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 [33] **Switzerland**
 [31] **012814/67**

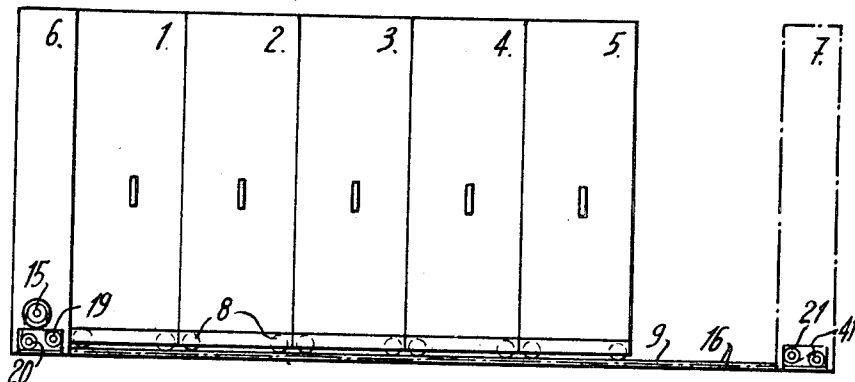
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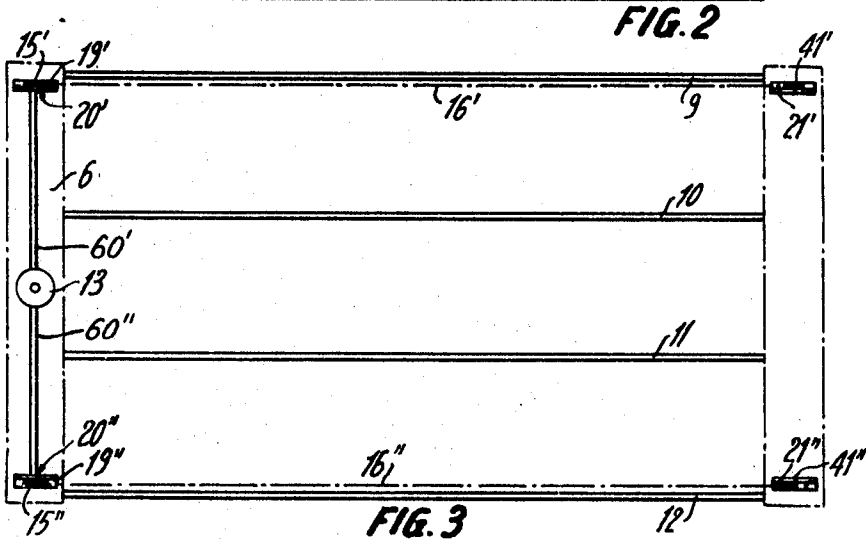
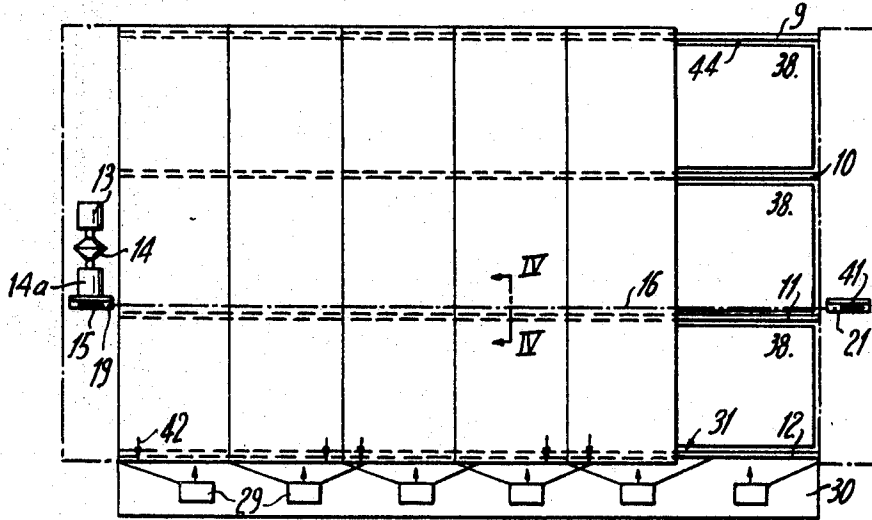
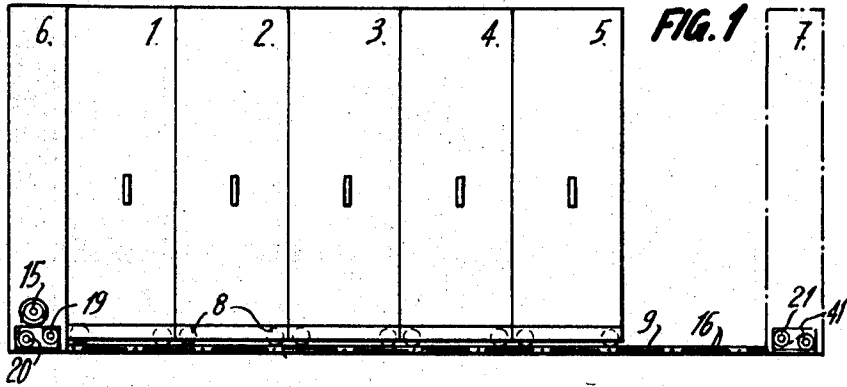
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[54] **ELECTRICALLY CONTROLLED TRACTION
 DEVICE FOR MOVABLE UNITS, ESPECIALLY
 CONTAINERS OR SHELVING UNITS**
 19 Claims, 9 Drawing Figs.

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 104/178, 312/199
 [51] Int. Cl. **A47b 53/02,**
 B61b 13/12
 [50] Field of Search 104/162,
 172, 173; 312/199; 104/178, 76

ABSTRACT: A device for moving several shelving units to open a gangway between any of them. The units are mounted on rails over a chain and have a solenoid to operate a plunger to engage the chain. A motor is variably coupled to the chain depending on the number of units to be moved and switches mounted along side of the rails control the movement of the units over specific lengths.





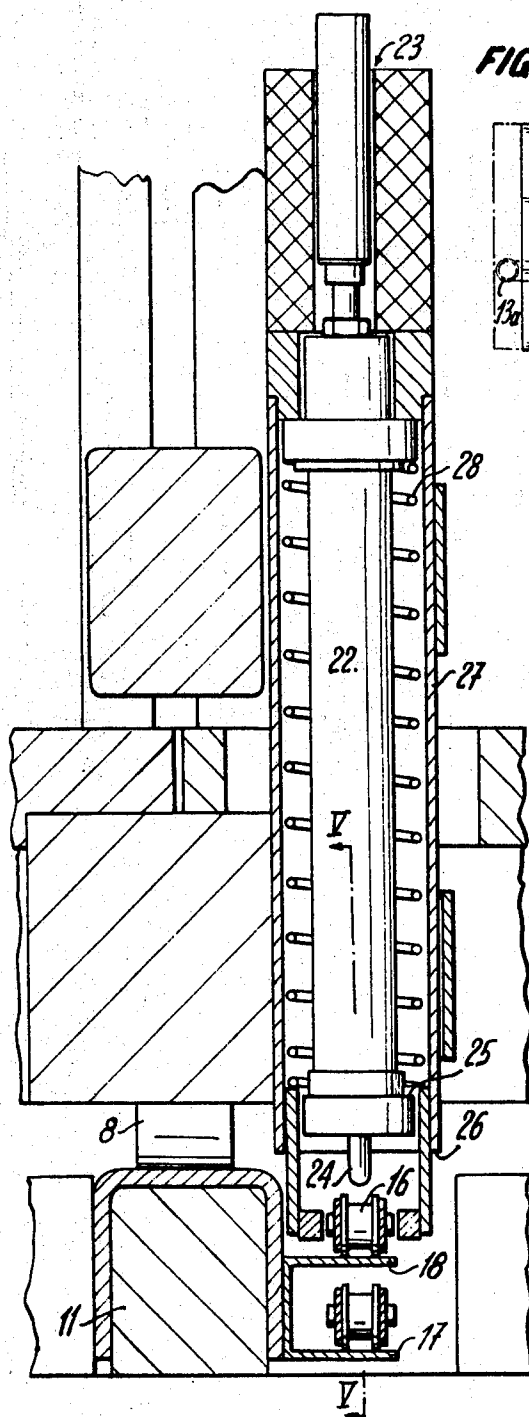


FIG. 4

FIG. 7

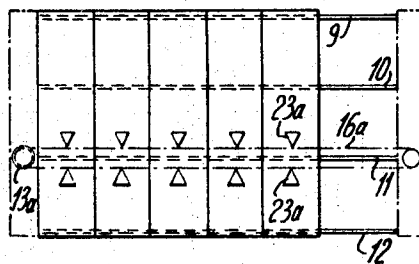
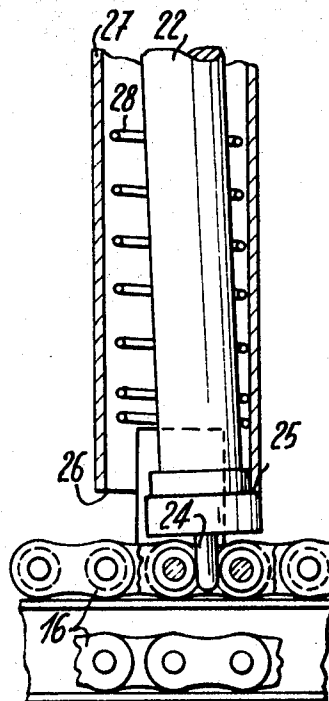


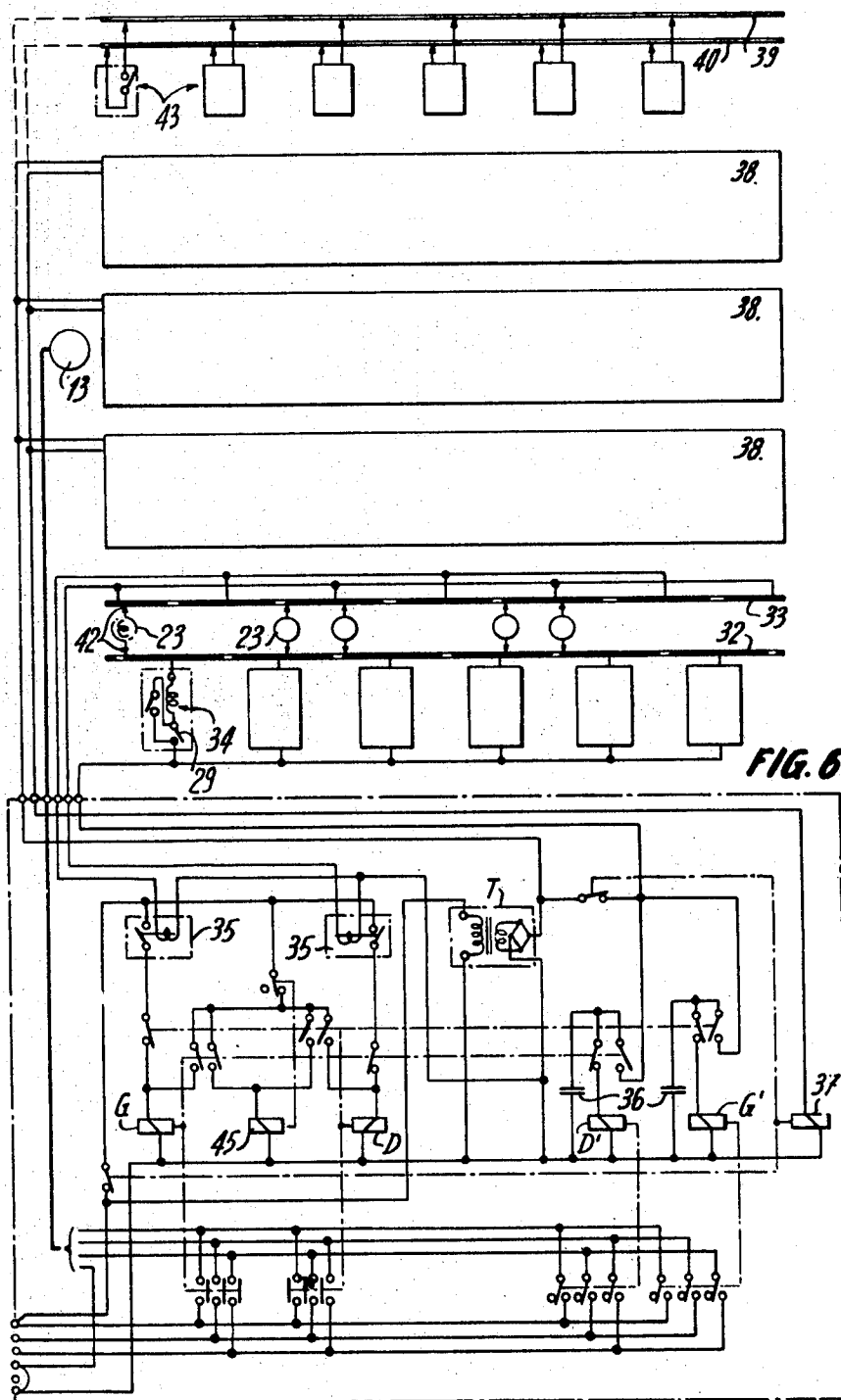
FIG. 5



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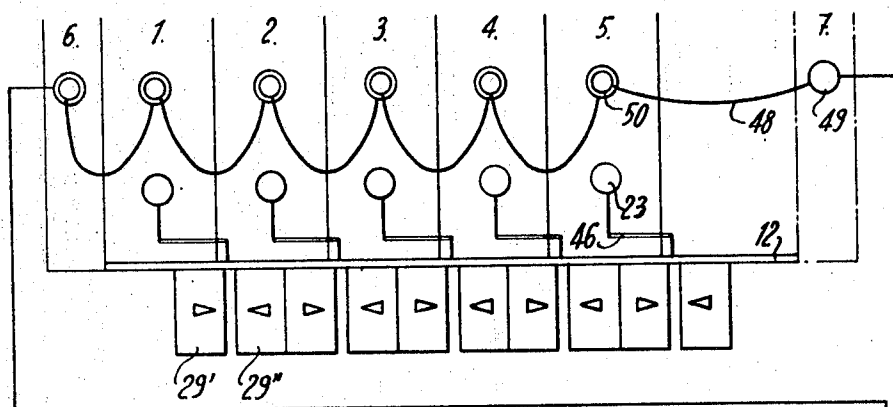


FIG. 8

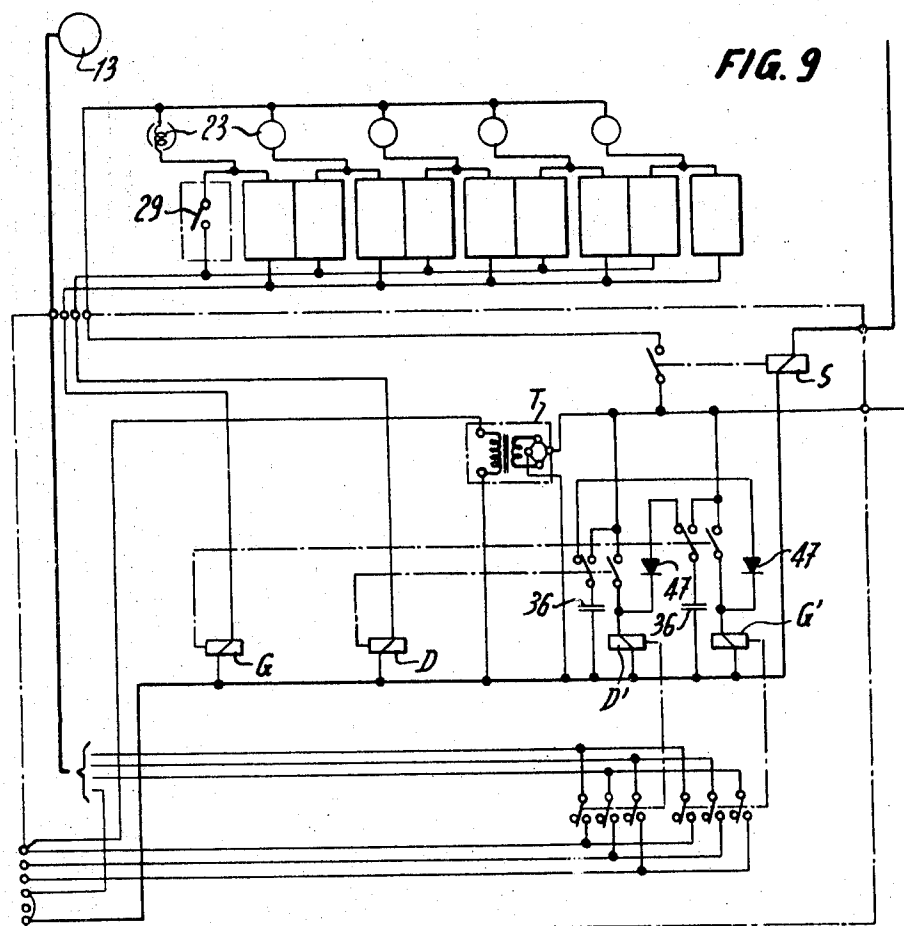


FIG. 9

ELECTRICALLY CONTROLLED TRACTION DEVICE FOR MOVABLE UNITS, ESPECIALLY CONTAINERS OR SHELVING UNITS

This invention relates to an electrically controlled traction device for movable units, especially containers or shelving units arranged side by side, to open a gangway between two neighboring units, with the aid of a traction means, driven by a motor, to which each of the units can be coupled.

With similar installations, especially when they comprise a number of heavily loaded units, difficulties arise to design the power transfer from the drive motor to the movable units, via the traction means and the coupling means, so that it is sufficiently elastic to render smooth starting of the movement possible.

In a known mechanical arrangement for moving such units, the latter are equipped with coupling devices, which are manually operated so that they slip on the traction means. This causes wear on the traction means and/or the couplings as well as difficulties to control the starting procedure without personal skill of the operator.

In another known arrangement the units are equipped with rotating coupling devices which are permanently engaged with the traction means and which can be manually braked to a standstill so that the corresponding unit is moved away by the traction means. In this case, wear mainly occurs on the brake of the coupling device. Personal skill of the operator is still necessary and the coupling means required on each unit considerably increases the cost.

The object of the invention, is to provide an electrically controlled traction device in which the motor by itself, or by means of a slight coupling, confers to the traction means a variable speed depending on the load carried and/or the time elapsed.

This slip coupling provides the desired elasticity, which with known arrangements is achieved by means of, for instance, a slip between the traction means and the coupling device on each unit, and this is also attained with the units connected in a slip-free way to the traction means. The slip coupling between the motor and the traction means replaces the expensive coupling devices on each movable unit, and these can be equipped with the simplest imaginable catches for the connection to the traction means.

Simultaneously with the starting of the motor, the operated unit is coupled to the traction means. At this time the slip coupling preferably transfers no moment of force.

Once the coupling takes place, the transferred moment of the slip coupling increases in a preset manner from zero to a maximum value. After a certain time, depending on the adjustment of the slip coupling as well as the number and weight of the units to be moved, this moment reaches a level at which the traction means is enabled to put the units into movement. While the moment and hence the force in the traction means further increases, the units are accelerated to a speed of movement which corresponds to the speed of the motor.

In practice, the units thus get started and accelerated smoothly, independently of their weight and number, without personal interference by the operator.

The wear problems which are caused with the known arrangements to get elastic traction are important and are avoided by means of a slip coupling consisting of an induction coupling with variable magnetization current. Such couplings have no wear whatsoever. A hydraulic coupling is suitable too, but the transferred moment is not so easy to control automatically.

Among slip couplings with little wear, centrifugal clutches should be mentioned. Since their transferred moment depends on the speed of the drive shaft, they offer less possibilities to get a varying moment over a long time than induction couplings. Finally, a multiple-disc clutch with electromagnetic control offers about the same control possibilities as an induction coupling, apart from the fact that the starting moment immediately changes from zero to a minimum value of about half the maximum moment. It further presents noticeable wear.

By means of an appropriate electric control, the motor can be started with a switch related to the desired gangway. If each of the movable units has a catch for connection to one traction means or to two synchronously running traction means, the same switch, depending on the position of the units next to the desired gangway, starts the motor in one or the other direction and connects one or the other of the units to the traction means. If the movable units can be connected to one or the other of two parts of an endless traction means, the same switch, depending on the position of the units next to the desired gangway, connects one or the other of these units to the part of the endless traction means which moves in the desired direction.

For a better understanding of the characteristic scope and feature of this invention, reference may be made to the accompanying drawing and following specification, in which drawing:

FIG. 1 is a vertical view of the device of this invention as mounted on movable shelving units.

FIG. 2 is a view from above of the installation according to FIG. 1.

FIG. 3 is a view from above similar to FIG. 2 referring to an alternative arrangement.

FIG. 4 is an enlarged fragmentary vertical sectional view along the line IV-IV of FIG. 2 showing the coupling device mounted on shelving unit 4.

FIG. 5 is an enlarged fragmentary vertical sectional view along the line V-V of FIG. 4 showing the coupling device on shelving unit 4 after connection the chain 16.

FIG. 6 is a diagrammatic representation of the electrical circuit of FIG. 1.

FIG. 7 is a view from above similar to FIG. 2 referring to another alternative arrangement.

FIG. 8 is a vertical view similar to FIG. 2 referring to an alternative device of this invention as mounted on a shelving unit.

FIG. 9 is a diagrammatic representation of the electrical circuit of FIG. 8.

The installation shown in FIG. 1 and 2 comprises a number of movable shelving units 1-5 arranged between fixed units 6 and 7 of which 7 has no active part in the working of the installation. The movable units are fitted with wheels 8, which run on rails 9-12 on the floor, so that a free space can be opened between optional neighboring shelving units.

In the embodiment shown in FIGS. 1 and 2 the shelving units 1-5 are movable by an endless chain 16 running over a drive sprocket 15 and idler sprockets 19 and 20 in fixed unit 6 and over idler sprockets 21 and 41 in fixed unit 7. An electric motor 13 mounted in the fixed unit 6 drives the sprocket 15 and hence the chain 16 through a slip coupling 14 and a reducer 14a. The two parts of the chain 16 run on top of each other guided by the idler sprockets and by rails 17 and 18 (see FIG. 4).

The arrangement shown in FIG. 3 is like that of FIG. 2 except that it has two parallel chains 16' and 16'' driven respectively by drive sprockets 15' and 15'' and guided by idler sprockets 19', 20', 21' and 41' and by idler sprockets 19'', 20'', 21'' and 41'' respectively. The drive sprockets 15' and 15'' of the two chains are connected with the motor drive unit 13 (including a slip coupling and reducer as in FIG. 2) through shafts 60' and 60'' so that the drive sprockets and the two chains 16' and 16'' are driven in synchronism with one another. The arrangement of FIG. 3 has the advantages of a parallel drive of the shelving units and the distribution of the load between two chains.

Under each shelving unit 1-5, one resp. two coupling devices are fitted for connection of the shelving unit to the upper part of the chain 16 resp. the chains 16' and 16''. These coupling devices consist of a plunger 22 actuated by an electromagnet 23 and fitted with a pin 24 at its lower end, which may be inserted between two links of the chain (FIG. 4). As soon as the chain 16 drives the corresponding shelving unit, the plunger 22 is pulled somewhat aside so that the shoulder 25 at its lower end hooks under the lower edge 26 of the tube

27. As long as the chain 16 moves in the same direction, the corresponding shelving unit 1—5 remains connected to the chain 16 also when the electromagnet 23 no longer pushes the plunge 22 down (FIG. 5).

As soon as the chain 16 is driven in the other direction, the shoulder 25 on the plunger 22 is released from the lower edge 26 of the tube 27 and plunger 22 returns to its initial position under influence from the spring 28.

It will be seen that the engagement of the pin 24 in a link of the drive chain provides a positive nonslipping connection between the respective shelving unit and the drive chain. On the other hand, the coupling 14 provides a sliding connection between the drive chain and the motor 13. As described above, the coupling is selected from the group consisting of an induction coupling with variable magnetization control, a hydraulic coupling, a centrifugal clutch and a multiple disc clutch with electromagnetic control.

The electric control of the motor 13 and the coupling devices is for instance carried out in the following way:

The installation is operated by means of pedal switches 29 each of which controls the opening of one gangway.

These pedal switches or pedals are fitted in a slanting wooden board 30, placed in front of the installation and connected electrically to segmented contact rails on a wooden bar 31 fixed to the front supporting rail 12. Furthermore, all pedals are connected to the electric control line at 24 V tension.

On the wooden bar 31 there are two series of contact rails, the lower series 32, connected to the pedals, is segmented to establish the length of influence for each pedal. The upper series 33, which is also segmented, consists of parts alternately connected to one of two lines generating impulses to start the motor in the right and in the left direction respectively. The segmentation of this series of rails is such that depending on the position of the shelving unit to be driven, an impulse to start in one or the other direction is achieved.

The segmentation of the two series of contact rails is made in accordance with the depth of the movable shelving unit. Bar 31 may thus be manufactured in optional length and for a specific depth of shelving unit. (This assumes of course that all movable units in an installation are of the same depth.) The bar is adapted to actual gangwidth by observing that the segments of the two series of contact rails will lie symmetrically to the two ends of the bar (i.e. the distance from the middle between two outer segments in the lower series to each end of the bar should be exactly equal, and be equal to half the gangwidth minus half the depth of the shelving unit). If the bar is thus adapted, it can be used without changes for any gangwidth larger than half the depth of the shelving unit, and smaller than $\frac{1}{2}$ times this depth.

The control of the solenoid 23 in the driven shelving unit is thus achieved by means of the start impulse pedal 29 for the actual gangway, and this is done in such a way that control tension of 24 V is led to a wire to start in a certain direction via the related segment in the lower series of contact rails 32, a brush against it, the solenoid 23, a brush against the upper series of contact rails 33 and one of its segments. The electric circuit is first maintained during a distance of movement of almost half the depth of the shelving unit, then the brush against the upper series of contact rails changes segment and in fact closes the circuit for impulse to start in the other direction. Since the electric circuit is locked, the motor 13 cannot reverse. The solenoid 23 is thus still under tension. This state lasts a further distance of movement of almost half the depth of a shelving unit, that is as long as the brush against the lower series of contact rails still lies against the segment related to the operated pedal 29. As soon as this brush leaves this segment, the solenoid 23 has no tension and the coupling device only remains connected to the chain due to the hooking in as described above.

Each start impulse pedal 29 is equipped with a Reed relay - a current relay - connected in such a way that the pedal is short-circuited after only a short impulse through sharp

pressing of the pedal. Hence only a short impulse to start secures desired hooking in of the coupling device.

In order to obtain the above mentioned maximum relation of $1\frac{1}{2}$ between gangwidth and depth of shelving unit, the brushes 42 have to be fitted differently onto each shelving unit, namely one-fourth depth of the shelving unit to the left and the right of the middle of every second shelving unit. If all brushes were fitted equally on all shelving units, only gangwidths up to the depth of the shelving unit would be controlled automatically.

Thanks to the arrangement of the brushes on each shelving unit and the division of the lower series of contact rails, the pedal related to the desired gangway couples one or the other of the shelving units depending on their position.

When the impulse circuit for start in a certain direction of the motor has been closed as described above, another Reed relay switches 220 V control tension to the contactor (G or D) for this direction of movement. At the same time a time-limit relay 45 receives this control tension. This time-limit relay controls the running time in the chosen direction of movement of the motor, and has to be adjusted to different gangwidths so that a slightly longer running time is achieved than is needed by the movement itself. Thanks to this surplus time, the traction will manage to absorb a possible back kick of the moved units and press them together again.

As soon as this time has elapsed, the motor stops. Simultaneously, however, the contactor for the motor switches a condenser 36, which has been charged under 24 V tension during the above mentioned running time, so that it discharges over a relay G' or D'. As a result, the relay reverses the motor 13 while condenser 36 is discharging. This reversing movement permits the required release of the coupling device of the driven unit from the chain.

In the electric circuit there is a further relay 37 to switch off the control tensions of 220 V to the contactors of the motor and of 24 V to the start impulse delivery means, if a safety device, in the form of pressure sensitive mats 38 between the rails below the shelving units or 43 on the kick boards of the movable units, are short-circuited. If such mats are used on the kick boards, two uninterrupted contact rails 39—40 are fitted on a second wooden bar 44, against which two optionally located brushes slide.

Finally, there is a transformer and a rectifier (T). These work continuously when the installation is ready for use and provide the control tension of 24 V DC which is necessary because of the open contact rails. The contact rails are not under tension when the installation is not operated.

Thus the described installation is not provided with any flexible electric wires to the shelving units. The operation occurs automatically after pressing a start impulse pedal 29—which is located exactly in front of the desired gangway. The device automatically chooses the shelving unit to be driven and the direction of movement achieving the desired gangway. To facilitate the choice of the correct pedal to obtain desired access between two shelving units, direction lines are marked on the slanting board 30, which point towards the opening between the two shelving units, which will move apart after pressing the pedal. These lines are of course influenced by the actual gangwidth and have to be adapted to each installation.

The lines from two pedals will only meet if the gangwidth is equal to the depth of the shelving unit, and it is then advantageous to provide them also with arrows indicating the direction of movement. In this special case, the operator thus has to observe the present position of the existing gangway when choosing the adequate pedal.

If the shelving units are numbered, the pedals may of course be provided with corresponding double numbers instead of direction lines so that, for instance, pedal 1—2 opens a gangway between the shelving units 1 and 2.

An installation according to FIG. 1—7 and the above description is thus operated by means of only a short start impulse with the pedal 29. When such an impulse has been given, the device thus achieves in a fully automatic way the desired

movement of shelving units. If there is a person in the gangway which is to be closed, the device cannot be started provided it is equipped with pressure sensitive mats 38 as a safeguard. If such mats 43 are provided on the kick boards of the movable shelving units only, the device may anyway get started but the traction ceases as soon as any one of these mats is touched.

Since safeguards - also in cheaper versions - considerably increase the cost of the installation, it is desirable to try to meet existing safety regulations in such a way that the provision of safeguards becomes unnecessary.

According to usual safety regulations, safeguards are required when operation occurs by impulse only, if the traction force is higher than 150 kps and if the moved units have an energy of movement of more than 15 kpm.

If movement only occurs as long as the pedal is pressed down and the traction force is not more than 150 kps, no safeguards are required if the speed of movement is limited in relation to the total weight of the movable units, so that the energy of movement is less than 15 kpm.

FIGS. 8 and 9 show an alternative device of this invention in which these requirements are taken into account, so that safeguards become optional. Furthermore, this version does not provide fully automatic choice of direction of movement depending on the position of the units. For each gangway position, two pedals are provided, one for movement to the left and one for movement to the right. Instead of the relatively complicated arrangement of contact rails and brushes, the solenoid on each unit is directly connected by means of a flexible cable with two adjacent pedals for different directions of movement and related to different gangways.

FIG. 8 thus shows only the front support rail 12 and in front of this, pedals 29' for movement to the right and 29'' for movement to the left. From a fixed point on the support rail to a fixed point on a movable unit there is a flexible cable 46, one for each movable unit. This cable connects the solenoid 23, which influences the pin 24, on a movable unit with the two pedals 29' and 29'' related to the gangways on both sides of this movable unit. Due to the flexible cable instead of the arrangement with contact rails, the gangways can be of optional width and are not limited to 1½ times the depth of the unit at the most.

FIG. 9 shows the simplified circuit diagram provided for this alternative device. Here the contactors G and D are replaced by relays for 24 V control tension. Here, too, a short reversing movement with the aid of a discharging condenser 36 over the relay D' or G' is provided to facilitate release of the connection between the pin and the chain, but as the installation is no longer only operated by means of an impulse, the hooking in as described above (FIG. 5) is unnecessary. In order to avoid undesired charging of these condensers, diodes 47 are provided. A safeguard as shown on FIG. 6 can of course be provided also in this alternative device of the invention, if desired or if the traction force and/or the energy of movement is higher than what is acceptable for installations without safeguard.

In FIG. 8 and 9, however, an alternative safeguard is shown. In FIG. 8 a cable 48 connects two adjacent units. This cable can for instance be fixed by its right end on an iron plate 49 on one unit and have a handle 50 with a permanent magnet at the other end. This magnet is placed on an iron plate on the next unit on the left. With all these cables placed according to the FIG. 8, an electric connection is provided between the two fixed units 6 and 7.

If the iron plates 49 on the fixed units are connected to control tension via a relay S as shown in FIG. 9, and if this relay switches control tension to the solenoids 23 only when it is under tension, the pedals 29' and 29'' can only operate the installation if the circuit between the fixed units via the movable ones is not broken. To get access to a gangway this circuit has to be broken - the handle end of the cable has to be removed from the iron plate - and in this way the person in the gangway can be sure that the installation cannot be operated and squeeze him between two units.

The two electric controls systems described above can also of course be used with a known version of traction of shelving units according to FIG. 7, where the motor 13a always drives the endless traction means 16a in the same direction. In this case each shelving unit must be provided with two coupling devices controlled by solenoids 23a, which are coupled to one or the other of the parts of the traction means moving in opposite direction, so that the driven shelving unit can be moved in the desired direction.

I claim:

1. A storage installation comprising a plurality of movable storage units and means for selectively moving said units toward and away from one another to open a gangway between selected units, said means comprising motor drive means, flexible traction means extending in the direction of movement of said units, slip coupling means for coupling said flexible traction means to said motor drive means, individual connecting means for selectively coupling individual ones of said units firmly to said flexible traction means in nonslipping relation thereto, each said connecting means comprising catch means mounted on individual ones of said units and movable between an engaged position in which said catch means is engaged with said flexible traction means to connect the respective unit thereto and a disengaged position out of engagement with said flexible traction means, means biasing said catch means toward disengaged position, electromagnetic means energizable to move said catch means to engaged position to transmit force from said flexible traction means to said respective unit to move said unit, means for holding said catch means in said engaged position even after deenergization of said electromagnetic means as long as force is being transmitted from said flexible traction means to said respective unit and for releasing said catch means for movement to said disengaged position by said biasing means upon cessation of transmission of said force when said electromagnetic means is deenergized, and control means controlling the operation of said motor drive and the selective actuation of said connecting means to move one or more of said units to open a gangway between designated storage units.

2. A storage installation according to claim 1, in which said traction means comprises at least one link chain and in which said catch means comprises a pin engageable in a link of said chain and a plunger carrying said pin, said electromagnetic means when energized moving said plunger in a lengthwise direction to engage said pin in a link of said chain.

3. A storage installation according to claim 2, in which said biasing means comprises spring means for moving said plunger in a direction to disengage said pin from said chain.

4. A storage installation according to claim 3, in which said holding means includes a cylinder in which said plunger is freely slidable and laterally movable, and a shoulder on said plunger engageable with an end of said sleeve to hold said plunger in chain-engaging position when said plunger is moved laterally by the pull of said chain on said pin.

5. A storage installation according to claim 4, in which said motor drive means comprises means for reversing the direction of movement of said chain, and in which said plunger is released for disengaging movement by said spring when the direction of movement of said chain is reversed.

6. A storage installation according to claim 1, in which said traction means comprises a link chain and in which said catch means is engageable with a link of said chain.

7. A storage installation according to claim 6, in which said motor drive means comprises means for reversing the direction of movement of said chain and in which said holding means comprises means for retaining said catch means in chain-engaging position as long as said chain is moving in one direction and for releasing said catch means from said chain when the direction of movement of said chain is reversed.

8. A storage installation according to claim 7, in which said control means comprises means for automatically reversing said motor drive means at the end of movement of said chain in one direction to release said catch means.

9. A storage installation according to claim 1, in which said traction means comprises a plurality of parallel link chains, and in which said motor drive means comprises means for simultaneously driving said chains in synchronism with one another.

10. A storage installation according to claim 1, in which said motor drive means and said connecting means are electrically operated and in which said control means comprises electric circuit means for momentarily energizing said electromagnetic means to connect selected units to said traction means and for concurrently energizing said motor drive means.

11. A storage installation according to claim 10, in which said motor drive means is reversible to drive said traction means selectively in opposite directions, and in which said control means comprises means for selecting the direction of movement of said traction means depending on the location of said units with respect to the gangway to be opened.

12. A storage installation according to claim 10, in which said control means comprises individual switch means for each gangway to be opened.

13. A storage installation according to claim 12, in which said individual switch means is positioned at the location of the respective gangway to be opened.

14. A storage installation according to claim 13, in which said switch means comprises a single switch pedal at each gangway location and in which said control means comprises means for determining the direction of movement of selected units according to the position of said units with respect to the gangway to be opened.

15. A storage installation according to claim 14, in which said control means comprises sectionalized contact rails and contacts carried by individual units electrically engageable with said rails.

16. A storage installation according to claim 10, in which said control means comprises safety means for preventing operation of said drive means to move selected units to close an existing gangway when said gangway is occupied.

17. A storage installation according to claim 16, in which said safety means comprises a pressure sensitive mat in said gangway.

18. A storage installation, comprising a plurality of movable storage units and means for selectively moving said units toward and away from one another to open a gangway between selected units, said means comprising motor drive means, flexible traction means extending in the direction of

movement of said units, sliding coupling means for coupling said traction means to said motor drive means, connecting means for selectively coupling individual ones of said units firmly to said traction means in nonslipping relation thereto and control means controlling the operation of said motor drive and the selective actuation of said connecting means to move one or more of said units to open a gangway between designated storage units, said motor drive means and said connecting means being electrically operated and said control means comprising electric circuit means for actuating said connecting means to connect selected units to said traction means and for concurrently energizing said motor drive means, including individual switch means positioned at the location of each gangway to be opened, said motor drive means being reversible and said individual switch means comprising two switch pedals at individual gangway locations, one of said pedals being operable to operate said motor drive means in one direction and the other of said pedals being operable to operate said motor drive means in the opposite direction.

19. A storage installation, comprising a plurality of movable storage units and means for selectively moving said units toward and away from one another to open a gangway between selected units, said means comprising motor drive means, flexible traction means extending in the direction of movement of said units, sliding coupling means for coupling said traction means to said motor drive means, connecting means for selectively coupling individual ones of said units firmly to said traction means in nonslipping relation thereto and control means controlling the operation of said motor drive and the selective actuation of said connecting means to move one or more of said units to open a gangway between designated storage units, said motor drive means and said connecting means being electrically operated and said control means comprising electric circuit means for actuating said connecting means to connect selected units to said flexible traction means and for concurrently energizing said motor drive means, said control means comprising safety means for preventing operation of said drive means to move selected units to close an existing gangway that is occupied, said safety means comprising disconnectable electric cables extending between adjacent units in position to be disconnected to afford entry to a gangway between selected units, said cables comprising part of said control means and incapacitating said motor drive means when one of said cables is disconnected.

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