is fixedly connected to or integral with the support element 4b. The support base 16a in turn rests on the floor 15b by means of at least one roller 16b. Preferably, this roller 16b is arranged on the furniture module 2
30 opposite the rail system 4a. However, several rollers could also be provided, for example at the corners of the support base 16a opposite the rail system. By using rollers 16b, the weight of the module 2 is better distributed to opposite areas of the support system formed
35 by the support base 16a and the support element 4b, and thus greater stability is achieved. At this point, the above-mentioned central advantage of the furniture system

1 also becomes clear: since the drive of the furniture system is arranged on the wall side and is only anchored in the floor at some points, the structure of the furniture system 1 is simplified: as already mentioned, there is no need for continuous, long guide grooves to be embedded in the floor in order to move the furniture modules in a guided manner. This is advantageous, since floors can be made of a variety of materials with different physical properties that would have to be taken into account differently. Also, any floor heating does not have to be taken into account in the present case. Furthermore, floor undulations pose less of a problem in the present furniture system 1 since only said rollers 16b roll on floor 15b. The rollers 16b can be made of a suitable rubber, which on the one hand has a spring effect and on the other hand is gentle on the floor in contrast to harder materials.

Preferably, each furniture module 2 comprises an optoelectronic sensor 13a, in particular a light grid 13b, for detecting an obstacle when the furniture module 2 is moving. The optoelectronic sensor 13a comprises at least one light source and at least one receiver and is designed to cover the entire width of the furniture module 2, which is illustrated in Fig. 1 by the diverging lines 13b. In this case, the light source and the receiver project away from a front or rear side of the furniture module 2 and are each held by means of a spring (not shown), so that they can be pressed into a niche provided for this purpose against the spring force when colliding with an object or merging with an adjacent module and no longer project out of the furniture module 2, which also triggers a detection. The niche for the optoelectronic sensor 13a is shown in Fig. 1 by the recess behind the bar marked 13a. In addition to the optoelectronic sensor, at least one pressure sensor 13c is provided for each furniture module 2. The pressure sensor 13c can be, for example, a pushbutton or pressure switch and is arranged

in the region of one, preferably both, of the front edges or edges of the support base 16a as viewed in the back and forth direction of travel. In embodiments of the furniture module, multiple pressure sensors are distributed along the edge or edges. By means of the pressure sensor or sensors, a detection can be triggered when the furniture module 2 collides with an object close to the ground that may not be detected by the light grid of the optoelectronic sensor. In the context of the present text, such a detection means that an emergency stop of the moving furniture module is subsequently initiated.

It is preferred that in particular in case of an emergency stop no subsequent start of any furniture module is allowed by the control computer until the emergency stop condition has been removed by the user.

The drive components and the optoelectronic sensor are housed in a wall connection which, as a screen, provides a tidy visual impression, protects the user from the moving parts of the furniture system 1 and protects the components of the furniture system 1 from dust, etc.

As already mentioned, the furniture system 1 is electrically driven. In the event of an interruption of the power supply or in the event of a fault, each furniture module 2 can also be controlled manually individually. For this purpose, a mechanical crank can be coupled to each furniture module 2, by means of which the furniture module 2 can be moved manually by turning the crank (not shown).

Fig. 2 shows a schematic circuit diagram of the furniture system 1 of Fig. 1 according to the invention in a typical configuration, integrated in an apartment. The furniture system 1 comprises several furniture modules 2; an office 2a, a closet 2b and a bed 2c, which are movable back and forth in the x-direction. Furthermore, a kitchen 2e and a bathroom 2d are provided in the apartment in a non-displaceable manner.

Furthermore, a living room may be provided in the area in front of the modules. It is noted that also only two furniture modules may be provided, for example a bed module and a wardrobe module. As can be seen in the figure, for maximum space utilization, the office 2a can be moved to the kitchen 2e to get more office space. Conversely, the office 2a can be moved to the right so that the kitchen becomes accessible. In other words, the present furniture system not only creates space between its own modules, but it can be positioned so that additional spaces associated with fixed apartment components can also be used in a modular fashion. However, it can also be provided that, for example, a sink and the refrigerator are accessible in any mode of operation.

Now, the modular design functions such that the modules 2a-2c can be moved to the left or to the right by means of an operating interface 18. For example, if the bed 2c is moved to the right and the closet is moved to the left, a bedroom with closet access is created. If the wardrobe is now moved to the right and the office module to the left, an office is created and the wardrobe module 2b rests against the bed module and is no longer accessible. The modules themselves can be supplied in a variety of configurations, for example as the standard modules mentioned above, or they can be customized to meet the customer's requirements. For example, various retractable or tiltable furniture elements can be provided in a module, such as a foldable or extendable table in office module 2a. Via the above-mentioned wall connection, each module 2 is supplied with power via a mains connection 22 and a power distributor 21. For example, this can accommodate lamps, such as a reading or work light, or other electrical devices, such as a TV set 17. Further, the modules may be such that they are accessible from both sides to allow the respective function to be used in multiple configurations.

Also shown in the figure are the control computer 10, the linear drive, the position sensor 11, and the motor 8 with the motor controller 12. Furthermore, the electrical connections with the control computer and the power supply are shown. These are connections for signals for positioning the furniture modules and for safety-related signals, which are associated, for example, with potential obstacles when moving the modules 2. In this case, all signal or power cables connected to moving parts are guided by means of a drag chain, so that a reliable connection is ensured and the cables are guided in a controlled manner. The drag chain 14 is also arranged in the wall connection for aesthetic and protection reasons.

The system further comprises sockets 20 and a network connection for the user. The network connection is intended on the one hand to provide the user with Internet access and on the other hand to connect the furniture system 1 itself to the Internet. This makes it convenient, for example, to call up a remote diagnosis in the event of a fault in order to determine the fault. Furthermore, this allows the furniture system to be remotely controlled by the user himself. For example, the user can set a specific furniture configuration with his smartphone before he gets home and send it to the furniture system 1, which then moves the modules accordingly on its own. To this end, the control computer 10 further comprises a module for processing user data that it receives from a user interface, regardless of whether this data originates from a remote device or through direct operation of the user interface. In addition to software for controlling the furniture modules 2, the control computer also includes software for changing parameters and setting various sizes or preset user profiles. Not only can the individual modules be moved independently by pressing a single button, but it is also possible to control intermediate positions of a module 2 by holding down the corresponding

"left" or "right" button until the desired position is reached.

The furniture system 1 can preferably also be integrated into home automation systems, with
5 corresponding interfaces being provided on the control computer 10 for this purpose.

The moving parts of the furniture system 1 are shielded from the environment as far as possible, on the one hand for safety reasons and on the other hand for
10 reasons of contamination. Wherever it makes sense, brush seals are used for this purpose, for example, which on the one hand repel dirt from the outside and on the other hand are suitable for sealing moving parts. In particular, such a seal may be provided at the wall connection along the
15 adjustable length for the cables carried along when the modules are moved, or at the roller 16b.

As mentioned, the furniture system can be integrated into existing homes. The procedure is such that first the rail system together with the drive and the
20 substructure 16a are attached. Subsequently, the furniture modules 2 are assembled, whereby, depending on the access possibilities for the apartment, the modules can be finished beforehand or transported in parts to the apartment and only then assembled. After that, the system
25 is connected to the necessary connections such as electricity, television and possibly network, if no WiFi is available. Finally, the furniture system is programmed and tested.

30 Although preferred embodiments of the invention have been described, it is pointed out that the invention can be realized in other ways within the scope of the following claims. In this context, terms used in the description such as "preferred", "in particular",
35 "advantageous", etc. refer only to optional and exemplary embodiments.

Claims

1. Modular furniture system having at least two furniture modules which can be moved electrically and independently of one another in an inhabited room having a floor, wherein each furniture module comprises its own motor controlled by a control computer of the furniture system, and wherein for the modular furniture system, an electric linear drive is provided with a first drive element fixed along a wall of the room and a second drive element fixed to each furniture module, the first drive element cooperating with the second drive element of each furniture module so that each furniture module is individually movable by means of the electric linear drive in cooperation with its own motor,

further comprising a rail system for supporting the furniture modules, wherein the rail system is arranged on the wall of the room and wherein, when each furniture module is moved, a supporting element of the each furniture module rests on the rail system.

2. Modular furniture system according to claim 1, wherein the first drive element is a toothed rack and the second drive element of each furniture module is a pinion engaged with the toothed rack, wherein for moving each furniture module, the pinion is coupled to the motor of each furniture module, or

wherein the electric linear drive is a spindle drive with a spindle mounted along the wall, or wherein the electric linear drive is a direct drive.

- 13 -

3. Modular furniture system according to claim 1 or 2, wherein a gear, in particular a planetary gear, is provided between electric linear drive and the motor of each furniture module.

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4. Modular furniture system according to one of the preceding claims, wherein a rail of the rail system is designed as a linear roller bearing and is substantially parallel to the floor of the room.

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5. Modular furniture system according to one of the preceding claims, wherein each furniture module is supported on the floor of the room by means of at least one roller, in particular which is arranged on each furniture module opposite the rail system.

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6. Modular furniture system according to one of the preceding claims, wherein a mechanical force limiter, in particular a torque limiter, in particular a slip clutch, is interposed between the motor of each furniture module and the electric linear drive, which is designed in such a way that it disconnects the connection between the motor of each furniture module and the electric linear drive as soon as a predefined torque is present, wherein the disconnection of the connection is detected by the control computer and the motor of each furniture module is thereupon switched off by the control computer.

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7. Modular furniture system according to one of the preceding claims, wherein the control computer for controlling a speed of each furniture module comprises a motor controller and a first encoder coupled to the motor

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- 14 -

of each furniture module for regulating a speed of the motor of each furniture module, in particular wherein the motor controller is electrically connected to the first encoder,

5 wherein the control computer further comprises a module for processing user data received from a user interface.

8. Modular furniture system according to one of the
10 preceding claims, further comprising an absolute displacement measurement system for position detection, wherein a cable tension sensor system comprises a cable fixed to a fixed reference point and, on each furniture module, a cable tension sensor cooperating with the cable
15 and having a second encoder for outputting a position signal.

9. Modular furniture system according to claim 8, wherein the control computer for detecting a disconnection
20 of the connection between the electric linear drive and the motor of each furniture module by means of the mechanical force limitation is designed in such a way that it compares the speed of the motor of each furniture module with the position signal of the second encoder continuously or at
25 predefined time intervals and checks whether a deviation is above a predefined threshold value.

10. Modular furniture system according to one one of the preceding claims, wherein each furniture module
30 comprises an optoelectronic sensor, in particular a light grid, for detecting an obstacle during movement of each furniture module, wherein the optoelectronic sensor

- 15 -

comprises a light source and a receiver and is designed to cover the entire width of each furniture module, wherein the light source and the receiver project away from a front or rear side of each furniture module and are each held by
5 means of a spring, so that they can be pressed into a niche provided for this purpose against the spring force when colliding with an object and no longer project out of each furniture module, whereby a detection is triggered.

10 11. Modular furniture system according to one of the preceding claims, wherein a mechanical crank can be coupled to each furniture module, by means of which each furniture module is manually movable by turning the mechanical crank of each furniture module.

15 12. Modular furniture system according to one of the preceding claims, wherein at least one spacer is provided on each furniture module in order to ensure a safety distance when adjacent ones of the at least two modules
20 abut against each other.

13. Modular furniture system according to one of the preceding claims,
wherein two furniture modules are provided, wherein a
25 first furniture module is a bed module and a second furniture module is a closet module, or

wherein three furniture modules are provided, wherein a first furniture module is an office module, a second furniture module is a bed module with, in particular, a
30 fold-down bed, and a third furniture module is a closet module.

- 16 -

14. Modular furniture system according to one of the preceding claims, wherein each furniture module comprises at least one pressure sensor, in particular a push button or pressure switch, wherein the at least one pressure
5 sensor is arranged in the region of one, in particular the two, front edges of a support base of each furniture module as viewed in the back and forth direction of travel, in particular wherein a plurality of pressure sensors are distributed along the edge or edges of the support base of
10 each furniture module, so that a detection can be triggered by means of the at least one pressure sensor or the pressure sensors when each furniture module collides with an object close to the ground.