(57) L'invention concerne un dispositif qui permet de séparer deux bandes de matériau superposées durant leur déplacement sur un dispositif transporteur, la première bande étant posée amovible sur ledit transporteur. Le dispositif comprend un système d'aspiration (8, 9), mobile par rapport à la seconde bande de matériau, qui aspire par intermittence ladite seconde bande et la sépare de la première; et deux vilebrequins (10, 13) disposés à distance l'un de l'autre. Chaque vilebrequin tourne autour d'un premier axe de rotation (10a, 13a) et est relié rotatif au dispositif d'aspiration (8) par un second axe de rotation (10b, 13b). Le dispositif de l'invention est caractérisé par un dispositif d'entraînement comprenant un élément de préhension rotatif, relié à un élément de préhension formé sur l'un des vilebrequins. L'élément de préhension du dispositif d'entraînement et l'élément de préhension du vilebrequin tourment en décrivant des trajets qui ne coïncident pas et ne sont pas parallèles, et ils s'engrènent avec un décalage.

(57) The invention relates to a device for separating two lines of material which are arranged on top of each other. The lines of material are to be separated whilst they are being transported on a conveying device, the first of the lines of material being detachably fixed to the conveying device. The inventive device comprises a suction device (8, 9), which is moveable in relation to the second line of material and by which means it is able to temporarily draw the second material by suction and separate it from the first line of material. The device also has two cranks (10, 13) which are set apart and which each rotate about a first pivot pin (10a, 13a) and are each rotationally connected to the suction device (8) by a second pivot pin (10b, 13b). The inventive device is characterised by a drive device with a peripheral engaging element which is connected to an engaging element configured on one of the cranks. The paths of revolution of the drive device engaging element and the crank engaging element do not coincide and are non-parallel and the engaging elements engage with each other in such a way that they can be displaced in relation to each other.
Title: DEVICE FOR SEPARATING LINES OF MATERIAL WHICH ARE ARRANGED ON TOP OF EACH OTHER

Bezeichnung: VORRICHTUNG ZUR TRENNUNG ÜBEREINANDERLIEGENDER MATERIALBAHNEN

Abstract

The invention relates to a device for separating two lines of material which are arranged on top of each other. The lines of material are to be separated whilst they are being transported on a conveying device, the first of the lines of material being detachably fixed to the conveying device. The inventive device comprises a suction device (8, 9), which is moveable in relation to the second line of material and by which means it is able to temporarily draw the second material by suction and separate it from the first line of material. The device also has two cranks (10, 13) which are set apart and which each rotate about a first pivot pin (10a, 13a) and are each rotationally connected to the suction device (8) by a second pivot pin (10b, 13b). The inventive device is characterised by a drive device with a peripheral engaging element which is connected to an engaging element configured on one of the cranks. The paths of revolution of the drive device engaging element and the crank engaging element do not coincide and are non-parallel and the engaging elements engage with each other in such a way that they can be displaced in relation to each other.
DEVICE FOR SEPARATING MATERIAL WEBs LYING ON TOP OF EACH OTHER

The present invention relates to a device for separating two webs of material lying on top of each other, in particular those of bag bodies or individual portions thereof, while they are being transported on a conveying means, the first of the material webs being detachably fixed to the conveying means, the device comprising:

- a suction means movable with respect to the second material web, in order to temporarily suck the second material web and separate it from the first material web,

- two cranks spaced from each other, having a respective first rotatable joint for rotating the crank around this rotatable joint, as well as a respective second rotatable joint, to which the suction means is connected so as to be rotatable,

both cranks having the same distance between their respective first and second rotatable joints, and the distance between the first rotatable joints of both cranks being equal to the distance of the second rotatable joints of both cranks when they are connected to the suction means, so that the rotatable joints define the corners of a parallelogram.

Generally the process for manufacturing bags of any kind of material comprises one step wherein the pre-cut tubular bag bodies are folded at one end so as to form a bottom. For this purpose a slide is inserted into an open end between the walls of the flat bag body, movement of the slide, optionally co-operating with bars disposed outside the bag body, results in the desired folding of the side walls of the bag body. As the bag bodies are transported towards the slide in a state wherein they are lying flatly on top of each other, there is the problem that the seams of the open ends of the bag body or even complete border regions thereof adhere to each other, and thus the slide cannot be inserted between the bag body walls. This effect may be caused by electrostatic charging of the material webs, by the presence of adhesive residues, in case of plastic materials by welding of the bag body seams in the course of preceding cutting of the
bag body by means of a hot wire, or in case of airtight materials generally by contiguity of areas of the material. In any case the adherence of the seams of the ends of the sack bodies makes it necessary to provide for a production step wherein the end regions of the material webs are separated from each other, so as to be able to subsequently insert the slide between the material webs. Furthermore it is desirable to carry out this separation process while continuously transporting the bag bodies so as not to decrease the production speed. Additionally all movable parts of the device involved in the separation process are to be moving continuously, i.e. experience as little acceleration and deceleration as possible, so as to avoid premature wear and the necessity of high driving energy. From the point of view of wear and energy consumption of the device, uniformly rotating parts would be ideal.

The problems mentioned may be overcome by means of the device mentioned above, as for instance known from German Patent Application No. 1,511,021. It comprises a suction bar rotating with the machine timing, which is pivotally connected to levers by means of two pins, which levers are in their turn non-rotatably connected to gearwheels by pins disposed on the latter. The gearwheels engage a further rotatable gearwheel transmitting a driving force to the former gearwheels. Thus the suction bar moves in parallel to the direction of transport of hose portions. In order to linearize the speed of the suction bar, it is proposed to drive the driving gearwheel in its turn by an elliptical wheel gear not illustrated. Another driving means is neither disclosed nor suggested.

A disadvantage of the device disclosed in German Patent Application No. 1,511,021 is the use of an elliptical wheel gear, the production of which is expensive, on the one hand, and which does not enable complete linearization of the suction bar movement synchronously with the bag bodies moved by, on the other hand, but only more or less approximation thereof. The closer the approximation to a linearly uniform suction bar movement, i.e. the more pronounced the gearwheel ellipses, the higher the inevitable friction losses, too.
The present invention offers a solution to the disadvantages of the prior art which enables complete linearization of the suction bar movement synchronously with bag bodies moved by, while being highly economical.

Thus according to the invention a device of the above kind is provided with a drive means having an engagement element orbiting along a predetermined path and connected to an engagement element formed at one of the cranks, the orbits of the engagement element of the drive means and of the engagement element of the crank not coinciding and not being parallel, and the engagement elements engaging each other displaceably with respect to each other.

By means of the rotatable connection of the suction means with the two cranks, the rotatable joints involved forming a parallelogram, the suction means carries out a rotational movement in the course of which it approaches the second material web or contacts and sucks it, subsequently moving back again, the sucked second material web being pulled along, thus rising from the first material web. The rotational movement of the suction means is advantageous in that it has a velocity component in parallel with the conveying direction of the material webs so as to guide along the suction means with the movement of the material webs in the course of the separation process, as well as a velocity component at right angles with the conveying device in order to pull the second material web away from the first one. However, in case of uniform rotational movement the course of both velocity components would be sinusoidal, so that only at a certain crank angle the parallel velocity component of the suction means would be the same as the conveying speed of the material webs. As a consequence, the second material web would not only be lifted from the first one, but also displaced, which would have negative consequences during subsequent processing steps of the material webs. Thus it is necessary to linearize the course of the parallel velocity component of the suction device, which according to the invention is achieved by providing the orbiting engagement element of the driving means and the engagement element at the crank, moving along paths not identical with each other, it being possible to match the
parallel velocity of the suction means with the conveying speed of the material webs for a large range of crank angles by choosing the orbit paths of the engagement elements and the speed of the driving means accordingly.

With embodiments of the invention, the cranks may be formed as crank disks or with crank arms.

In order to make room for the displacements the engagement elements experience with respect to each other while orbiting, according to the invention it is provided either for the engagement element of the drive means or the engagement element of the crank to be formed with a cam engaging a slot or an oblong hole or a channel in the other engagement element. Alternatively it is also possible to provide a telescopic arm, which is articulated to the driving means and the crank.

Preferably the suction means communicates with a vacuum source. But as the suction means only has to operate during part of its revolution, it is advantageous in this case for the communication to be interruptable in dependence on the angular position of one of the cranks connected to the suction means.

A convenient embodiment of the device according to the invention is characterised in that a supply pipe of the suction means is vacuum-tightly connected to a through hole in a disk, the disk being rotatable together with one of the cranks, and a stationary vacuum bar connected to the vacuum source being substantially vacuum-tightly contiguous with to the opposite surface of the disk, the vacuum bar having a mouth opening taking the form of a circular arc and facing towards the disk surface, which opening coincides with the circular path described by the mouth of the through hole when the disk is rotated. In this embodiment a crank disk may serve as said disk.
A preferable embodiment of the suction means comprises a bar having an internal channel for connecting to a vacuum source and a plurality of exit openings extending from the internal channel, to which suction cups are conveniently attached.

Basically it is sufficient to drive only one of the cranks, the one to which the suction means is connected, as the driving torque is transmitted to the second crank by the suction means. It may however be the case that the cranks have to be set in motion from a dead centre, this dead centre being the crank position where the sides of the parallelogram formed by the joints of the crank coincide to form a line. In this position it is very unlikely that the cranks may be set in motion. In order to avoid this it is advantageous to connect the two cranks for synchronous movement by means of a belt or chain gear.

The driving means with the engagement element provided thereon may be formed in different ways. According to a first embodiment the engagement element is attached to a chain or a belt encircling at least two wheels, at least one of which is driven. The chain or belt defines an orbit path of the engagement element of the driving means. Preferably the chain or belt has a run in parallel with the conveying direction of the material webs, and the speed of the chain or belt is the same as the conveying speed of the material webs. Thus it is possible to achieve complete linearization of the velocity component in parallel with the conveying direction of the material webs as long as the engagement element moves in the parallel run. Favourably the engagement element has a channel at right angles with the chain or belt, wherein a cam or roller engages as engagement element of a crank.

A further embodiment of the invention is characterised in that the drive means comprises a driven disk, the rotational axis of which is offset with respect to the rotational axis of the crank it engages. The eccentricity of the driven disk and the crank connected therewith by way of engagement element achieves the desired linearization of the parallel velocity of the suction means.
The invention will now be described in more detail by way of examples, figure 1 schematically showing a first embodiment of the device according to the invention in side view, and figure 2 showing the same device in plan view. Figures 3 and 4 show details of the first embodiment of the inventive device, and figure 5 is a graph of the course of the parallel velocity component of the rotating suction means of the inventive device versus the crank angle. Figure 6 schematically shows a second embodiment of the device according to the invention in side view, and figure 7 is a plan view of the same device. Figures 8 and 9 show details of the second embodiment of the device according to the invention, and figure 10 is a graph of the course of the parallel velocity component of the rotating suction means of the inventive device versus the crank angle.

First referring to figures 1 and 2, they show a conveying means taking the form of a conveying belt 1 moving in the direction of arrow A. Tubular bag bodies 2a, 2a are arranged on the conveyor belt with their longitudinal axes oriented transversely to the conveying direction A, the major portion of the bag body lying horizontally on the conveyor belt, and only one end portion, the material webs of which are to be separated, being suspended from the longitudinal edge of conveyor belt 1. The conveying means furthermore has a second conveyor belt 3 arranged vertically below conveyor belt 1 and oriented along the longitudinal edge thereof, which turns around rollers 4, 5 at the same speed as conveyor belt 1. Conveyor belt 3 takes the form of a perforated conveyor belt having a plurality of holes 3a, a vacuum bar 6 being arranged behind it, so that the material web of bag body 2 facing towards conveyor belt 3 is sucked against the surface of conveyor belt 3 along the length of vacuum bar 6 and is fixed thereto during the belt’s continuous transport. In order the ensure that this first material web of the bag body is in fact sucked by conveyor belt 3, a downwardly inclined guiding rod 7 is provided, which guides the respective suspending portion of the bag bodies 2a towards conveyor belt 3.
A suction means as provided for by the invention is arranged on that side of the bag body portions suspended from conveyor belt 1 facing away from conveyor belt 3. This suction means comprises a bar 8 arranged in parallel with the suspended portion of the bag bodies, where a series of suction cups 9 are fixed to that side of the bar facing towards the bag body. The suction cups communicate with a vacuum channel 8a inside bar 8, the vacuum channel 8a being indirectly connected to a vacuum source not shown. On the one hand, the bar 8 is connected to a crank arm 10 rotating around a pivot bearing 10a, by means of a rotatable joint 10b, and furthermore connected to a crank disk 13 rotating around a pivot bearing 13a, by means of a rotatable joint 13b.

Coaxially with the axis of rotatable joint 10a, a pulley 11 is rigidly connected to the crank arm 10. Another pulley 14 is connected to crank disk 13 coaxially and rigidly as well. The two pulleys 11 and 14 are of equal diameter and are coupled to each other by means of a belt 15. This belt gear serves the purpose of synchronously moving the two cranks 10, 13 and of avoiding the failure of crank 13 running along by connection to bar 8 to be set in motion by driven crank 10 in case the cranks accidentally stop at a dead centre.

The cranks 10, 13 together with bar 8 fulfil the following dimensioning conditions: the rotatable joints 10a, 13a, around which crank arm 10 and crank disk 13, respectively, are rotating, have the same distance to each other as the rotating joints 10b, 13b when they are connected to bar 8; the distance between the rotatable joints 10a, 10b of the crank arm is the same as the distance between the rotatable joints 13a, 13b of the crank disk 13. Thus these four rotatable joints form the corners of a parallelogram. This arrangement of cranks with bar 8 so as to form a parallelogram results in the bar always maintaining a position in parallel with the material web while being rotated by driving one crank, the distance between the assembly and the material web being adjusted so that the suction cups 9 contact the material web when they come closest thereto.
Now referring to figure 4, illustrating an enlarged detail of figure 2, it shows the circular speed of rotatable joint 10b as vector \( v \), which may be resolved in a velocity component \( v_p \) in parallel to the conveying direction of the material webs, and a velocity component \( v_n \) at right angles with the conveying direction of the material webs. These velocity vectors also apply to bar 8. Both velocity components \( v_p, v_n \) would change sinusoidally in case of uniform circular speed, i.e. in case of uniform rotation of crank 10 around pivot bearing 10a. This is, however, undesirable, as already mentioned in the introduction. Instead, the aim is to linearize as far as possible the parallel velocity component \( v_p \) around the range of a crank angle \( \alpha \) of 90°, that is the range where bar 8 most closely approaches the material web. This is achieved by driving crank 10 by means of an eccentric element, as will be explained in the following with special reference to figures 2 and 3.

A drive means taking the form of a crown gear 16 with a rotational axis 16a, which is axially parallel to the rotational axis of rotatable joint 10a of crank 10, but offset therefrom by an eccentric distance \( e \), is coupled to a pinion 18, which is connected to the driving shaft 19 of a motor not shown, via a chain 17. At its lower side crown gear 16 has two guide plates 16b, 16b arranged approximately radially and in parallel with each other and defining a channel between them, which engages a cam or roller 10d. Roller 10d is arranged at the tip of a protrusion 10c of crank arm 10, protrusion 10c being the extension of crank arm 10 beyond pivot bearing 10a. As the rotational axes of crown gear 16 and crank 10 are offset from each other by a distance \( e \), crank 10 is not moved uniformly in case of uniform rotation of crown gear 16, but accelerated and decelerated as a function of eccentricity \( e \) and distance \( b \) (see figure 4) from roller 10d to pivot bearing 10a, roller 10d sliding in the channel between the guide plates 16b, 16b, so as to compensate for the displacement of the point of engagement between the roller and the guide plates.

The linearization of the parallel velocity component \( v_p \) achieved by the eccentric arrangement of crown gear 16 and the crank 10 driven by it is shown in the graph of
figure 5. It can be seen that in the range of crank angle $\alpha$ between 45° and 135° good linearization was achieved. Preferably the rotational speed of the crown gear 16 is adjusted in such a way that when $\alpha = 90°$, $v_p$ is equal to the conveying speed of the material webs, so that there is hardly any slip between the suction cups and the material web.

In figure 3, 19 designates a carrier plate of the machine body where the rotatable joint 10a is fixed. Furthermore, so as to show the rotating arrangement more clearly, figures 1 and 2 show crank 10 with bar 8 at a crank angle $\alpha$ of 90° in full lines and additionally at $\alpha = 45°$ in phantom lines (see reference numerals 8', 10'). In the same way figure 4 shows crank 10 with bar 8 at a crank angle $\alpha$ of 90° in full lines, and additionally in phantom at $\alpha = 135°$. Distance $a$ in figure 4 is the maximum distance between the centre of roller 10 and the centre of the driving crown wheel 16 and fulfils the condition $a = b + e$.

The suction cups 9 on bar 8 may be permanently connected to a vacuum source. It is considered to be more favourable, however, to connect the vacuum source while the suction cups approach the material web a relatively short time before the suction cups contact the material web, so that the suction cups may suck the material web, and to leave it switched on while the suction cups again move away from the conveying means of the material webs after they have passed the position closest thereto, pulling the sucked material web along, while at the same time the other material web of the bag body is sucked to conveyor belt 3. The vacuum source is finally disconnected again, when the distance between the two material webs is considered to be sufficient. In order to do so, it is provided for the crank disk 13 to have a through hole 13a parallel to the axis in the position where it is connected to the rotatable joint 13b, which hole extends into the rotatable joint 13b, the vacuum channel 8a of the bar 8 communicating with this through hole. A vacuum bar 20, which is mounted so as to be stationary, is vacuum-tightly contiguous to the opposing surface 13c of crank disk 13, the vacuum bar having a mouth opening 20a taking the form of a circular arc and facing towards the
disk surface, which coincides with the circular path described by the mouth of the through hole (13e) when turning the disk 13. The mouth opening 20a communicates with a connecting sleeve 20b to which a vacuum source not shown may be connected. Thus the vacuum channel 8a of bar 10 is only connected to the vacuum source over a clearly defined angular range of crank disk rotation.

In figures 6 to 9, a further embodiment of the device according to the invention is illustrated. The only difference between this embodiment and the first one is a different drive means by which crank 30 (corresponds to crank 10 of the first embodiment) is driven. Thus like reference numerals are used to designate like components of the device, and reference is made to the above description and a repeated detailed explanation omitted.

The drive means of the second embodiment no longer is an eccentric disk, but it comprises two twin-gears 31, 33 encircled by a double chain 32. The rotational axis of twin gear 33 is rigidly connected to an additional gear wheel 34, which is driven by the pinion of a motor not shown via a chain 35. An engagement element 36 is attached to the double chain 32 so as to move along therewith, which element consists of a U-beam, the longitudinal axis of which is at right angles with the double chain 32. The legs of this U-beam define a channel wherein a roller 30d, which is mounted at the end of crank 30 as its engagement element, is received slidingly. The orbital path of roller 30d when rotating crank 30 is shown at 30a. Between the twin-gears 31, 33, double chain 32 forms one run each in parallel with the conveying direction of the material paths on both sides, the double chain being driven at such a speed that the engagement element 36 moves at the same speed in a parallel run as the material webs move on conveyor belt 1. With particular reference to figure 9, it can be seen that the engagement element 36 reaches the beginning of the first parallel double-chain run when the crank angle α is about 45°. At this point in time the engagement element has made half its way around the twin-gear 33. From this point on crank 30, the roller 30d of which engages the engagement element 36, is driven at a velocity component vp in
parallel to the conveying direction of the material web, which component exactly corresponds to the conveying speed. This parallel velocity component is maintained until the engagement element reaches the twin-gear 31, i.e. the end of the parallel double chain run. At this point in time crank 30 has a crank angle of about 135°. From this point on, engagement element 36 changes from a translational movement to a rotational movement around the twin-gear 31, which changes the amount and finally also the sign of the parallel velocity component of crank 30, to which the modified movement of the engagement element is transmitted.

The graph of figure 10 shows that complete linearization of the parallel velocity component vp, which bar 8 experiences, has been achieved by parallel guiding of the engagement element over a crank angle range from about 45° to 135°.
CLAIMS

1. A device for separating two material webs lying on top of each other, preferably those of bag bodies (2, 2a), or individual portions thereof, while they are being transported on a conveying means (1), the first of the material webs being detachably fixed to the conveying means, the device comprising:

a suction means (8,9) movable with respect to the second material web for temporarily sucking the second material web and separating it from the first material web;

two cranks (10,13) spaced from each other, each having a first rotatable joint (10a, 13a) for rotating the crank around this rotatable joint, and a second rotatable joint (10b, 13b) to which the suction means is rotatably connected,

both cranks having the same distance between their respective first (10a, 13a) and second (10b, 13b) rotatable joints, and the distance between the first (10a, 13a) rotatable joints of both cranks being equal to the distance between the second (10b, 13b) rotatable joints of both cranks as they are connected to the suction means, so that the rotatable joints define the corners of a parallelogram, characterised by

a drive means (16;31-34) having an engagement element (16b;36) orbiting along a predetermined path and connected to an engagement element (10d;30d) formed at one of the cranks, the orbit paths of the engagement element (16b;36) of the drive means and of the engagement element (10d;30d) of the crank not coinciding and not being parallel, and the engagement elements engaging displaceably with respect to each other.

2. The device according to claim 1, characterised in that at least one of the cranks is a crank disk (13).
3. The device according to claim 1, characterised in that at least one of the cranks is a crank arm (10).

4. The device according to any of the preceding claims, characterised in that one of the engagement element (16b; 36) of the drive means and the engagement element (10d; 30d) of the crank (10; 30) comprises a cam, and the other comprises a slot, an oblong hole, a channel or at least one guiding rail or a guide plate (16b).

5. The device according to any of the preceding claims, characterised in that the suction means (8, 9) communicates with a vacuum source, the communication preferably being interruptable as a function of the angular position of one of the cranks connected to the suction means.

6. The device according to claim 5, characterised in that a supply pipe of the suction means is vacuum-tightly connected to a through hole (13e) in a disk, preferably a crank disk (13), and in that a stationary vacuum bar (20) connected to the vacuum source is substantially vacuum-tightly contiguous with the opposing surface (13c) of the disk, the vacuum bar (20) having a mouth opening (20a) taking the form of a circular arc and facing towards the disk surface (13c), which opening coincides with the circular path described by the mouth of the through hole (13e) when the disk is rotated.

7. The device according to any of the preceding claims, characterised in that the suction means comprises a bar (8) having an internal channel (8a) connectable to a vacuum source as well as a plurality of exit openings extending therefrom, to which preferably suction cups (9) are connected.

8. The device according to any of the preceding claims, characterised in that the two cranks (10, 13) are connected to each other for synchronous movement by a belt or chain gear (11, 14, 15).
9. The device according to any of the preceding claims, characterised in that the engagement element (36) of the drive means is attached to a chain (32) or a belt, which encircles at least two wheels (31, 33), at least one (33) of which is driven.

10. The device according to claim 9, characterised in that the chain (32) or belt has a run in parallel with the conveying direction of the material webs (2) and in that the speed of the chain or belt is equal to the conveying speed of the material webs (2).

11. The device according to claim 9 or claim 10, characterised in that the engagement element (36) of the drive means has a channel at right angles with the chain or belt, which channel is engaged by a cam or roller (30d) of a crank (30).

12. The device according to any of claims 1 to 8, characterised in that the drive means comprises a driven disk (16), the rotational axis of which is offset (distance e) with respect to the rotational axis of the crank (10) it engages.
Fig. 4

Fig. 5