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**Separation, synchronization and compression device**

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(56) Related Art
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**US 5713403**
**US 5667055**

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## ABSTRACT

A packaging device is presented for the separation, synchronization and compression of articles of all types with at least one rotating pair of drive elements, with at least one transverse rod arranged on each pair of drive elements, with a controlled drive motor for each pair of drive elements, characterized in that the design of the device is such that separation, synchronization and compression are carried out by the at least one pair of drive elements.

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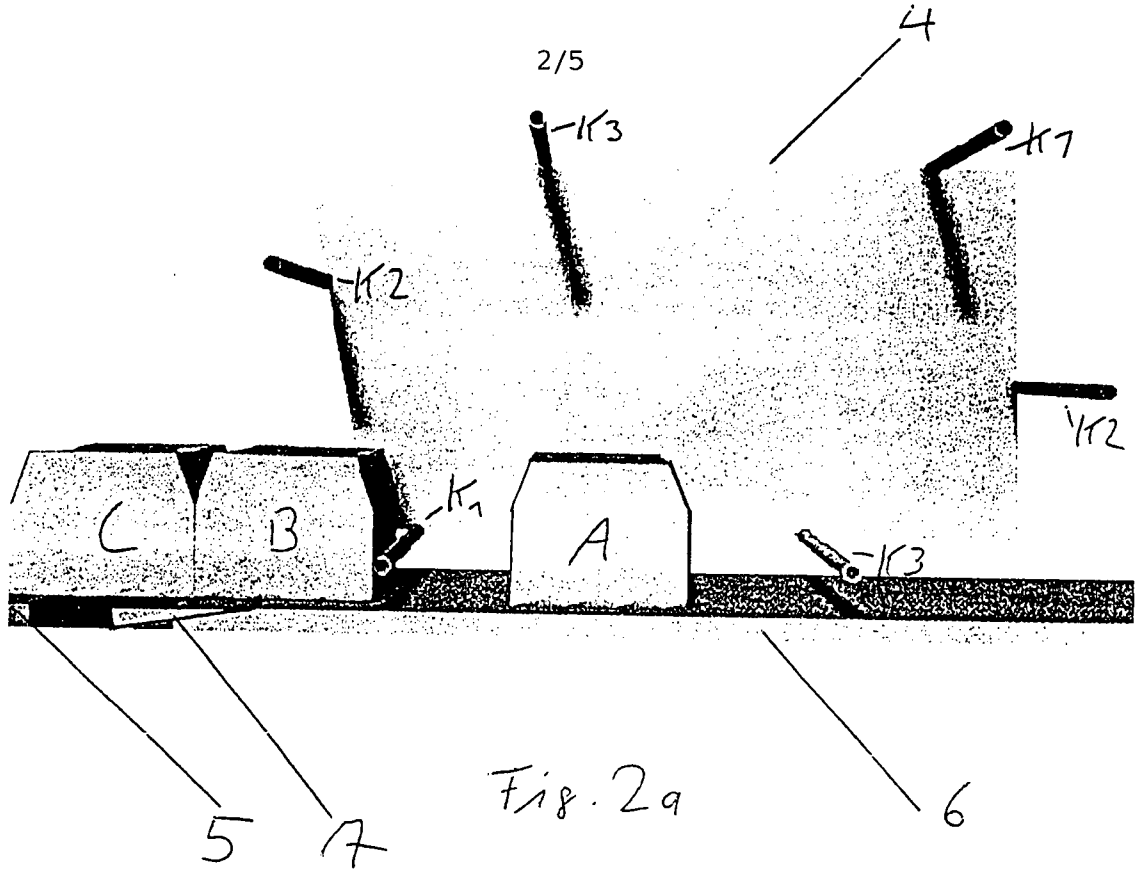


Fig. 2a

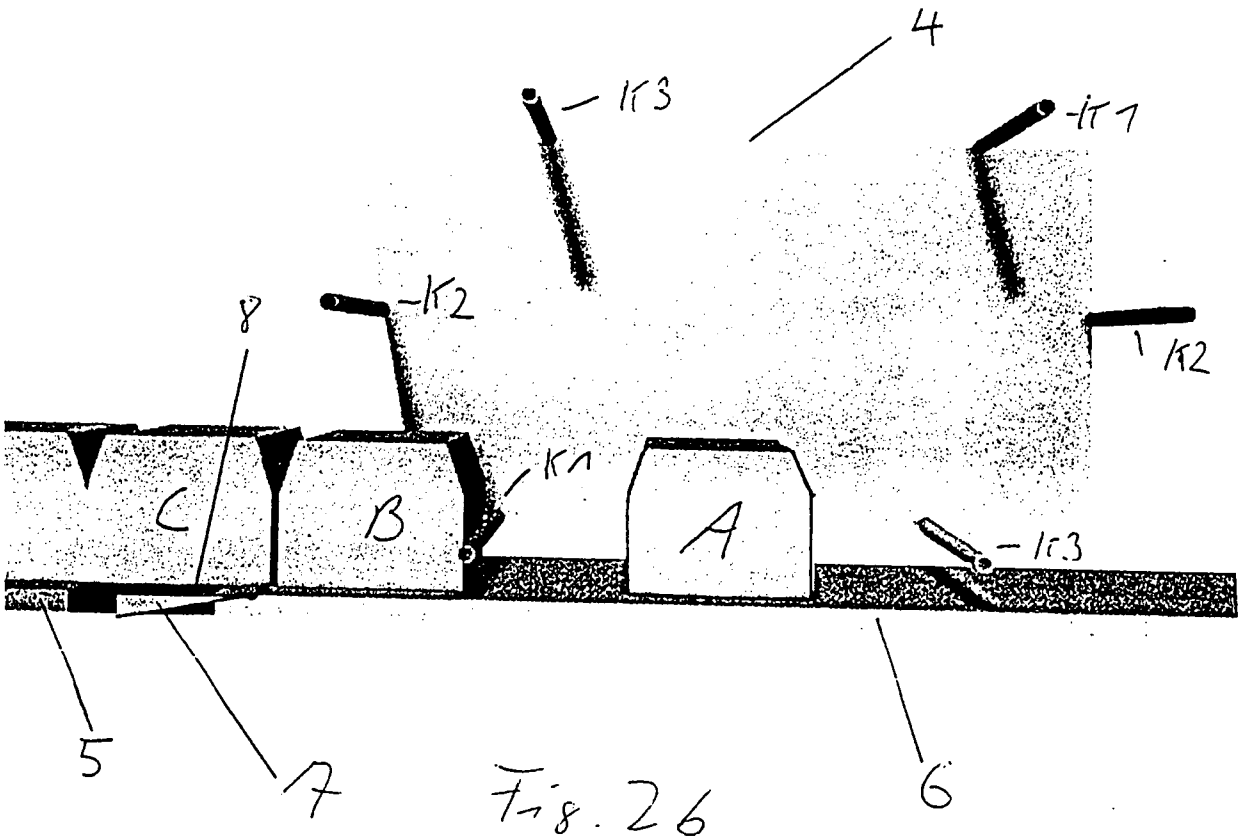


Fig. 2b

P001
Section 29
Regulation 3.2(2)

AUSTRALIA

*Patents Act 1990*

# COMPLETE SPECIFICATION

# STANDARD PATENT

Application Number:

Lodged:

Invention Title: **Separation, synchronization and compression device**

**The following statement is a full description of this invention, including the best method of performing it known to us:**

# SEPARATION, SYNCHRONIZATION AND COMPRESSION DEVICE

The present invention pertains to a device for separating, synchronizing and packaging articles in accordance with the preamble of claim 1.

Devices of this type are needed in packaging machines, in order to form or separate individual article groups or articles from continuous queues of fed article streams, which are subsequently packaged in cartons, boxes, trays and/or shrink-wrap film.

This packaging process consists of several sub-processes, in which it is the state-of-the-art to use individual machines for the implementation of these sub-processes, or at least to use individual, self-contained assemblies or modules.

First the article stream is fed to the separation device by a conveyor. The stream may consist of containers or goods of all types, such as, for example, bottles, bags, cans, cartons, pouch packs etc.

This conveyor is usually a device equipped with a wide conveyor belt, which is also equipped with sheet metal guides that form ordered channels above the conveyor belt.

These channels in turn subdivide the initially unordered incoming article stream into so-called rows.

By means of a suitable separation device, the desired article quantity is separated from this article stream, which is queued in individual channels, in which the article quantity is determined by multiplying the number of rows in the feed direction with the number of rows across the feed direction. The separated rows in feed direction in conjunction with the rows transverse to the feed direction comprise the so-called format that is to be packaged subsequently.

In order to enable any packaging of the format produced, it is necessary to create a gap between the produced format and the article stream following. This generally occurs by moving the article stream forward at an unchanged speed, while the created format is transported ahead at increased speed.

The next process step comprises the so-called compression, which serves to close gaps within the format resulting from the guides and possible displacements of the articles. To this end the format group is moved through

narrowing outer guides using a suitable device, which closes the gaps caused by the guides. At the same time, or subsequently, the format is pushed off the conveyor and onto a stationary plate, which also causes the gaps that are present within the rows in the feed direction to be closed.

Another important function that is performed during the compression phase is the correct positioning with respect to partitioning, but also the synchronization of the format with the machine cycle. This is necessary since spatial displacements arise constantly due to the delay, push-off and transfer of articles or of the format from or to moving or stationary components of the device, with the consequence that the format is not located at the position where it ought to be according to the planned course of movements.

Packaging of the compressed format takes place subsequently.

Numerous proposals have been made in the past for the implementation of the processes described above, in which the common element of all known proposals is that for at least the functions of separation and compression/synchronization dedicated, self-contained assemblies or modules are used, which means a high degree of effort in engineering design and manufacturing and the higher costs associated with it.

Likewise, devices that reflect the state-of-the-art have a large space requirement due to the numerous modules of which they are comprised.

A corresponding device was presented, for example, in DE 695 00 173. With this device, the article stream is first divided into individual rows of articles by finger-shaped elements entering the article stream from below, and the rows are transported further. The synchronization device then descends from above between the divided article rows and begins to push them, thereby synchronizing them.

This particular synchronization device consists of synchronously driven chains running parallel to and arranged on both sides of the container stream, in which several rods are arranged on said chains in such a way that the bars extend transverse to the direction of transport and thus take the articles along with them and synchronize them by means of their forward movement.

A particular characteristic of this device is that at the beginning of the synchronization two pairs of chains interlock, which at first causes each individual

article row to be transported by a dedicated transverse rod. After a certain distance one of the two chain pairs is diverted from the article stream, so that in the further course of the path only the remaining pair of chains performs the subsequent compression and synchronization, which also has the consequence that transverse rows (article rows transverse to the running direction) are transported by a single transverse rod, which in the end causes the actual format to be formed.

The disadvantage of this type of device is that a change of format is only possible by installation or removal of numerous transverse rods. In addition to that, the interlocking of both chain pairs and the further design characteristics of the device do not allow all desired formats to be produced.

Likewise a device according to US 3,194,382 was presented. With this device, all the transverse rows required for a format are formed directly at once upon separation from the article stream. With this proposal too, separation occurs through elements entering the article stream from below. Synchronization and compression occur by means of a chain pair located above the transport level, which is likewise equipped with transverse rods. This device too has the great disadvantage that changes of format can be achieved only by comprehensive refitting, especially of the separator unit, in which in addition to changing the chain used, relocation of the corresponding chain pulleys is necessary.

Likewise a device according to DE 298 07 979 became known. This device also works with separate assemblies for separating and synchronization/compression, in which a special device is suggested for separating the article groups. Guide tracks are provided for the separator unit instead of the known guide plates, in which these guide tracks are provided in such number that each longitudinal row of articles is surrounded on both sides by guide tracks. These guide tracks are implemented in two complete sets, in which each set is arranged at its own height level and these sets are located at two levels one on top of the other.

On each guide track comprises a so-called linear slide equipped with extendable and retractable retention levers.

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All linear slides are driven by a drive chain connected to each slide, in which all linear slides of a set or height level are driven by a shared servo motor and are moved synchronously.

Since the linear slides of the various sets are arranged at different heights, they can be moved back and forth completely independently of one another.

The separation of article groups occurs by a first set of linear slides with extended retention levers executing a forward movement, thereby holding back the article stream that presses on in relation to the faster moving conveyor belt. A second set of linear slides with retracted retention levers executes a reverse movement simultaneously.

As soon as this second set of linear slides reaches the end point of the reverse movement the retention levers are extended, which separates an article group from the article stream. Once the retention levers are extended, the first set of linear slides retracts its retention levers to free the leading edge of the article group just formed, which is thereupon transported further at the higher speed of the conveyor belt and at the same time creating a gap with respect to the article stream behind it, which is held back by the second set of linear slides.

The subsequent compression/synchronization of the article group takes place in a dedicated device in a known manner.

The disadvantage of such a device is that the stream of articles, which is already closely packed, must first be separated, among other things because the linear slides are arranged between the individual longitudinal rows. Further difficulties result from this arrangement due to the fact that during the compression very large gaps must be eliminated, which, particularly with articles sensitive to tipping, often causes them to topple. This is extremely undesirable in practical application.

Furthermore, processing of articles with a square cross-sectional area poses great difficulties since a closed outer surface is formed if several such articles are queued closely together, providing no suitable point of entry for the retention levers.

The great mechanical effort and cost in monetary terms of such a device is also clearly disadvantageous.

The task and objective of the present invention is to avoid the disadvantages described above and to create a device that allows the required costs, the number of components and the space requirements to be reduced significantly. For this purpose it is intended to combine the separating unit and the compression/ synchronization unit into a single unit.

In one aspect, the present invention provides apparatus for separating, synchronising and compacting for the packing of objects of all kinds, said apparatus having at least one inlet conveyor, at least one hold-back wedge, at least one main conveyor and at least one compacting unit, wherein the speed of the main conveyor is greater than that of the inlet conveyor, the said apparatus having at least one pair of driving elements disposed so as to rotate, at least one crossbar that is disposed at each pair of driving elements and a controlled drive motor for each pair of driving elements, wherein the at least one pair of driving elements has a controlled sequence of movement that includes different speeds, wherein the structural development of the apparatus is such that the separating is carried out by the hold-back wedge that is displaceable forward and backward and the synchronising and compacting of the objects is carried out by the at least one pair of driving elements, and wherein the speed of the main conveyor is constant.

In a second aspect, the present invention provides a method for the operation of an apparatus in accordance with the first aspect, wherein the sequence of movement of the at least one pair of driving elements and/or the at least one crossbar includes different speeds during one operating cycle.

The present invention will be explained in more detail below based on embodiments thereof.

In particular

Figure 1 shows a device according to the invention in a simplified, perspective representation, and

Figures 2a through 2g: show a course of movements in accordance with the invention in a likewise simplified representation.

Further developments, advantages and application possibilities of the invention are apparent from the following description of embodiments and the drawing. All characteristics described and/or represented pictorially constitute by

themselves or in any combination the object of the invention, regardless of their summary in the claims or what they are referenced to. At the same time, the content of the claims is made a part of the description.

At least one pair of drive elements 1 is provided for a separation and synchronization station according to the invention, which is designed to have at least one transverse rod 2.

These drive elements can be, for example, metal chains or also ones manufactured from other suitable materials, especially also so-called roller chains. Likewise the use of toothed belts is envisioned, especially toothed belts on which the aforementioned transverse rod 2 can be attached using suitable elements.

One pair of drive elements 1 means in this context the drive elements that are driven by a common drive motor, in which one of these drive elements 1 is located on the left and one drive element 1 on the right of the path of the article groups to be separated, or which have been separated.

In the embodiment depicted in Figure 1, roller chains were selected as drive elements 1. Altogether three pairs of rotating drive elements 1 are arranged, and two transverse rods 2 are mounted on each drive element 1.

The implementation of variations that comprise a number of drive element 1 pairs and a number of transverse rods 2 that differ from the embodiment shown, does not represent a departure from the scope of the present application.

Each of the pairs of drive elements 1 are driven by a dedicated motor 3, in which this motor can, for example, be an electrical stepper motor, servo motor or synchronous motor. All motor types have in common that the angle of rotation, direction of rotation and rotation speed can be specified by a computer or another suitable control device and that compliance with these set values can be monitored using suitable monitoring devices such as, for example, rotary encoders, and can be transmitted for subsequent evaluation.

An additional provision for the control and operation of these motors is that the speed and/or direction of rotation of the motor and thus also the speed of movement and/or direction of movement of the pairs of drive elements 1 driven by this motor be able to be adapted to various set values within one or half a revolution of the drive elements 1. Likewise, provision is made that the speed of movement of the drive elements 1 can also reach a value of zero meters per second, in which this speed value not only is reached by necessity during a possible change of the direction of movement but can also be specified for a particular time interval.

The length of a working cycle is determined by the number of transverse rods 2 installed on a pair of drive elements 1. If only one transverse rod 2 is installed in each case, then a working cycle corresponds to one revolution of the drive elements 1. If, however, two transverse rods 2 are installed, then a working cycle corresponds to half a revolution of the drive elements 1.

In the exemplary embodiment shown the design of the device is such that the individual drive elements 1 cannot overtake one another due to the transverse rods 2 being arranged at the same height. In a further embodiment of the present invention it is provided that drive elements 1 and/or transverse rods 2 are arranged such that they can overtake one another.

In the individual representations 2a through 2g of Figure 2 the particularly advantageous course of movements for the present invention is shown. To simplify the graphical representation, illustration of the articles to be packaged, for example bottles, was omitted in the present embodiment. Instead, only the

enveloping body of the parcelled article groups or article groups still to be divided subsequently (such as Fig. 2a, item B and C, or Fig. 2d, item C and D) is shown.

In Figure 2 the explicit representation of the three drive elements 1 was omitted; only the movement track 4 of the drive elements 1 is shown in the diagrammatic sketch. The transverse rods 2 attached to the three drive elements 1 were labelled according to their association with a particular drive element 1. Thus, for example, the transverse rods 2 labelled K2 are attached to the second drive element 1 and the transverse rods 2 labelled K3 are those attached to the third drive element 1.

The articles to be separated and synchronized are fed to the separating, synchronizing and packaging device by an incoming conveyor 5, in which the articles are held under constant dynamic pressure by the uninterrupted feed of the incoming conveyor 5 within the separating unit and thus are inclined to move in the feed direction.

Inside the device, the articles are first held back by the incoming conveyor 5 on a stationary, not movable component, such as a sheet 8 or similar. Located beneath this sheet is a retaining wedge 7, which executes a controlled course of movements. This course of movements comprises a forward and reverse movement at different, not necessarily constant speeds in each case, and possible, additionally defined stationary phases.

The main conveyor 6 extends from the sheet 8 or retaining wedge 7 respectively. This main conveyor 6 is operated at a constant speed that is higher than that of the incoming conveyor 5.

The key components of the course of movements of a device according to the invention will be described below as an example. This, however, does not represent a limitation of the scope of the present invention. Deviations from the course of movements depicted, omission or addition of movement segments and/or components used do not constitute a departure from the scope of protection of the present invention.

As shown in Figure 2a, the subsequent article stream is kept under dynamic pressure by the incoming conveyor 5, so that the article groups B and C to be separated subsequently are pushed together against each other without gap. The retaining wedge 7 assumes an important function in the actual

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separation. During the forward movement of the incoming article stream, the retaining wedge 7 also moves forward and supports the article group B, which is to be separated, during this forward movement, which prevents this article group from coming in contact with the main conveyor 6.

Contact by the article group B, which is to be separated, with the main conveyor 6 must be prevented at first, since the main conveyor 6 is operated at a higher belt speed than the incoming conveyor 5, and premature contact would lead to the undesirable formation of gaps within the article group to be separated due to the difference in speed.

If the length of the article group to be separated is greater than the effective length of the retaining wedge 7, that is, if part of the article group is already resting on the main conveyor 6, then the transverse rod K1, which moves at the speed of the incoming conveyor 5, prevents gap formation within this article group.

If the article group B to be separated is located far enough above or on the main conveyor 6, the retaining wedge 7 carries out a reverse movement so that the entire article group B to be separated is placed on the main conveyor 6 and thus acquires the higher speed of the main conveyor 6. Since the transverse rod K1 at this point also assumes the higher speed of the main conveyer 6, the desired gap is formed with respect to the subsequent article group C.

The reverse movement of the retaining wedge 7 ends at the leading edge of the subsequent article group C to be separated. Once this leading edge has been reached, the retaining wedge 7 again follows the forward movement of the article group C, and at the same speed as the article group C (see Fig. 2b).

If the gap between article groups B and C is large enough (see Fig 2c and 2d), the next transverse rod 2, K2 in this case, drops into the gap that arises and prevents premature gap formation within the subsequent article group C, in which, after the transverse rod K2 drops into the gap, it moves essentially at the speed of the incoming conveyor 5 in the feed direction. At the same time the retaining wedge 7 moves further forward so that contact is maintained with the leading edge of the article group C, preventing this article group from coming in contact with the main conveyor 6 at this point.

Once the previous article group B has been transported a certain distance by the main conveyor, the speed of the associated transverse rod K1 increases, causing the transverse rod K1 to separate itself from the article group B.

As depicted in Figures 2e and 2f, the transverse rod K1 continues to move at a speed higher than the main conveyor 6 until it reaches the rear of the previous article group A. Once the rear is reached, the transverse rod K1 once again moves at the speed of the main conveyor 6 and pushes the article group A through the compression unit, which is not shown.

These compression units are state-of-the-art and typically consist of guide plates arranged on both sides of the path, which form a funnel-shaped bottleneck, which causes any gaps present between the transverse rows of the article group to be closed. Gaps present within the longitudinal rows are closed by pushing the article group against a stationary component, such as a plate, in which the transverse rod K1 causes the forward movement of the article group by pushing.

As soon as the transverse rod K1 has pushed the article group off the stationary component, all gaps in the article group have been closed, and the article group is positioned exactly and synchronized with the cycle of the machine. After that the transverse rod is removed from the plane of the article groups.

In addition to the advantage already described above, in which separating, synchronizing and compression stations are all implemented in a single module, there are further benefits derived from the extremely advantageous embodiment of the present invention.

Thus, for example, changes of the formats to be produced are possible in a simple manner, especially where the number of transverse rows is constant, since changing the number of longitudinal rows only requires an adaptation of the programmed movement sequences of the drive chains 1 and retaining wedge 7, which can essentially take place "at the push of a button" and without mechanical refitting of the packaging machine itself.

To implement this function, provision is made that the necessary movement profiles of the drive elements 1 and retaining wedge 7 and other control parameters, such as the speeds of conveyors 5/6, be stored for each desired format and/or for each article to be processed in the machine control unit

in such a way that the relevant data can be called up easily by operating personnel.

The advantages of the present invention are particularly useful with formats that remain essentially unchanged, particularly also in the case of frequent article changes, since different articles generally also have different dimensions, which require laborious, time-consuming configuration work in known packaging devices, an effort which is eliminated almost entirely in a device according to the invention.

By combining the functions of separating, synchronizing and compressing in one module, a significant reduction of the required machine length is achieved, which enables additional considerable cost savings given the significant cost of space.

Another important advantage is derived from the extremely advantageous design of the present invention.

Since it is not necessary to arrange components in the path of the divided article groups in the case of a device according to the invention, this results in the possibility of constructing at least the main conveyor 6 as a single-part, wide conveyor belt with a continuous surface. Compared to the state-of-the-art, in which it is usual to form the main conveyor 6 from several parallel running, narrow conveyor belts, this approach has the advantage that there are no surface irregularities that might cause articles to topple during transport but also in particular during the compression cycle.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Apparatus for separating, synchronising and compacting for the packing of objects of all kinds, said apparatus having at least one inlet conveyor, at least one hold-back wedge, at least one main conveyor and at least one compacting unit, wherein the speed of the main conveyor is greater than that of the inlet conveyor, the said apparatus having at least one pair of driving elements disposed so as to rotate, at least one crossbar that is disposed at each pair of driving elements and a controlled drive motor for each pair of driving elements, wherein the at least one pair of driving elements has a controlled sequence of movement that includes different speeds, wherein the structural development of the apparatus is such that the separating is carried out by the hold-back wedge that is displaceable forward and backward and the synchronising and compacting of the objects is carried out by the at least one pair of driving elements, and wherein the speed of the main conveyor is constant.

2. Apparatus according to claim 1, wherein the structural development of the apparatus is such that the crossbars that are disposed on different pairs of driving elements cannot pass one another.

3. Apparatus according to one of claim 1 or 2, wherein the structural development of the apparatus is such that the crossbars that are disposed on different pairs of driving elements can pass one another.

4. Apparatus according to one of claims 1 to 3, wherein the at least one pair of driving elements are chains.

5. Apparatus according to one of claims 1 to 3, wherein the at least one pair of driving elements are toothed belts.

6. Apparatus according to one of claims 1 to 5, wherein the apparatus includes means, which make it possible for the hold-back wedge to perform the forward and backward movements at different, controlled speeds.

7. Apparatus according to one of claims 1 to 6, wherein both the inlet conveyor and the main conveyor are each provided with their own drive motor.

8. Apparatus according to one of claims 1 to 7, wherein the main conveyor is in the form of a one-part, wide conveyor belt that includes a substantially closed surface.

9. Method for the operation of an apparatus in accordance with any one of claims 1 to 8, wherein the sequence of movement of the at least one pair of driving elements and/or the at least one crossbar includes different speeds during one operating cycle.

10. Method according to claim 9, wherein the at least one crossbar initially holds back the group of objects that is to be separated in relation to the main conveyor, then is moved forward at a greater speed, once it reaches the previously separated group of objects synchronizes the said group of objects with the operating cycle of the apparatus and then pushes this group of objects through a compacting unit.

11. Method according to claim 10, wherein the at least one crossbar, once it has separated one group of objects, is initially moved at a speed similar to that of the main conveyor, is then advanced at a higher speed, and is then moved once again at a speed similar to that of the main conveyor.

12. Method according to any one of claims 9 to 11, wherein the adjusting of the apparatus to changed formats and/or changed article dimensions with an unchanged number of transverse rows is effected exclusively by means of changing the control parameters within the control program, and/or the control of the apparatus.

13. Method according to claim 12, wherein the relevant control parameters per format and/or object dimension are stored and can be called up as required.

14. Method according to any one of claims 9 to 13, wherein the holdback wedge executes a forward movement and a backward movement.

15. Method according to claim 14, wherein the hold-back wedge executes the forward movement at a first speed and the backward movement at a second speed.

16. Method according to claim 15, wherein the first speed and the second speed are identical.

17. Method according to one of claims 9 to 16, wherein the inlet conveyor and the main conveyor are each driven at their own speeds which are independent of each other.

18. Apparatus for separating, synchronising and compacting for the packing of objects of all kinds, or a method for the operation of said apparatus, substantially as herein described with reference to any one of the embodiments illustrated in the accompanying figures.

**KHS MASCHINEN-UND ANLAGENBAU AKTIENGESELLSCHAFT**

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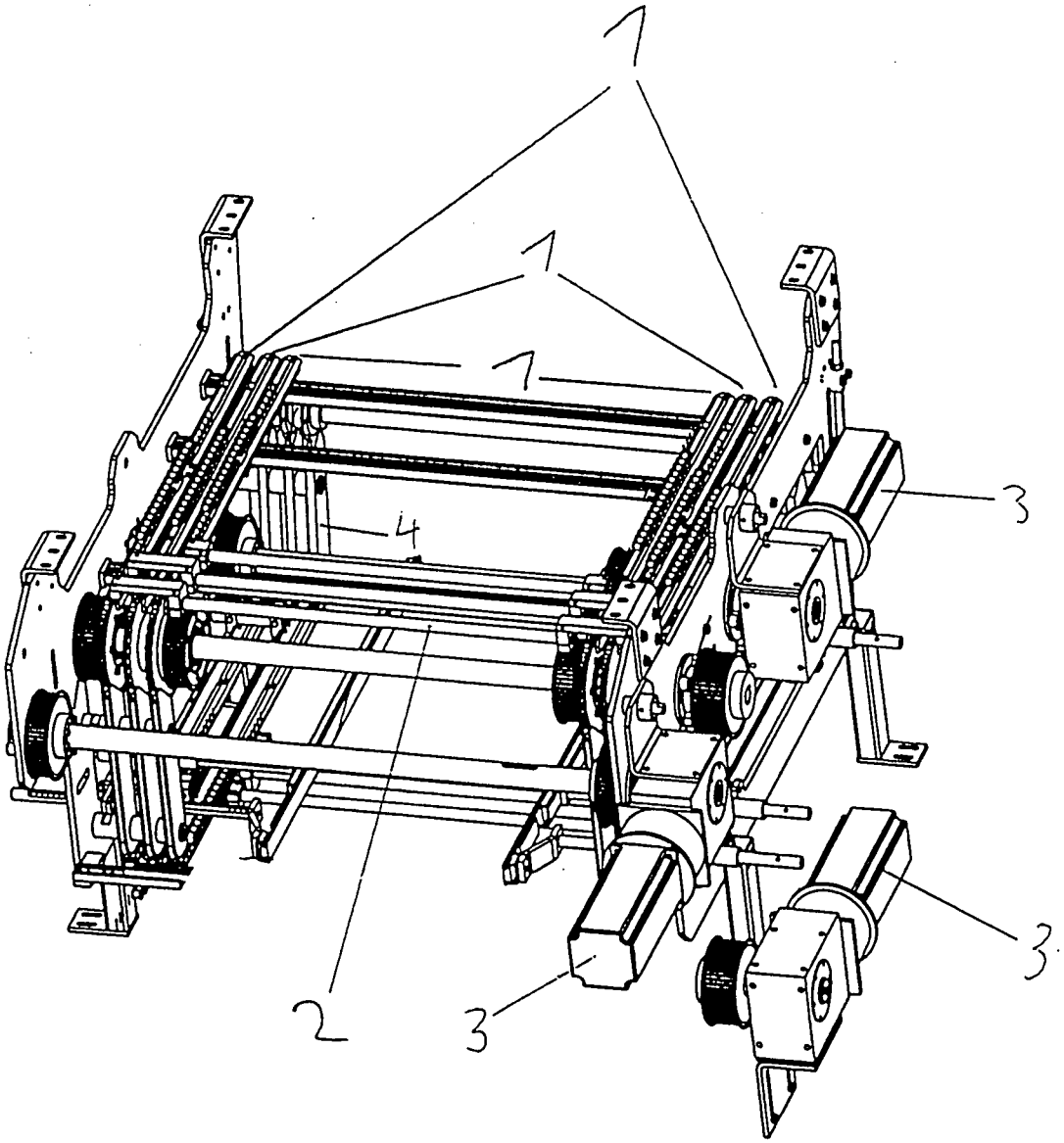


Fig. 1

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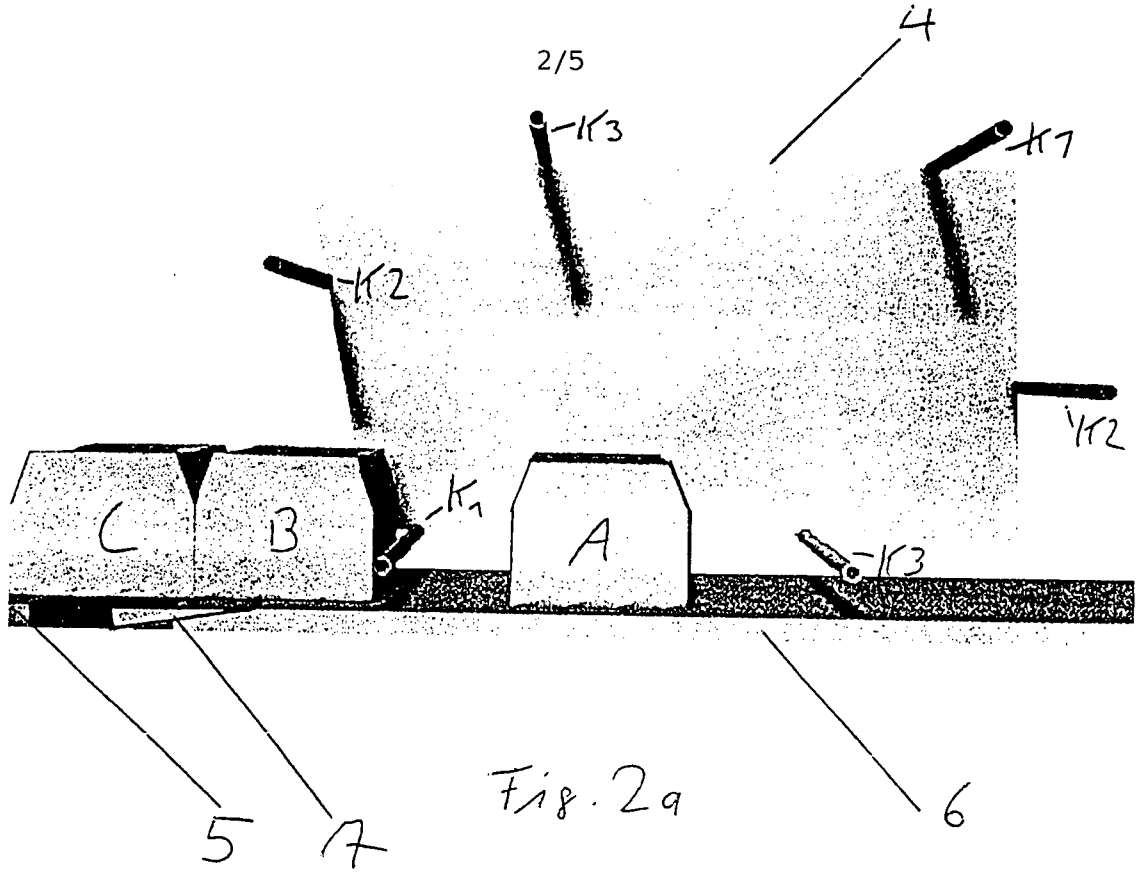


Fig. 2a

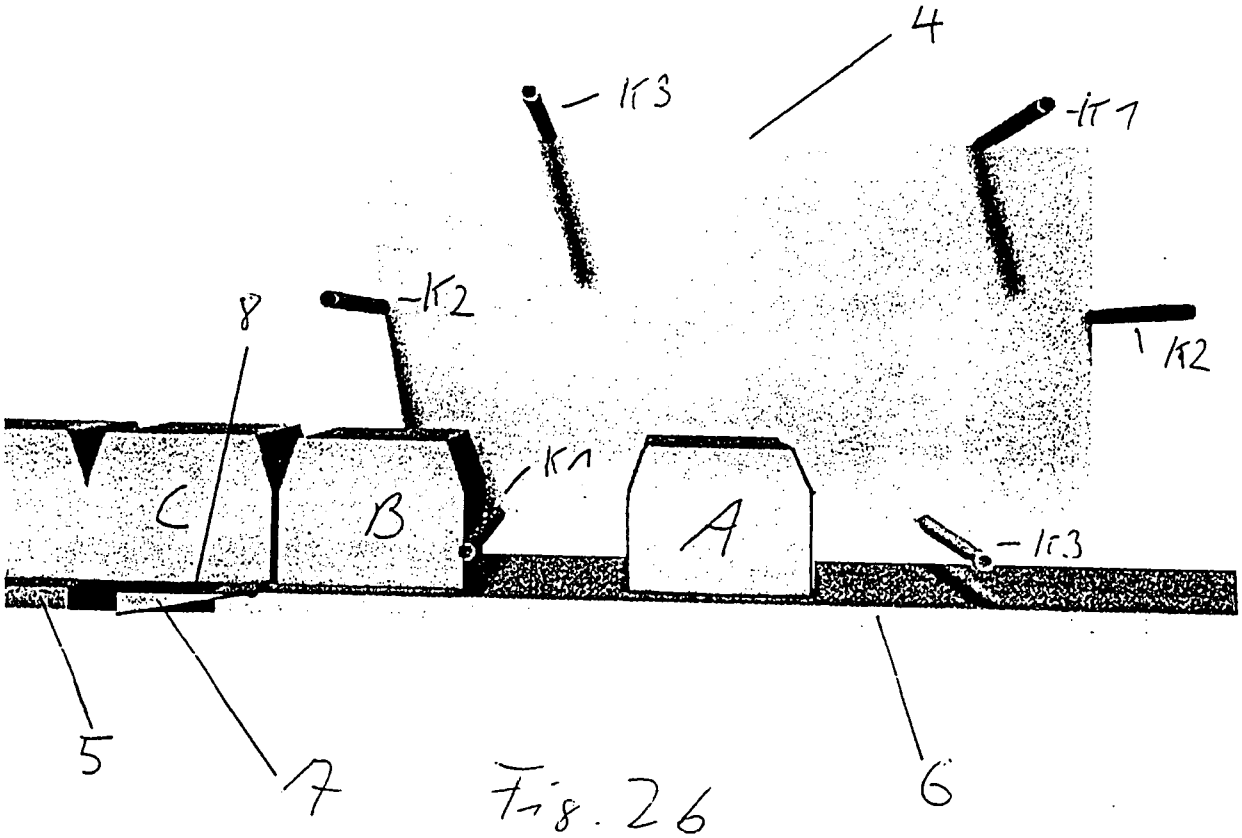


Fig. 2b

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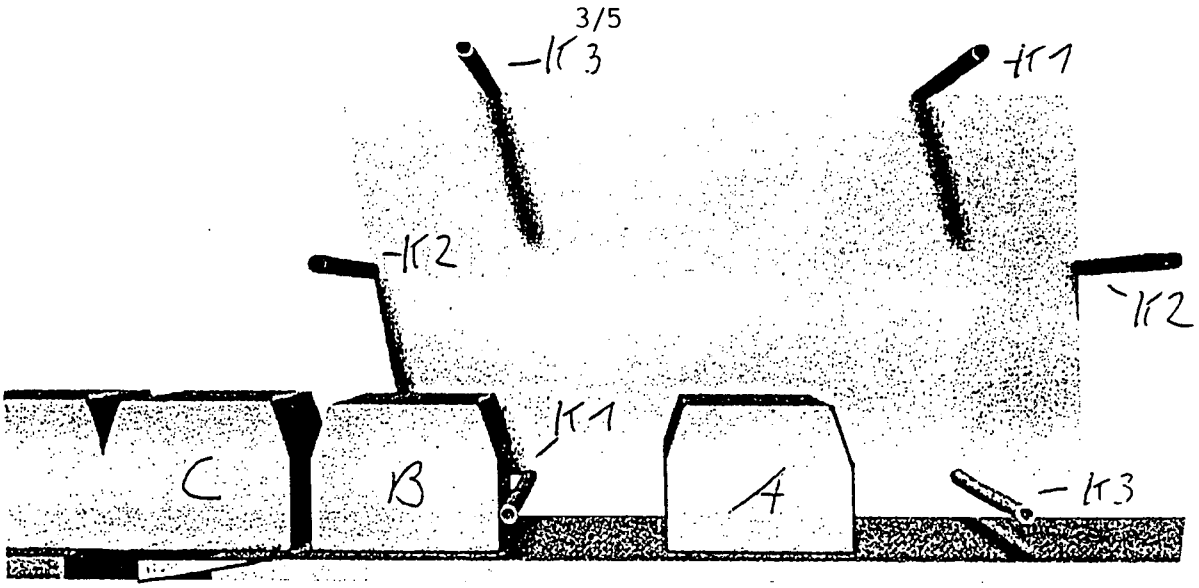


Fig 2c

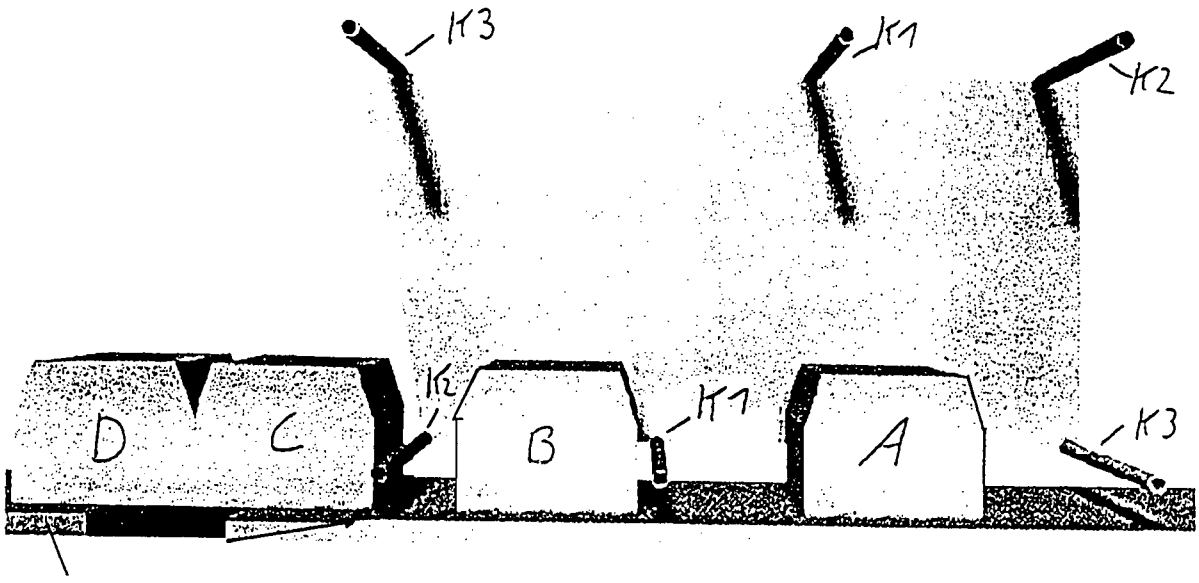


Fig. 2d

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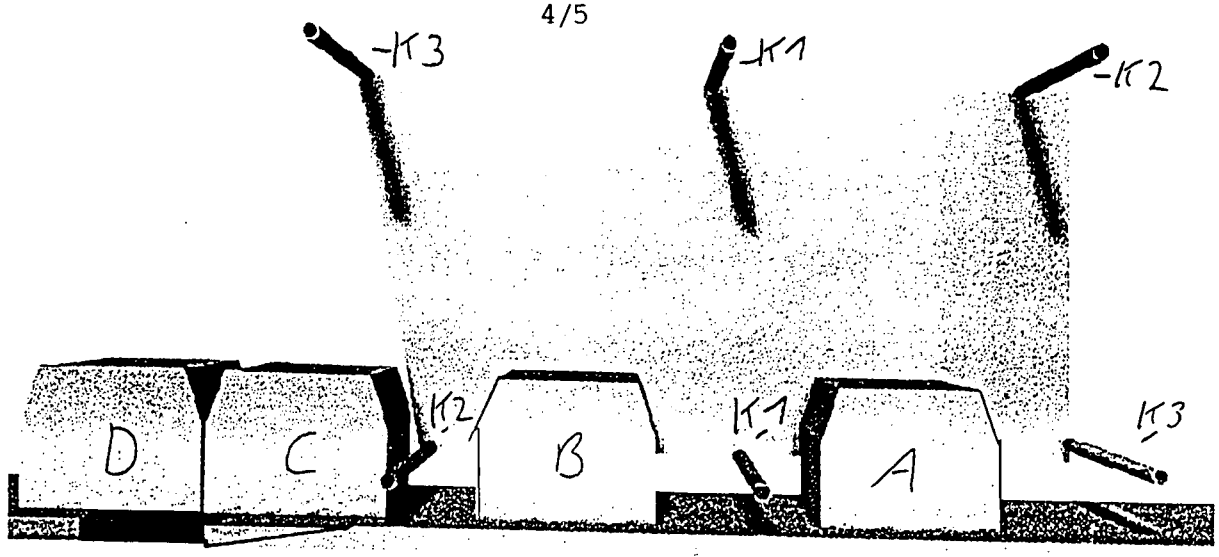


Fig. 2e

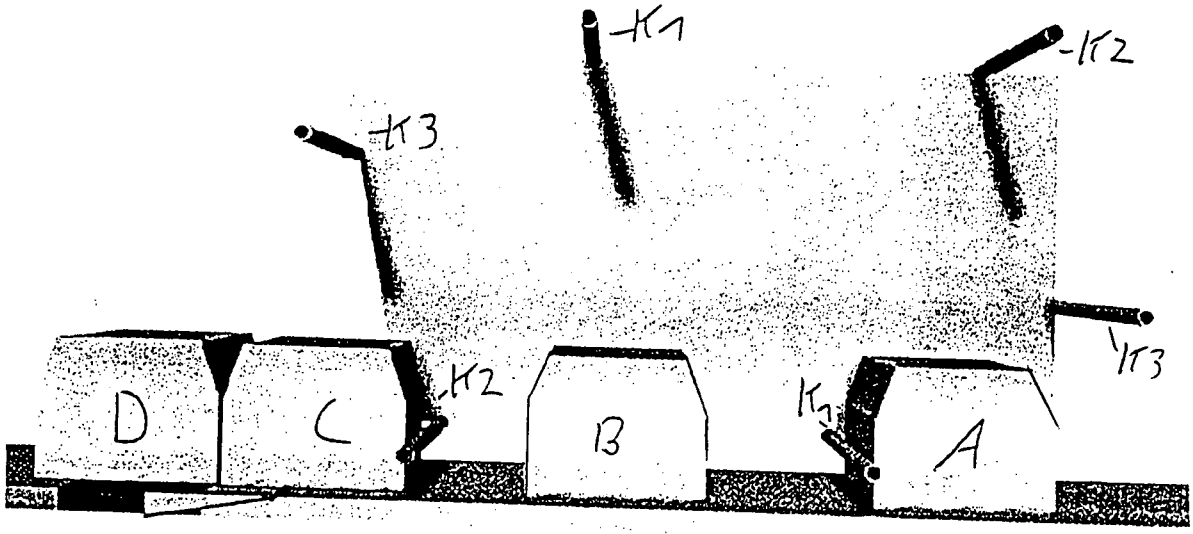


Fig. 2f

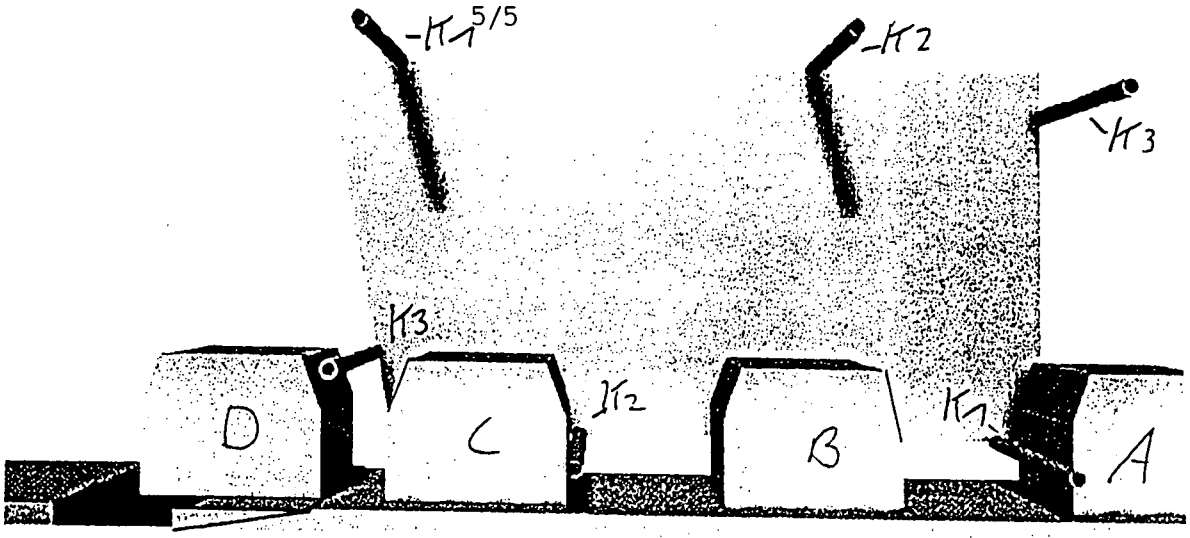


Fig. 2g