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(54) Abstract Title
Suspension conveyor system

(57) A suspension conveyor system comprises a support surface 16 for carrying objects 10; a plurality of load hooks 1 arranged to pick up the objects 10 from the support surface 16 and to deposit the objects thereon; a conveyor 5-7 for automatically transporting the load hooks 1; pivot joints 3 by means of which the load hooks 1 are linked to the conveyor; pivoting means for pivoting the load hooks 1 to pick up and/or deposit objects; and each load hook 1 having an inner receiving space with an inner face leg 15 extending inwardly from the free end of the load hook; wherein the load hooks 1 are suitable for automatically picking up individual or plural objects from the support surface without affecting the automatic transport movement of the load hooks, for which purpose the respective load hook is moved to a loading position in which the inner face leg 15 is oriented substantially in the conveying direction and extends below the support surface 16, with an entry opening 17 of the load hook extending above the inner face leg 15 and oriented in the conveying direction. The inner face leg 15 may be rectilinear and while in the loading position extends parallel to and below the support surface 16 within a groove 13 formed in the support surface 16.

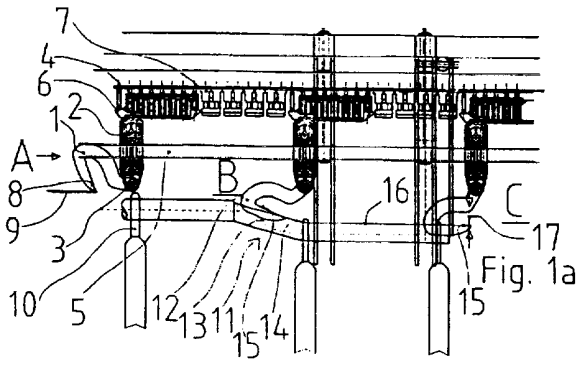

Fig. 1a

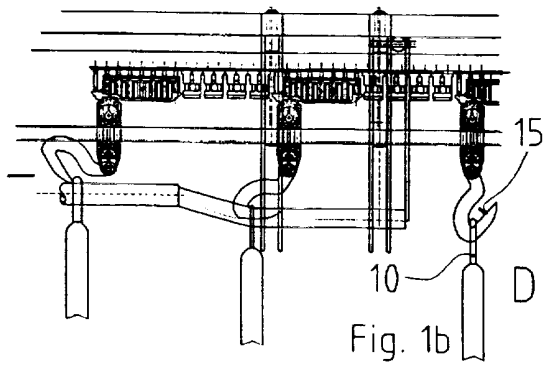

Fig. 1b

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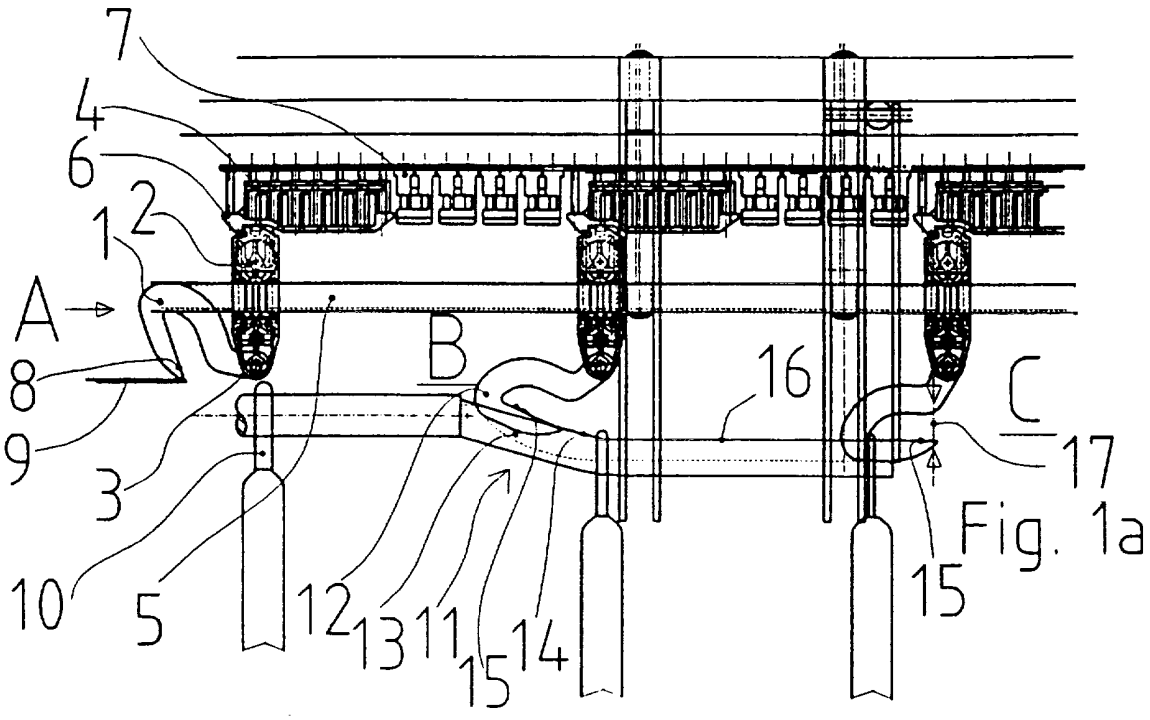

Fig. 1a

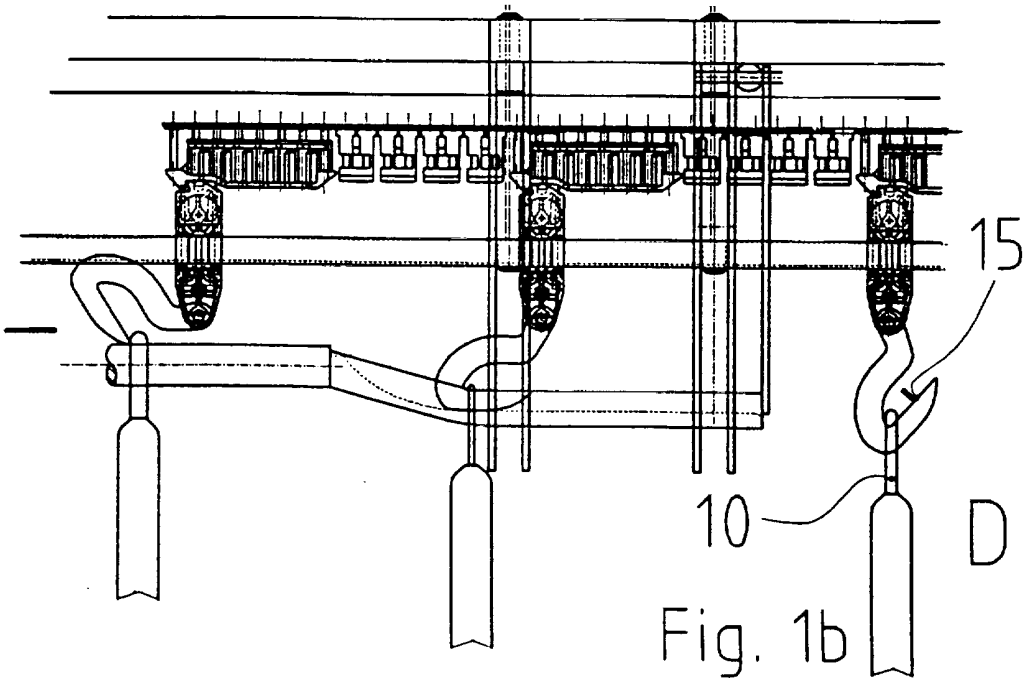

Fig. 1b

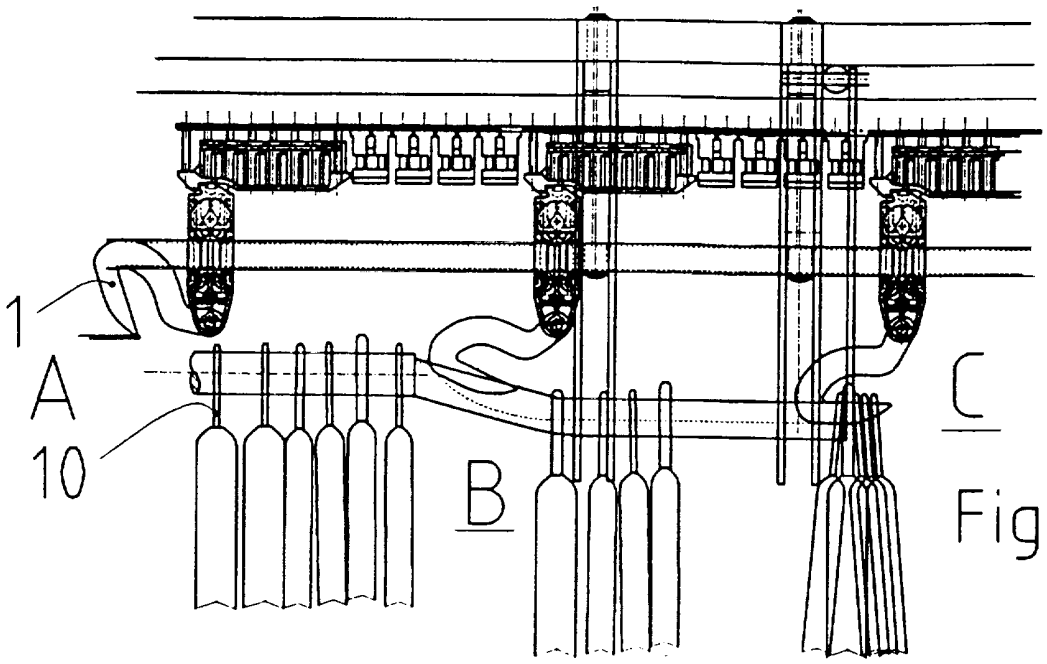

Fig. 2a

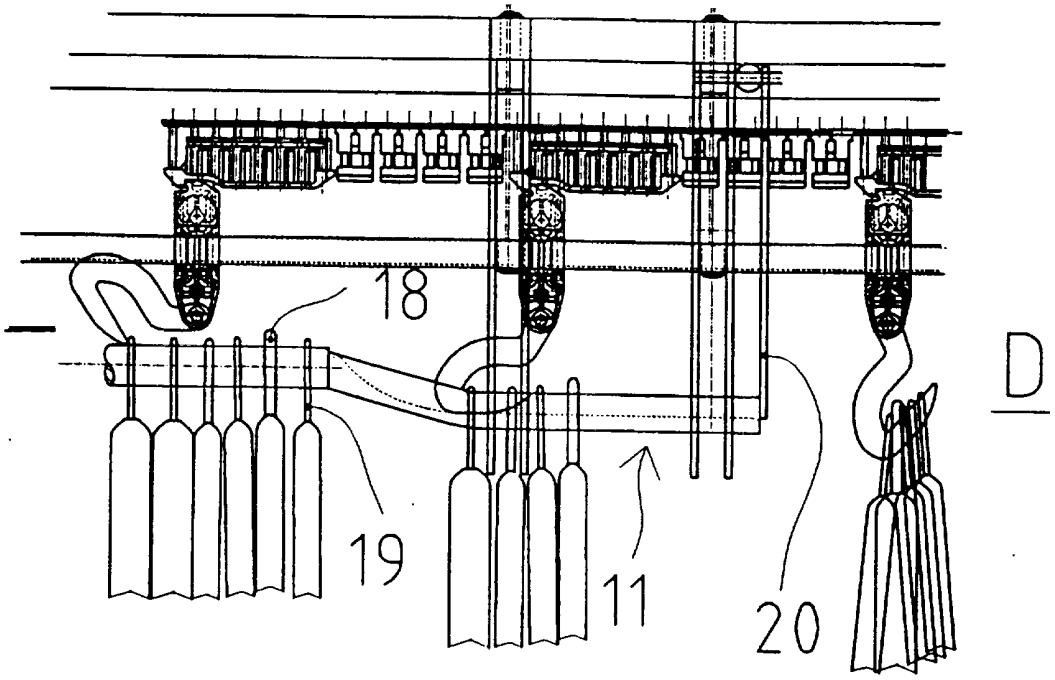

Fig. 2b

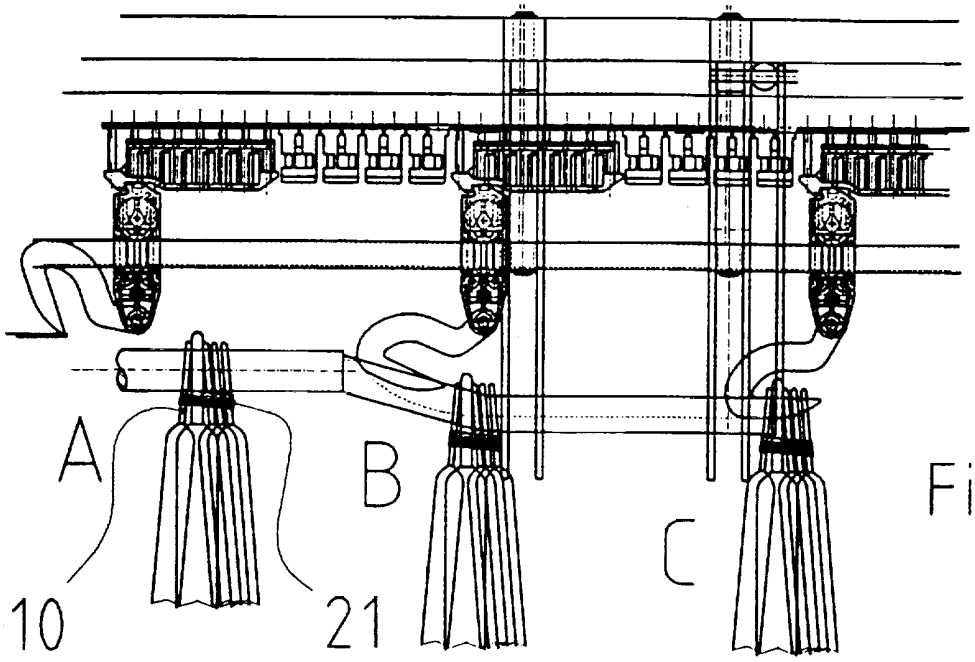

Fig. 3a

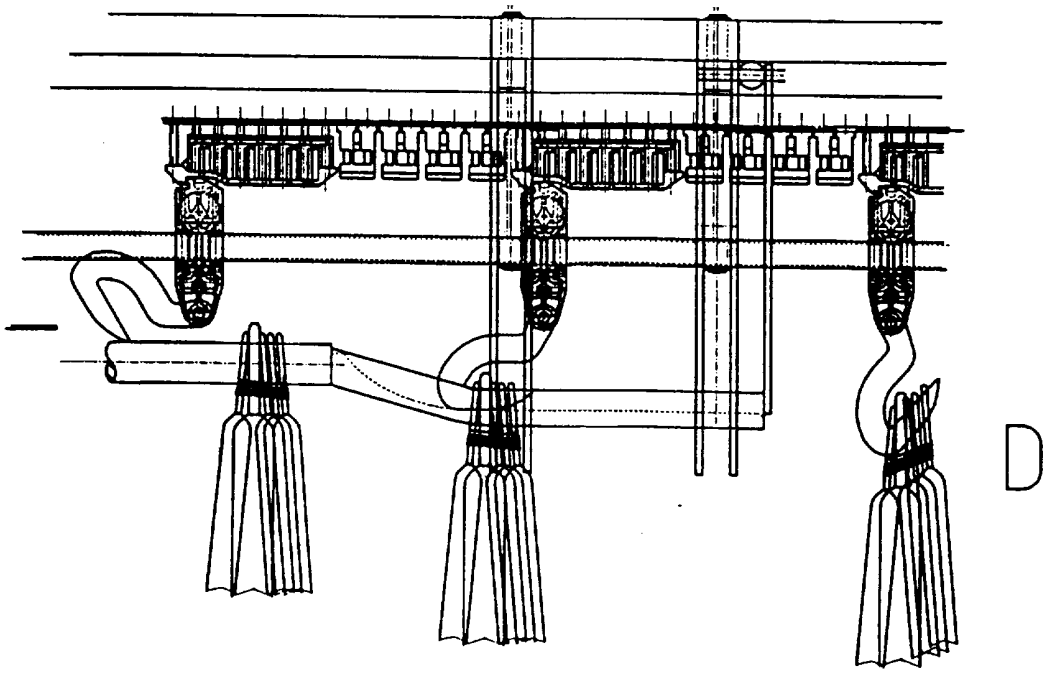

Fig. 3b

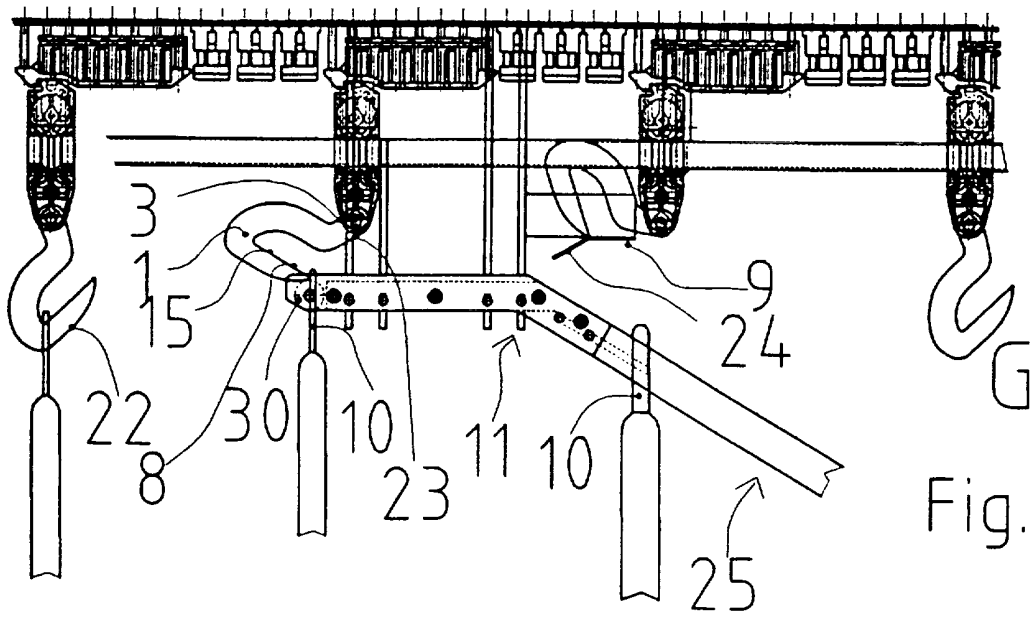

Fig. 4a

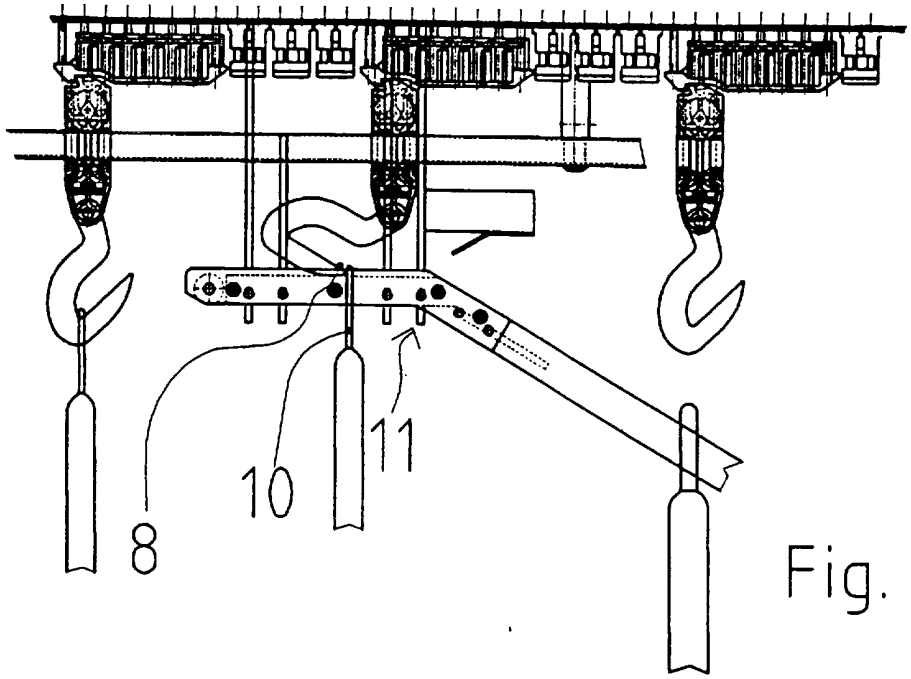

Fig. 4b

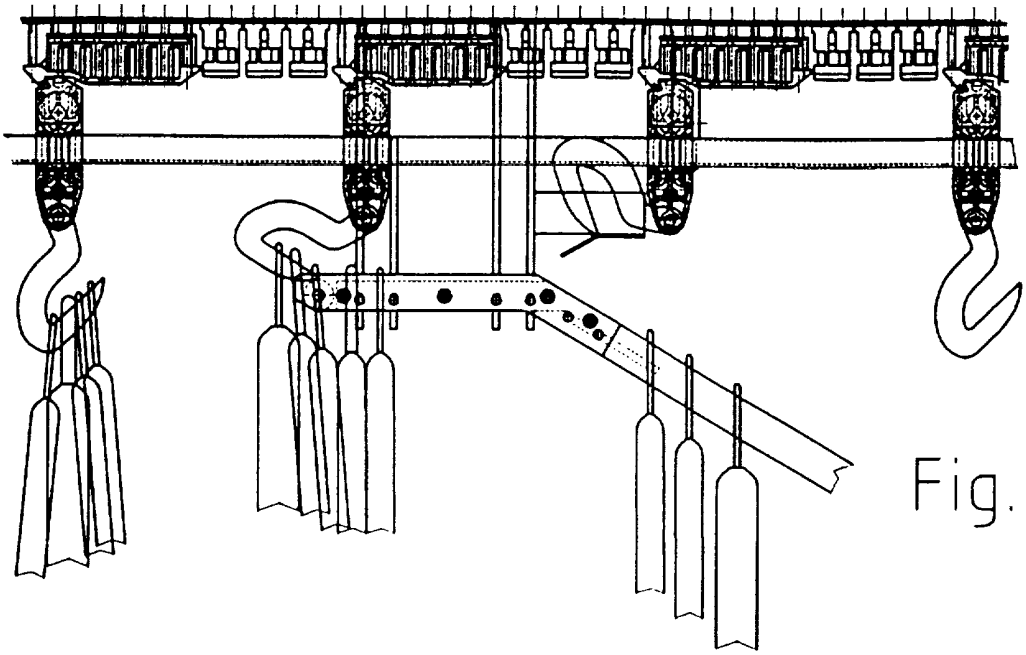

Fig. 5a

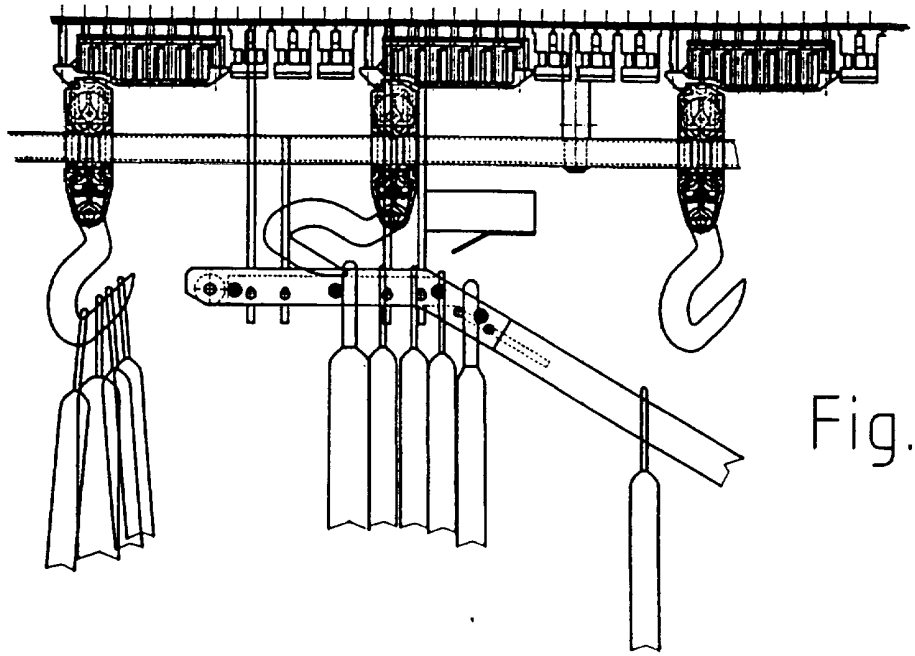

Fig. 5b

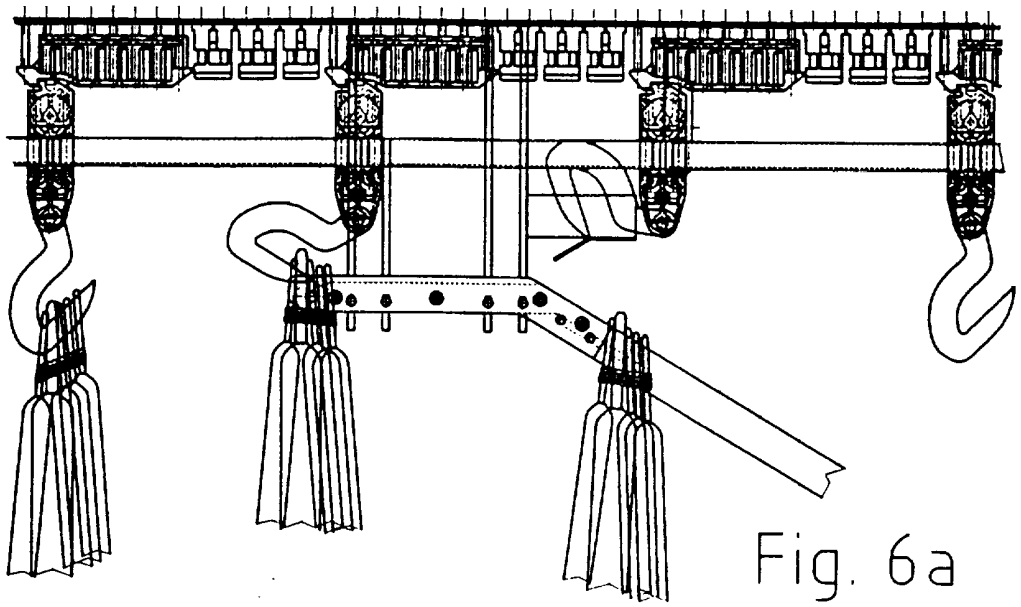

Fig. 6a

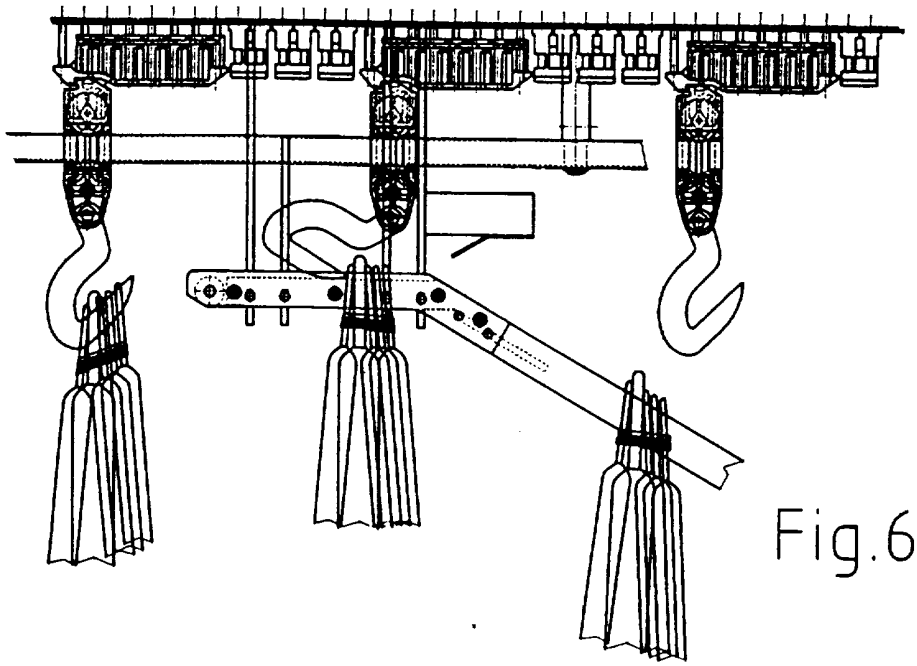

Fig.6b

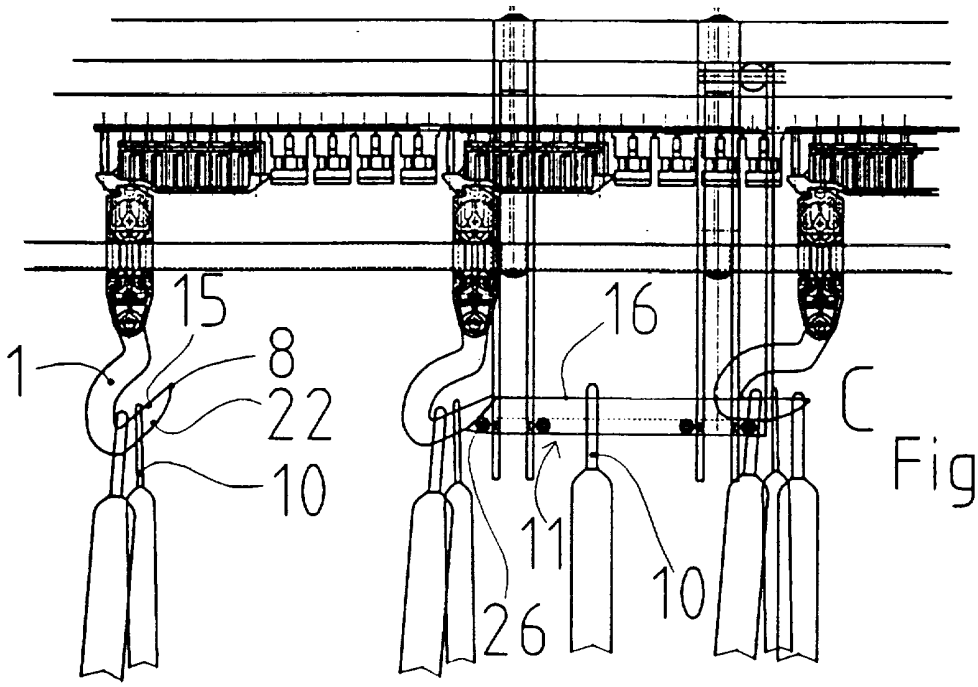

Fig. 7a

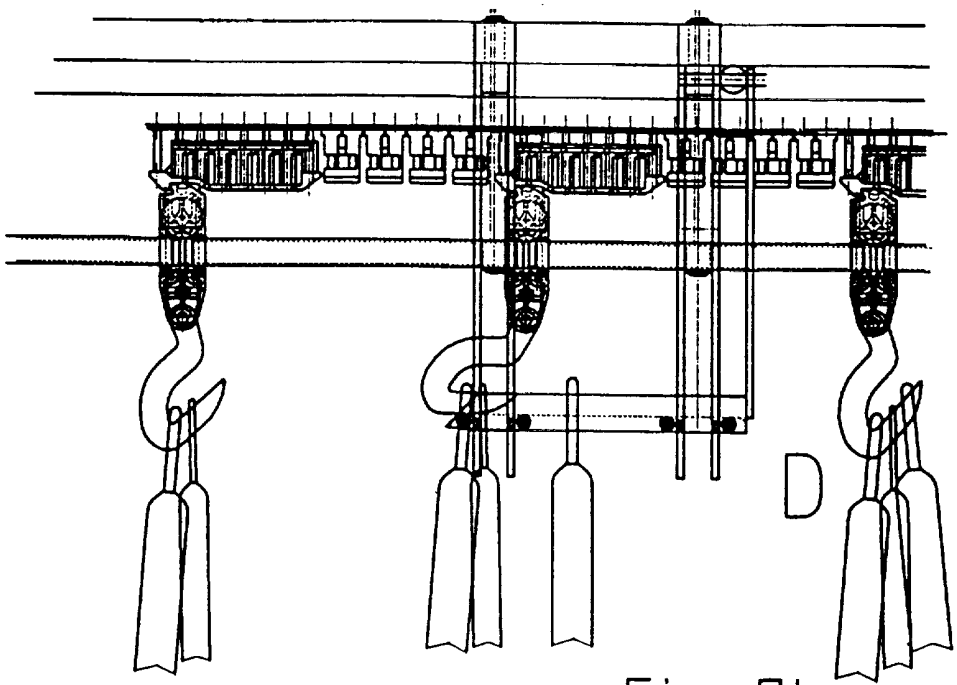

Fig. 7b

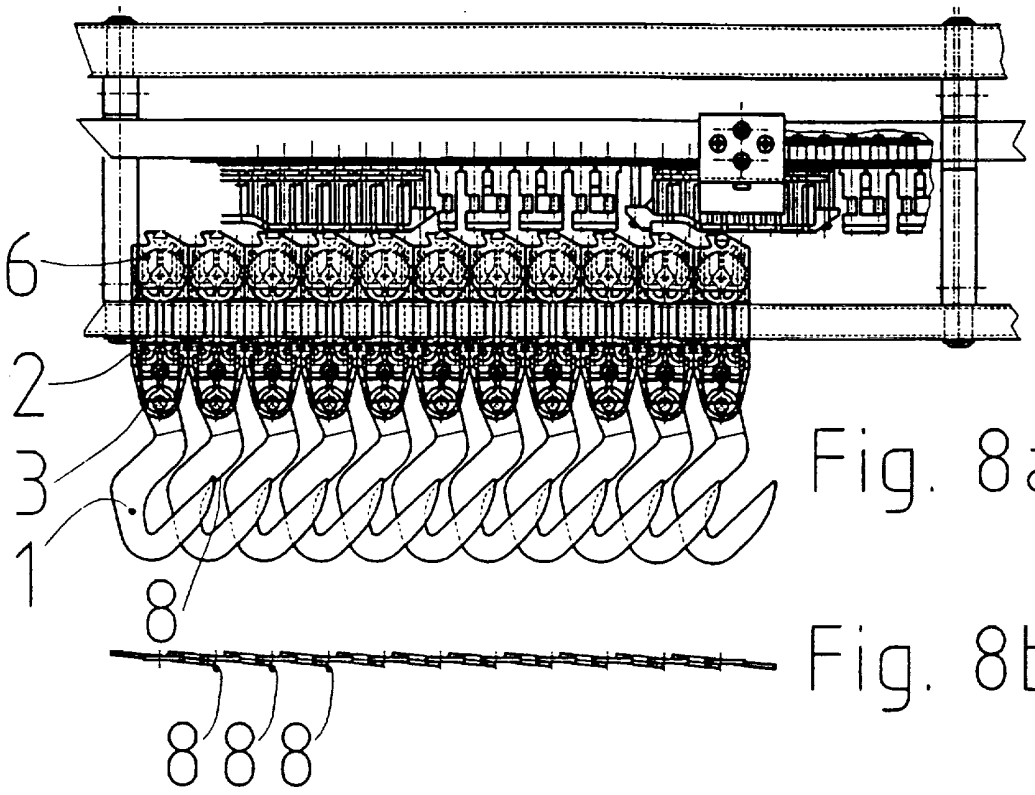

Fig. 8a

Fig. 8b

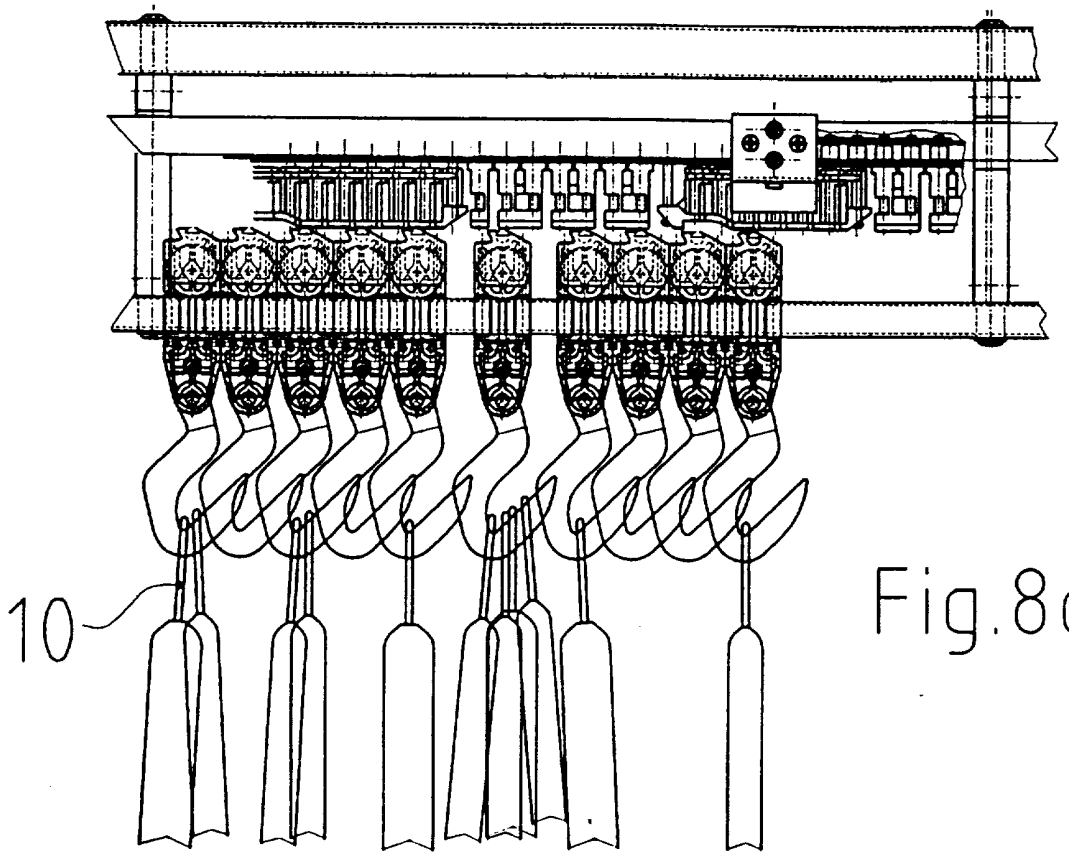

Fig.8c

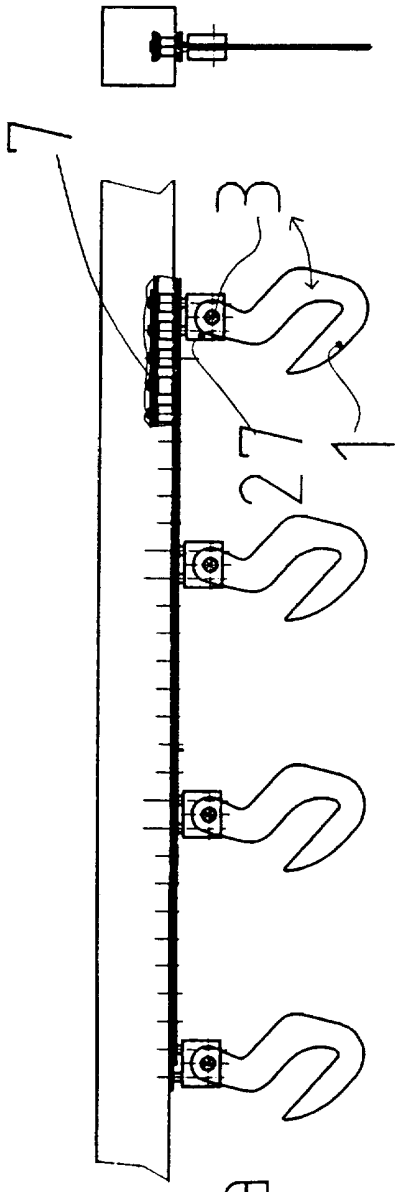

Fig. 9a

Fig. 9b

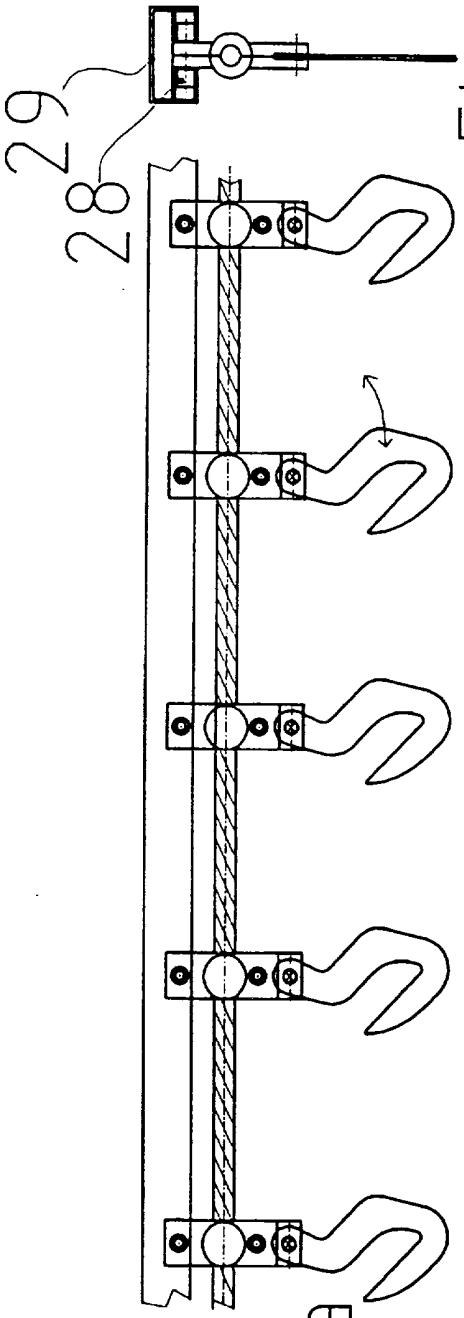

Fig. 10a

Fig. 10b

Suspension conveyor system comprising a load hook for picking up various objects

The invention relates to a suspension conveyor system comprising: support surfaces for carrying objects; a plurality of load hooks arranged to pick up these objects from the support surfaces and to deposit the objects thereon; conveyor means for automatically transporting the load hooks; joints by means of which the load hooks are linked to the conveyor means, said joints allowing the load hooks to be pivoted about a pivoting axis extending transversely to the conveying direction; pivoting means for pivoting the load hooks about the pivoting axis to pick up and/or deposit objects; each load hook comprising an inner receiving space having an inner face leg extending inwardly from the free end of the load hook.

Such a load hook has been known from WO 95/27674, for example. Such a load hook can pick up objects from a carrier bar or deposit them thereon. In so doing, the load hook may be conveyed continuously, i.e. it may pick up or deposit the objects automatically during the transport movement of the load hook. For this purpose, a link end of the load hook is linked pivotally to a conveyor means, while a free end of the load hook comprises an entry opening through which the objects can enter into the inner hook space. The entry opening faces downwards while picking up an object. When the entry opening is moved over an object, the hook and thus the entry opening can easily pivot downwardly to pick up the object to be entrained in the entry opening. Thus, the object to be entrained is caught in the entry opening and can be pushed along the support surface until the end of the carrier bar comprising the support surface is reached, where the hook is released and thus pivots downwardly, receiving the object completely in the inner hook space.

While this technique has proven highly advantageous to pick up and deposit objects without interrupting the transport movement of the load hook, on the fly so to speak, some drawbacks have

arisen therein. Firstly, the variety of different types of objects to be conveyed in the same suspension conveyor system is limited by the size of the entry opening. Typical objects to be conveyed in such suspension conveyor systems include coat hangers, for example in textile stocks, in major and minor dry cleaning shops, and in the textile manufacturing industry where individual work pieces may be conveyed to various processing stations. In particular with respect to coat hangers, there is the problem of varying cross-sections, for example including very small cross-sections of coat hanger hooks made of wire material as opposed to large cross-sections, e.g. 10 mm, of coat hanger hooks made of plastics. A further problem resides in bundling, e.g. with the hook necks of a plurality of coat hangers being tied together, using adhesive tape, for example. The load hook according to WO 95/27674 is limited with respect to its versatility in picking up varying coat hangers, in particular if bundles of coat hangers are involved.

Another problem of conventional suspension conveyor systems resides in the logistic area. Suspension conveyor systems such as the one disclosed in WO 95/27674 are not capable of picking up a plurality of objects on one load hook, let alone loading additional objects onto a load hook already carrying one or several objects. This problem is not only due to the abovementioned problem of the entry opening size but in particular to the problem of achieving such an automatic additional loading during the continuous transport movement of the load hook, i.e. without stopping, decelerating or otherwise affecting the transport movement of the load hook. This problem is serious in particular due to the fact that a basic form of a suspension conveyor system comprises a plurality of load hooks which are arranged at intervals on a conveyor line, e.g. a conveyor chain, rope or cable, and cannot be uncoupled from this rope or chain. In a basic form, the rope or chain circulates in an endless loop, so that stopping of an individual load hook would imply stopping the whole suspension conveyor system, which is unacceptable from a production point of view. However, even if individual roller apparatuses are

used which can be uncoupled from a pulling means such as a chain or rope, as suggested by WO 95/27674, it is not an optimum solution to have to initiate an uncoupling operation and a subsequent coupling operation in order to load (additional) objects onto a load hook or to unload objects therefrom. Also in this situation, the optimum solution is to load and unload objects during the transport movement of the load hook.

The invention solves the problem of improving a suspension conveyor system of the abovementioned type such that increased flexibility in loading the load hook with objects is achieved.

According to the invention, this object is achieved in that the load hooks are suitable for automatically picking up individual or plural objects from the support surfaces without affecting the automatic transport movement of the load hooks, for which purpose the respective load hook is moved to a loading position in which the inner face leg is oriented substantially in the conveying direction and extends below the support surface, with an entry opening of the load hook extending above the inner face leg and oriented in the conveying direction.

Owing to this arrangement, the loading of objects is achieved - put in simple terms - in the manner of a fork lift, with the inner face leg of the load hook being comparable to a prong of a fork lift. This achieves a considerable advantage in that even objects arranged at intervals along the support surface can be collected on this inner face leg during loading like on a fork lift prong. Once the objects have been picked up from along the support surface, the load hook can be either pivoted so that the objects cannot drop down any more, or a retaining element can be projected at the free end of the load hook so as to prevent the objects from dropping in the unpivoted state of the load hook. In a basic form, the retaining element might be a pin extensible from the inner face leg at the free end of the load hook.

This design clearly shows that on the one hand a large receiving opening into the inner space of the load hook can be realised such as to be oriented in the conveying direction when loads are to be picked up, which allows any objects of different sizes to be picked up, and on the other hand the loading of objects is facilitated in that various objects can be picked up one after another along a support surface and can then be conveyed continuously to another support surface, e.g. another processing station, and additional objects can be loaded by bringing the load hook into the loading position again. Making another comparison with everyday life, the suspension conveyor system of the invention resembles a bus traffic allowing various passengers to get on board one after another, as opposed to a conventional motorbike traffic where the motorbike size is adapted to the specific motorbike drivers. This comparison illustrates in a particularly clear manner that not only the flexibility of the objects to be conveyed but also the conveying efficiency, i.e. the number of objects conveyed per unit time, can be enhanced to a considerable extent by the suspension conveyor system according to the invention.

An advantageous embodiment of the invention is characterised in that the respective support surface forms part of a carrier bar extending parallel to the conveying direction, and the inner face leg is rectilinear and arranged to be pivoted to the loading position by means of the pivoting means such that the inner face leg extends parallel to, and below, the support surface.

Even though a pivoting movement of the load hook into the loading position is not mandatory (as indicated above), the pivoting movement provides an advantage in that the load hook may be effectively brought to a rest position when idling and thus be stored, or conveyed in an empty state thereof, in a compact manner. Another effect achieved is that the load hook may push the objects along the carrier bar even when the load hook is not completely pivoted to its loading position, and may

then pick up the objects, like a fork lift does, at a suitable place by finally pivoting to its loading position. Therefore, the overall effect of the pivotability of the load hook is particularly advantageous because simple unloading of the load hook is achieved by pivoting the load hook to its unloading position; hence, a complicated ejection mechanism can be dispensed with.

An advantageous embodiment is provided such that the pivoting means is formed as a groove extending in the longitudinal direction of the carrier bar and defined by two groove walls and a groove bottom, the transport movement of the load hook causing the load hook to pivot automatically into said groove to the loading position.

Alternatively, the carrier bar may simply consist of two parallel walls or rails forming a slot therebetween into which the load hook can plunge. In another exemplary alternative arrangement, the objects may project laterally from a single bar having no groove. The essential aspect is that the inner face leg of the load hook can travel below the objects to realise the fork lift concept so to speak.

According to another advantageous embodiment of the carrier bar groove variation, the suspension conveyor system is arranged such that the load hook comprises an outer hook surface which engages the groove bottom both while pivoting to the loading position, in order to guide and pivot the load hook to its loading position, and while being in the loading position.

In this manner, the groove may act as a template or cam plate to cause the load hook to pivot in a controlled fashion. Alternatively, such controlled pivoting may be accomplished by lateral projections of the load hook which slide along rockers like on a cam plate. Anyhow, as mentioned above, a pivoting movement is not necessary prior to loading because the natural loading position may be identical to the transport position of the load hook; in this case, however, additional measures have

to be taken to prevent the objects from falling down.

Advantageously, the groove bottom may be arranged such as to start from the support surface (as seen in the conveying direction) and to descend in a curved manner into the depth of the carrier bar to a place of maximum depth from which the further part of the groove bottom extends linearly in the conveying direction.

The unloading issue has to be considered in addition to the loading issue. To unload the conveyed objects, they are preferably deposited on a carrier bar again. As indicated above, this could be achieved by an ejection mechanism in the load hook. According to a preferred embodiment of the invention, however, automatic unloading of the load hook is achieved in that a portion of the outer hook surface extending from the free end of the load hook is arranged to abut on an abutment member in the conveying direction due to the transport movement of the load hook, the abutment member pivoting the load hook to the unloading position due to the continuing transport movement of the load hook.

A particular advantageous aspect of this advantageous embodiment is that the conveying movement of the load hook is utilised to pivot the latter. However, to achieve the same object in a manner similar to the abovementioned optional pivoting movement of the load hook to its loading position, the unloading operation may also be supported by any suitable rocker engaging any part of the hook, or a projection disposed on the hook, in order to pivot the load hook to the unloading position using the transport movement of the load hook. In the unloading position, the objects slide along the inclined inner face leg onto the carrier bar, the inner face leg forming an oblique plane; the objects may be conveyed further from that carrier bar by means of a worm conveyor or by gravitation along an inclined carrier bar or may be finally stored there until they are withdrawn manually, for example.

According to an alternative embodiment for pivoting the load hook to its unloading position, the suspension conveyor system is arranged such that the inner hook surface is followed, toward the joint, by a portion of the outer hook surface which abuts on a rocker due to the transport movement of the load hook in order to automatically unload the load hook, the rocker being arranged to pivot the load hook to the unloading position and further to an upwardly pivoted empty conveying position due to the continuing transport movement of the load hook, and holding the load hook in this position.

It is advantageous for the conveyor means to comprise a plurality of respective roller apparatuses to which the load hooks are linked. Owing to this arrangement, the objects may be advantageously brought to the loading area independently of the roller apparatuses and the load hooks linked to the roller apparatuses can pick up the objects in the loading area. This means that in a first phase the roller apparatuses are not required in the loading area but objects can be accumulated on a carrier bar and a roller apparatus for picking up the objects does not have to be provided until any desired point in time. This may be accomplished in a particularly advantageous manner in that the objects are transferred to the loading area by means of an object transfer mechanism independent of the conveyor means, and the object to be loaded triggers a signal releasing a roller apparatus from a group of roller apparatuses, the roller apparatus being coupled for automatic conveyance and thus transported to the loading area where the signal-triggering object is automatically picked up by the load hook linked to the roller apparatus. This variation automatically achieves the effect that the respective roller apparatus is provided "just in time".

The object transfer mechanism is advantageously constituted by a worm conveyor. On the other hand, any type of conveyor may be used. The objects may be even moved manually to the loading area.

In order to be able to implement a suspension conveyor system as compact as possible, it is particularly advantageous if the free hook end is displaced transversely to the conveying direction with respect to a link centre of the load hook, as seen in a plan view, to enable a compact, tile-type nesting of neighbouring load hooks of roller apparatuses neighbouring each other within a group, thus realising an optimum group density. This nesting allows a very compact grouping of roller apparatuses independently of the dimensions of the load hooks. As a rule, the dimension of the load hooks in the conveying direction will exceed that of the roller apparatuses, at least when these have been brought to an empty conveying state or are stored in a dense grouping area. The nesting, or the load hook geometry required for such nesting, achieves the effect that the group density is determined only by the housing dimensions of the roller apparatuses in the conveying direction or by the track rollers thereof, but not by the size of the load hooks.

According to a particularly simple, inexpensive and reliable embodiment of the suspension conveyor system, the conveyor means comprises a chain or traction cable to which the plurality of load hooks are linked at a distance from each other. Although this variation does not ensure the same flexibility and sorting facility as roller apparatuses do which can be uncoupled, this embodiment is still very economic and reliable and is to be seriously contemplated also for the reason that the invention realises automatic loading and unloading without affecting the transport movement of the load hooks so that even transport hooks which travel along an endless circuit and cannot be uncoupled meet their purpose perfectly.

As has already been mentioned above, the suspension conveyor system according to the invention is also distinguished by an advantageous logistic design in which a pre-loaded load hook is arranged to automatically receive additional objects from another support surface without affecting the continuous transport movement of the load hooks.

Preferred exemplary embodiments of the invention will be explained in greater detail with reference to drawings wherein

Figure 1a is a lateral view of part of the suspension conveyor system, showing the individual load hooks being loaded with a respective object until a point in time just before the load hooks are pivoted to the final conveying position;

Figure 1b is a representation corresponding to Figure 1a, with one of the load hooks also shown in the final conveying position in which an object is conveyed freely suspended;

Figure 2a is a representation corresponding to Figure 1a, with a plurality of individual and different objects being loaded onto a load hook;

Figure 2b is a representation corresponding to Figure 2a, with one of the load hooks also shown in the final conveying position in which a plurality of objects are conveyed freely suspended;

Figure 3a is a representation corresponding to Figure 2a, with the plurality of different objects tied together to form a bundle and each load hook picking up a bundle;

Figure 3b is a representation corresponding to Figure 3a, with one of the load hooks also shown in the final conveying position in which a bundle of objects is conveyed freely suspended;

Figure 4a is a lateral view of part of the suspension conveyor system, showing the process of unloading objects from load hooks each carrying one object, with one of the load hooks shown in its unloading position pivoted completely upwardly;

Figure 4b is a representation corresponding to Figure 4a, however without showing a load hook pivoted completely upwardly;

Figures 5a and 5b are representations corresponding to Figures 4a and 4b, with each load hook carrying and unloading a plurality of different objects;

Figures 6a and 6b are representations corresponding to Figures 5a and 5b, with each plurality of objects tied together to form a bundle carried by, and unloaded from, a respective load hook;

Figure 7a is a lateral view of part of the suspension conveyor system, showing the process of loading an additional object onto a load hook already carrying several objects;

Figure 7b is a representation corresponding to Figure 7a, with one of the load hooks shown in its final conveying position after another object has been added, the objects being conveyed suspended freely;

Figure 8a shows a dense grouping position of roller apparatuses carrying load hooks nested into each other to achieve an optimum group density;

Figure 8b is a plan view of the nested load hooks;

Figure 8c is a representation corresponding to Figure 8a, wherein the nested load hooks are partially loaded with one or plural objects;

Figure 9a is a lateral view of a free path portion of the suspension conveyor system wherein the load hooks are linked directly to a conveyor chain without intermediate roller apparatuses;

Figure 9b is a front view of the conveyor portion according to Figure 9a;

Figure 10a is a representation corresponding to Figure 9a, wherein the traction member is not constituted by a chain but by a cable, and the load hooks are linked directly to the

traction cable without any intermediate roller apparatuses;

Figure 10b is a front view of the conveyor portion shown in Figure 10a.

Figure 1a shows a preferred embodiment of the suspension conveyor system in the loading area thereof. According to this embodiment, the load hooks 1 are pivotally linked to roller apparatuses 2 through joints 3. The roller apparatuses 2 can be transported along a profiled roller rail 5 by means of a drive coupler 4, with the rollers 6 of the roller apparatuses 2 supported by roller rail 5. The drive couplers 4 are transported by a chain 7 and, thus, can transport the roller apparatuses 2 with the load hooks 1 linked thereto from the left-hand side to the right-hand side in the drawing. In the position designated A, the load hook is pivoted completely upwardly clockwise. The free hook end 8 is supported by a rocker 9. Depending on the extension of rocker 9 from the right-hand side to the left-hand side of the drawing, the load hook can be kept in its position pivoted completely upwardly clockwise although the load hook is transported from the left-hand side to the right-hand side, with the free end 8 of load hook 1 slidingly supported by rocker 9. While according to the illustration the load hook moves from the left-hand side to the right-hand side and the roller apparatus, drive coupler and drive chain simultaneously move from the left-hand side to the right-hand side due to their positive interconnection, the object 10 is moved independently of the load hook by a worm conveyor (not shown) into the vicinity of the loading area, which is substantially designated by the areas B and C. In predetermined proximity of the areas B and C, the load hook 1 is released from its empty conveying position A, for example from an accumulated group of roller apparatuses. In a preferred arrangement, such as the one shown in Figure 8a, the roller apparatuses may be accumulated in a position in which the load hooks are not pivoted clockwise upwardly. In that case, a very short rocker could be used which pivots the load hooks only for a short period, i.e. over a short transport path, upwardly.

When the load hook 1 is released from position A, the free hook end 8 falls onto the carrier bar 11 and, thus, continues to drag the object 10 from the left-hand side to the right-hand side into position B situated in the immediate loading area. During this phase, an outer surface 12 of the load hook 1 engages the curved groove bottom 13, while the object 10 which was first entrained along carrier bar 11 by the free hook end 8 slides down an inclined carrier bar plane 14 and, thus, is ahead of load hook 1 which is continuously transported from the left-hand side to the right-hand side. The outer surface 12 of load hook 1 acts as a cam follower on the groove bottom 13 such as to positively pivot the load hook counter-clockwise to a position in which an inner face leg 15 of the load hook extends parallel to, and slightly below, a support surface 16 of carrier bar 11 on which the objects 10 rest. During this operation, in position C, the entry opening 17 of load hook 1 is oriented in the conveying direction. The objects 10 are thus picked up in the loading area C, like by a fork lift prong; the entry opening 17, or entry plane, of load hook 1 extends relatively high in the vertical direction and, thus, allows relatively high and different objects to be picked up by the load hook 1. The final conveying position is designated D in Figure 1b. After the loaded load hook has left the carrier bar 11, the load hook 1 swings - by gravitation or possibly by an assisting spring mechanism - to the final conveying position, in which the object 10 is transported suspended freely from the load hook 1. Owing to this automatic pivoting movement, the inner face leg 15 is inclined upwardly and the gravitational force holds object 10 on the bottom of the substantially U-shaped inner hook space. The objects 10 are thus secured in the load hook because otherwise they could fall out of the hook in position D only if they were pushed against the inclined plane formed by the inner face leg in this position, and upwardly against the gravitational force beyond the free end 8 of load hook 1. In an immediately alternative embodiment, however, the load hook according to position C in Figure 1a may have reached its final position, i.e. the load hook may cease pivoting further counter-clockwise. Then other means would have to

ensure that the objects do not slide beyond the free hook end 8. This may be accomplished by an element provided to close the entry opening 17. To this end, one might conceive a pin actuable by a rocker and extensible from the plane of the inner face leg in a direction closing the entry opening. Alternatively, closing latches may be provided, for example such that entry into the hook is enabled by urging away a latch closed by a resilient or gravitational force whereas this latch cannot be opened from the interior of the hook space.

Figures 2a and 2b show the same portion of the suspension conveyor system as that in Figures 1a and 1b, but with a plurality of objects 10 being loaded onto the load hook 1. Like in Figures 1a and 1b, the various positions of the load hook are designated A, B, C and D. It is also apparent that the objects are different from each other, for example a coat hanger hook 18 having a large cross-section is shown beside a coat hanger hook 19 having a small cross-section. This allows a load hook 1 to be loaded not only with a plurality of varying objects 10 but even with mixtures of different objects. The superior concept becomes apparent again. In the loading area, the load hook picks up the objects 10 like a fork lift prong and is capable of pushing the various objects together. To facilitate the accumulating action, a mechanical resistance may be provided in the form of a closing spring 20 which is bent away by the load hook and the objects that the load hook pushes along the carrier bar 11.

Figures 3a and 3b show an illustration corresponding to Figures 2a and 2b except that the individual groups of objects 10 are bundled by means of an adhesive tape 21. While in this embodiment the load hook is not required to push the various objects together because these are already closely tied together, the present suspension conveyor system proves to be superior again: Although the bundle projects relatively high above the support surface in the vertical direction, this constitutes no problem for the bundle entering into the load hook because the loading position of load hook 1 presents the

vertically high entry opening 17.

Figures 4a and 4b show the portion of the suspension conveyor system in which an unloading operation takes place. In this embodiment, the transport movement of the load hook from the left-hand side to the right-hand side causes a hook portion 22 to abut onto an abutment member 30 constituted by a roller in the present case. Due to the transport movement of the load hook, the latter is made to pivot clockwise in the further course of movement, whereby the inner face leg 15 is first pivoted back clockwise to the horizontal position and then pivoted further, beyond this horizontal position, to a position in which the inner face leg 15 extends downwardly presenting an inclined plane descending from the bottom of the inner hook surface toward the free hook end 8 so that the objects 10 slide down onto the carrier bar 11. Like during picking up of the objects 10, these objects will then be dragged along the carrier bar 11 by the free hook end 8.

The inner hook surface is followed by a portion 23 of the outer hook surface extending toward the joint 3. In the further course of conveyance, this portion 23 abuts on rocker 9, more specifically on the inclined rocker portion 24. This results in the load hook 1 being pivoted further clockwise to an empty conveying position pivoted completely upwardly, this position being designated F. This further clockwise pivoting movement assists, on the one hand, in unloading the load hook 1 completely onto the carrier bar 11 and, on the other hand, in pivoting the load hook out of the way in a compact manner. The discharged objects 10 can then be conveyed further from the unloading area along an inclined carrier bar portion 25 by gravitational conveyance. Of course, other conveyor means such as a worm conveyor can be used. The empty load hooks may be accumulated in their upwardly pivoted state F, forwarded to the next loading area, or released to the normal position G in the further course of conveying for accumulation or conveyance.

Figure 4b again illustrates position E in which the objects 10

are dragged by the free hook end 8 along the carrier bar 11.

According to this embodiment, the transport movement of the load hook was utilised to pivot the hook from the loaded normal position to the unloading position and back to the unloaded normal position; to this end, the abutment member 30 in the form of a roller engaged the portion 22 of the outer face of load hook 1, and then the portion 23 following the inner hook surface toward the joint 3 engaged the rocker 9. Alternatively, however, the pivoting movement may be effected by any other portions of the hook and by interaction of these portions with rockers or abutment members utilising the transport movement of the hook. Indeed, other pivoting mechanisms such as levers, or even drive means such as motors, may be used. However, a particularly economic and reliable embodiment will be achieved if the pivoting movement of the load hook is caused by the transport movement of the hook.

Figures 5a and 5b show the corresponding portion of the suspension conveyor system in which the unloading operation is performed; this unloading operation is similar to that described with reference to Figures 4a and 4b except that a plurality of loose objects collected and conveyed on one hook are unloaded in the present case.

Figures 6a and 6b show an unloading operation analogous to the one described with reference to Figures 5a and 5b except that the plurality of objects 10 carried by each hook are bundled.

A particular embodiment of the logistic design of the suspension conveyor system is shown in Figures 7a and 7b. This embodiment concerns the possibility of loading additional objects onto a load hook 1 already loaded with objects. As can be seen, the load hook is first loaded with two objects 10 in loading position D; then portion 22 of the outer hook surface following the free end 8 of load hook 1 abuts on an abutment member 26 which pivots the load hook 1 clockwise to the loading position C due to the transport movement of the load hook; in

the loading position C, the inner face leg 15 is oriented horizontally and, thus, can engage a further object 10 from below which rests on the support surface 16 of carrier bar 11. In the further course of operation, this additional object is thus pushed onto the inner face leg 15, and the position resembles the loading position C as shown in Figure 2a, for example. As shown in Figure 7b, the load hook 1 can then be released from carrier bar 11 and swing back to the final loaded position D by the action of gravitation.

A particularly advantageous embodiment is shown in Figures 8a and 8b wherein the load hooks 1 are nested into each other in a tile-type arrangement, i.e. overlapping each other in a dense group. This embodiment is interesting when using roller apparatuses 2 and allows to achieve a considerable group density which is determined only by the housing dimension of the roller apparatuses 2 or the dimension of the transport rollers 6. The plan view of the hooks is shown in Figure 8b. As can be seen therein, each free hook end 8 is laterally displaced with respect to the link centre of joint 3. This arrangement enables a tile-type overlapping of the load hooks 1 when grouped together.

As shown in Figure 8c, such nesting or overlapping of the load hooks 1 is even possible when they have been loaded with objects 10. This in particular implies a storage advantage, i.e. enables numerous objects 10 to be grouped together or stored in a limited space within the suspension conveyor system.

Figure 9a shows a lateral view of a straight conveying path in an embodiment dispensing with roller apparatuses. Instead the load hooks 1 are mounted directly on the conveyor chain 7 through respective mounting pieces 27 and joints 3. Any type of chain may be used, such as a round steel chain, bush chain or roller chain.

In a basic form, the joint 3 may be embodied by a pin

penetrating aligned through bores of the mounting piece 27 and load hook 1. The pin thus constitutes a pivot axle, and the mounting piece 27 may comprise a groove and thus be bifurcated so to speak, in order to receive the load hook 1 in the groove by means of the pin. In particular if a bush chain or roller chain is used, as schematically shown in Figure 9a, the mounting piece 27 may be mounted directly on extended axles of the chain links, with these axles oriented vertically. In this embodiment, only the chain has to be guided, and a plurality of load hooks 1 are mounted at intervals on the chain 7 through respective mounting pieces 27. Since the suspension conveyor system allows objects to be loaded and unloaded and even added during movement of the conveyor, the chain 7 may circulate in an endless loop and all load hooks may be in a state of permanent transport movement. In the embodiment illustrated in Figure 9, the conveying direction is from the right-hand side to the left-hand side, as opposed to the previous representations. Figure 9b shows a front view of the conveyor path according to Figure 9a.

A further alternative arrangement is shown in Figure 10a according to which the conveyor chain shown in Figure 9a has been replaced by a conveyor rope or cable. Figure 10b shows a front view of this alternative. In contrast to the conveyor path shown in Figures 9a and 9b, it is recommended to provide a cable conveyor with additional guiding means, for example in the form of rollers or slide elements 28 running in a guide profile 29.

Claims

1. A suspension conveyor system comprising:

support surfaces (16) for carrying objects (10);

a plurality of load hooks (1) arranged to pick up these objects (10) from the support surfaces (16) and to deposit the objects (10) thereon;

conveyor means for automatically transporting the load hooks (1);

joints (3) by means of which the load hooks (1) are linked to the conveyor means, said joints (3) allowing the load hooks (1) to be pivoted about a pivoting axis extending transversely to the conveying direction;

pivoting means for pivoting the load hooks (1) about the pivoting axis to pick up and/or deposit objects (10);

each load hook (1) comprising an inner receiving space having an inner face leg (15) extending inwardly from the free end (8) of the load hook (1);

characterised in that

the load hooks (1) are suitable for automatically picking up individual or plural objects (10) from the support surfaces (16) without affecting the automatic transport movement of the load hooks (1), for which purpose the respective load hook (1) is moved to a loading position in which the inner face leg (15) is oriented substantially in the conveying direction and extends below the support surface (16), with an entry opening (17) of the load hook (1) extending above the inner face leg (15) and oriented in the conveying direction.

2. The suspension conveyor system according to claim 1, characterised in that the respective support surface (16) forms part of a carrier bar (11) extending parallel to the conveying direction, and the inner face leg (15) is rectilinear and arranged to be pivoted to the loading position by means of the pivoting means such that the inner face leg (15) extends parallel to, and below, the support surface.

3. The suspension conveyor system according to claim 2,

characterised in that the pivoting means is formed as a groove extending in the longitudinal direction of the carrier bar (11) and defined by two groove walls and a groove bottom (13), the transport movement of the load hook (1) causing the load hook (1) to pivot automatically into said groove to the loading position.

4. The suspension conveyor system according to claim 3, characterised in that the load hook (1) comprises an outer hook surface which engages the groove bottom (13) both while pivoting to the loading position, in order to guide and pivot the load hook (1) to its loading position, and while being in the loading position.

5. The suspension conveyor system according to claim 4, characterised in that the groove bottom (13) is arranged such as to start from the support surface (16), as seen in the conveying direction, and to descend in a curved manner into the depth of the carrier bar (11) to a place of maximum depth from which the further part of the groove bottom (13) extends linearly in the conveying direction.

6. The suspension conveyor system according to any of claims 1 to 5, characterised in that a portion (22) of the outer hook surface extending from the free end (8) of the load hook (1) is arranged to abut on an abutment member (30) in the conveying direction due to the transport movement of the load hook (1), the abutment member (30) pivoting the load hook (1) to the unloading position due to the continuing transport movement of the load hook (1) in order to automatically unload the load hook (1).

7. The suspension conveyor system according to any of claims 1 to 5, characterised in that the inner hook surface is followed, toward the joint (3), by a portion (23) of the outer hook surface which abuts on a rocker (9) due to the transport movement of the load hook (1) in order to automatically unload the load hook (1), the rocker (9) being arranged to pivot the

load hook (1) to the unloading position and further to an upwardly pivoted empty conveying position due to the continuing transport movement of the load hook (1), and holding the load hook (1) in this position.

8. The suspension conveyor system according to any of claims 1 to 7, characterised in that the conveyor means comprises a plurality of respective roller apparatuses (2) to which the load hooks (1) are linked.

9. The suspension conveyor system according to claim 8, characterised in that the objects (10) are brought to the loading area independently of the roller apparatuses (2) and the load hooks (1) linked to the roller apparatuses (2) can pick up the objects (10) in the loading area.

10. The suspension conveyor system according to claim 9, characterised in that the objects (10) are transferred to the loading area by means of an object transfer mechanism independent of the conveyor means, and the object (10) to be loaded triggers a signal releasing a roller apparatus (2) from a group of roller apparatuses (2), the roller apparatus (2) being coupled for automatic conveyance and thus transported to the loading area where the signal-triggering object (10) is automatically picked up by the load hook (1) linked to the roller apparatus (2).

11. The suspension conveyor system according to claim 10, characterised in that the object transfer mechanism is constituted by a worm conveyor.

12. The suspension conveyor system according to any of claims 8 to 11, characterised in that the free hook end (8) is displaced transversely to the conveying direction with respect to a link centre of the load hook (1), as seen in a plan view, to enable a compact, tile-type nesting of neighbouring load hooks (1) of roller apparatuses (2) neighbouring each other within a group, thus realising an optimum group density.

13. The suspension conveyor system according to any of claims 1 to 7, characterised in that the conveyor means comprises a chain or traction cable to which the plurality of load hooks (1) are linked at a distance from each other.

14. The suspension conveyor system according to any of claims 1 to 13, characterised by a logistic design in which a pre-loaded load hook (1) is arranged to automatically receive additional objects (10) from another support surface (16) without affecting the continuous transport movement of the load hook (1).

Amendments to the claims have been filed as follows

1. A suspension conveyor system comprising:

support surfaces (16) for carrying objects (10);

a plurality of load hooks (1) arranged to pick up these objects (10) from the support surfaces (16) and to deposit the objects (10) thereon;

conveyor means for automatically transporting the load hooks (1);

joints (3) by means of which the load hooks (1) are linked to the conveyor means, said joints (3) allowing the load hooks (1) to be pivoted about a pivoting axis extending transversely to the conveying direction;

pivoting means for pivoting the load hooks (1) about the pivoting axis to pick up and/or deposit objects (10);

each load hook (1) comprising an inner receiving space having an inner face leg (15) extending inwardly from the free end (8) of the load hook (1); wherein

the load hooks (1) are suitable for automatically picking up individual or plural objects (10) from the support surfaces (16) without affecting the automatic transport movement of the load hooks (1), for which purpose the respective load hook (1) is moved to a loading position in which the inner face leg (15) is oriented substantially in the conveying direction and extends below the support surface (16), with an entry opening (17) of the load hook (1) extending above the inner face leg (15) and oriented in the conveying direction;

the respective support surface (16) forms part of a carrier bar (11) extending parallel to the conveying direction, and the inner face leg (15) is rectilinear and arranged to be pivoted to the loading position by means of the pivoting means such that the inner face leg (15) extends parallel to, and below, the support surface; and

the pivoting means is formed as a groove extending in the longitudinal direction of the carrier bar (11) and defined by two groove walls and a groove bottom (13), the transport movement of the load hook (1) causing the load hook (1) to pivot automatically into said groove to the loading position.

2. The suspension conveyor system according to claim 1, characterised in that the load hook (1) comprises an outer hook surface which engages the groove bottom (13) both while pivoting to the loading position, in order to guide and pivot the load hook (1) to its loading position, and while being in the loading position.

3. The suspension conveyor system according to claim 2, characterised in that the groove bottom (13) is arranged such as to start from the support surface (16), as seen in the conveying direction, and to descend in a curved manner into the depth of the carrier bar (11) to a place of maximum depth from which the further part of the groove bottom (13) extends linearly in the conveying direction.

4. The suspension conveyor system according to any of claims 1 to 3, characterised in that a portion (22) of the outer hook surface extending from the free end (8) of the load hook (1) is arranged to abut on an abutment member (30) in the conveying direction due to the transport movement of the load hook (1), the abutment member (30) pivoting the load hook (1) to the unloading position due to the continuing transport movement of the load hook (1) in order to automatically unload the load hook (1).

5. The suspension conveyor system according to any of claims 1 to 4, characterised in that the inner hook surface is followed, toward the joint (3), by a portion (23) of the outer hook surface which abuts on a rocker (9) due to the transport movement of the load hook (1) in order to automatically unload the load hook (1), the rocker (9) being arranged to pivot the load hook (1) to the unloading position and further to an upwardly pivoted empty conveying position due to the continuing transport movement of the load hook (1), and holding the load hook (1) in this position.

6. The suspension conveyor system according to any of claims 1 to 5, characterised in that the conveyor means comprises a

plurality of respective roller apparatuses (2) to which the load hooks (1) are linked.

7. The suspension conveyor system according to claim 6, characterised in that the objects (10) are brought to the loading area independently of the roller apparatuses (2) and the load hooks (1) linked to the roller apparatuses (2) can pick up the objects (10) in the loading area.

8. The suspension conveyor system according to claim 7, characterised in that the objects (10) are transferred to the loading area by means of an object transfer mechanism independent of the conveyor means, and the object (10) to be loaded triggers a signal releasing a roller apparatus (2) from a group of roller apparatuses (2), the roller apparatus (2) being coupled for automatic conveyance and thus transported to the loading area where the signal-triggering object (10) is automatically picked up by the load hook (1) linked to the roller apparatus (2).

9. The suspension conveyor system according to claim 8, characterised in that the object transfer mechanism is constituted by a worm conveyor.

10. The suspension conveyor system according to any of claims 6 to 9, characterised in that the free hook end (8) is displaced transversely to the conveying direction with respect to a link centre of the load hook (1), as seen in a plan view, to enable a compact, tile-type nesting of neighbouring load hooks (1) of roller apparatuses (2) neighbouring each other within a group, thus realising an optimum group density.

11. The suspension conveyor system according to any of claims 1 to 5, characterised in that the conveyor means comprises a chain or traction cable to which the plurality of load hooks (1) are linked at a distance from each other.

12. The suspension conveyor system according to any of claims 1

to 11, characterised by a logistic design in which a pre-loaded load hook (1) is arranged to automatically receive additional objects (10) from another support surface (16) without affecting the continuous transport movement of the load hook (1).

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Application No: GB 0010978.5 26 **Examiner:** Paul Makin
Claims searched: 1-14 **Date of search:** 14 August 2000

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): B8A (AGA, AGB, ALA)

Int Cl (Ed.7): B65G 17/20, 47/61

Other: Online : WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	US 2816643 (KLAMP) see particularly Figure 12	1,7,8,9, 13 & 14

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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