

## **DESCRIPTION**

### **Device and Method for the continuous Generation of a faultless Conveyor Belt**

The invention refers to a device for the continuous elimination of faulty modules from a bulk of modules, which are continuously arranged to be detachable on at least one conveyor belt in at least one row and a device as well as a method for the continuous generation of a faultless conveyor belt from a conveyor belt with modules placed on it and arranged continuously in at least one row, whereby the conveyor belt has faulty and faultless modules.

During the generation of endless conveyor belts, on which modules are arranged continuously in rows, the requirement may arise, that only functioning and faultless modules remain on the conveyor belt. This may be the case, if the conveyor belt is stockpiled as an endless roll in a dispenser and the modules carry electronic information, e.g. labeling a pallet or a packet.

Usually, a conveyor belt exists as a preliminary stage in the generation of such a faultless conveyor belt, on which faulty and faultless modules are arranged. The error rate is usually determined by the defective products during the fabrication of the modules.

In the EP 1 096 423 A2, methods and devices for the generation of such a faultless conveyor belt are described.

In a first version described therein, the faultless conveyor belt is generated from two conveyor belts, on which at a time faulty and faultless modules are arranged. On the first conveyor belt only faulty modules are detached by a detachment device and subsequently removed. From the second conveyor belt only faultless modules are detached and subsequently inserted into gaps of the first conveyor belt, which materialise by the removal of faulty modules. After the removal, the first conveyor belt becomes the faultless conveyor belt.

In a second version, a first conveyor belt is provided, on which again faulty and faultless modules are arranged. In addition, a second, empty conveyor belt is provided. For the generation of the faultless conveyor belt, at first all modules are detached from the first conveyor belt. In a selection process, among the detached modules only functioning modules are transferred to the second, empty conveyor belt, thus this becomes the faultless conveyor belt.

Due to the selective detaching and transferring processes, operational states may occur, in which one speed of the conveyor belt must be reduced for ensuring a safe operation.

Hence, the purpose of the invention is to provide a device for the continuous elimination of faulty modules and a device as well as a method for the continuous generation of a faultless conveyor belt facilitating a safe operation at a high speed.

The invention solves this problem by a device for the continuous elimination of faulty modules according to claim 1, a device for the continuous generation of a faultless conveyor belt according to claim 13 as well as a method for the continuous generation of a faultless conveyor belt according to claim 17.

The devices and the method have in common, that the modules are arranged on the conveyor belt to be detachable. I.e. they can be detached from the conveyor belt unharmed and subsequently put up again. Silicon-coated paper material or something similar may be used as material of the conveyor belt. At the modules and/or on the conveyor belt, an adhesive layer may be applied enabling a detachable splicing of conveyor belt and module.

The device for the continuous elimination of faulty modules encompasses a monitoring device for the identification of faulty modules and a facility for the take-over of faulty modules to be eliminated. The monitoring device may use various criteria for the detection of a module's status. If the modules are electronic modules with a memory, which can be read contactless, a verification of the electronic module's serial number or a verification of specific memory contents may happen via a radio frequency interface. Alternatively or additionally, a response speed during the insertion of the module into an electromagnetic field may be applied. Also an optical monitoring by cameras in conjunction with image editing algorithm may be used for the detection of a faulty module. The take-over facility takes over a faulty module and conveys it to its further processing, e.g. recycling or disposal, away from the conveyor belt. According to invention, at least one detachment device is provided, which detaches each module from the conveyor belt at least partly and puts it up again on the conveyor belt shifted as compared to previous position, and at least one selection device is also provided, which selects a module (identified by the monitoring device as faulty and at least partly detached from the conveyor belt), so that it will be taken over by the take-over facility. Because by this way each module is gently detached from the conveyor belt and, if the module is faultless, reattached on a shifted position of the conveyor belt, no selective detaching (regulated by the module's status) will be necessary, which may require a reduction of the belts' speed. I.e. the detaching may happen at the full speed of the belt. This

increases the capacity of such device. The detachment device and selection facility are cooperating in such a manner, that a faulty, partly detached module for selection is charged with a force in such a way, that it will be deflected in the direction of the take-over facility causing a take-over. A faultless module is not charged with a force, whereby it is put up again with its detached part on a shifted sector of the conveyor belt.

In an advanced design version, the detachment device includes a first deflection facility of the conveyor belt, whereby the conveyor belt runs over the first deflection facility and the first deflection facility causes the partial detaching of the module by the belt's deflection from a transport direction into a detaching direction. Preferably, the detachment device includes in addition a second deflection facility of the conveyor belt, whereby the conveyor belt runs over the first deflection facility and the second deflection facility, the second deflection facility causes a belt deflection into the transport direction in a respective deflection sector and in the deflection sector the module (at least partly detached from the belt) will be reattached on the belt. The first and second deflection facilities of the belt facilitate an easy detaching or peeling and a subsequent, shifted take-over of the faultless modules onto the belt. Preferably, the detachment device includes in addition a deflection roller, whereby the conveyor belt runs over the first deflection facility, the deflection roller and the second deflection facility. This facilitates an easy and flexible conveyor belt control, whereby (from the position of the deflection roller in relation to the deflection facilities) various parameters may be set, e.g. a shifting rate. Preferably, the first deflection facility has a first layer in the transport level and the second deflection facility has a second layer in the transport level of the belt, whereby there is a gap between the first and the second layer and a rotation axis of the deflection roller is outside the transport level. The edges bordering the gaps of the first and the second layer run preferably parallel. The rotation axis of the deflection roller may run parallel to

to the edges, in horizontal orientation in the centre of the gap and in vertical orientation shifted away from the transport level by a distance, which is larger than the diameter of the deflection roller.

In an advanced design version, the selection device includes a dabbing roller, with which a faulty module (at least partly detached from the belt) is deflected for selection into the direction of the take-over facility. The dabbing roller may press for instance against a module's part detached from the belt, whereby due to the force it will be moved or deflected in the direction of the take-over facility. Alternatively or additionally, the selection device includes a compressed air device, with which a faulty module (at least partly detached from the belt) is blown for selection into the direction of the take-over facility.

In an advanced design version, the take-over facility includes a take-over roller for the take-over of faulty modules. Preferably, the take-over roller has air circulation openings over its perimeter acting for the generation of a controllable low or high pressure, which causes the adhesion or detachment of a faulty, taken module. Such design supports a take-over and removal of a faulty module, because the module is pulled by the low pressure towards the take-over roller. The controllable low pressure may be switched off at a suitable position of the roller, e.g. during the pulling-off of the faulty module, or converted into high pressure, whereby the detachment of the module is eased. Preferred is a collection roller being in an effective connection with the take-over roller for the collection of faulty modules, whereby a faulty module is transferred from the take-over roller to the collection roller. The collection roller may collect the faulty modules in several layers, whereby the take-over roller is reset into its functional status by the pulling-off of the faulty module.

In an advanced design version, a pressing-on roller is provided causing the pressing-on of a module being reattached on the belt. If a faultless module

at first is detached by the detachment device and subsequently reattached on a shifted position, initially the module's adhesion to the belt is reduced. At a reduced adhesion there is a risk, that the module unintentionally is being detached in the following belt sectors, e.g. in sectors of deflections. For compensating this effect, the module is pressed-on, whereby more or less the initial adhesion will reappear.

In an advanced design version, the modules are arranged in several rows on the belt and a selection device is allocated to each row. Hence, the rows are sharing the monitoring device, take-over facility and the detachment device. However, since the sequence of faulty or faultless modules between the actual rows may vary, an individual selection device for each row must be provided. The arrangement of the modules in several rows on the belt facilitates a parallel processing, i.e. the potential capacity increases roughly in proportion to the number of rows.

The device according to invention for the continuous generation of a faultless conveyor belt encompasses an aforementioned device for the continuous elimination of faulty modules and at least one supply facility, which inserts a faultless module in the belt's sectors, from which a faulty module has been eliminated. Favorably, several supply facilities are used for the enhancement of the transport speed, which are preferably arranged in the transport direction behind each other. The combination of elimination device and supplier facilitates the generation of a faultless conveyor belt with high speed, because the elimination will happen without any reduction of the belt's speed.

In an advanced design version, an additional conveyor belt is allocated to the supply facility containing only faultless modules.

In an advanced design version, the modules are transponders. Preferably, a programming unit is provided, which programs the transponders on the

faultless belt. The transponders are preferably used with transponder labels.

With the method according to invention for the continuous generation of a faultless conveyor belt, each module is at least partly detached from the conveyor belt, a faulty, at least partly detached module removed, a faultless module is reattached shifted on the conveyor belt and a removed module replaced by a faultless module.

In an advanced design version, the belt speed is constant.

Further advantages and features of the invention come from the claims and the following description of favorable design versions of the invention, depicted schematically in the drawings. It is shown in:

Fig. 1

a device for the continuous elimination of faulty transponders for a case, where the elimination is not necessary.

Fig. 2

a device for the continuous elimination of faulty transponders of Fig. 1 for a case, where the elimination of a faulty transponder is necessary.

Fig. 3

a device for the continuous generation of a faultless conveyor belt with the device for the continuous elimination of Fig. 1 and

Fig. 4

a device for the continuous generation of a faultless conveyor belt, on which transponders are arranged in several rows on the conveyor belt.

Fig. 1 shows a device 1 for the continuous elimination of faulty modules in form of transponders from a bulk of transponders 2, which are continuously, equidistant arranged to be detachable on a conveyor belt 3 in one row. The transponders 2 are arranged on the conveyor belt 3, centered in regard to the transport direction x. On the conveyor belt 3, faultless and faulty transponders 2 may be arranged.

The transponders 2 are realised as flat, flexible foil modules and in each case they include an integrated circuit (not shown) with transponder function, which is linked up to a foil shaped antenna. The transponders 2 are furnished with an adhesive layer (not shown) on the side facing the conveyor belt 3, facilitating a multiple putting up and detaching of the transponders 2 from the conveyor belt 3.

The device 1 includes a monitoring device or a reading gadget 10 for the identification of faulty transponders 2, a take-over facility in form of a take-over roller 20 for the take-over of faulty transponders 2 (to be eliminated), a detachment device encompassing a first deflection facility 30, second deflection facility 31 and a deflection roller 32, which detaches each transponder 2 at least partly from the conveyor belt 3 and, if faultless, puts up again on the conveyor belt 3 shifted as compared to previous position, a selection device in form of a dabbing roller 40, which deflects a faulty transponder 2 (at least partly detached from the belt 3) into the direction of the take-over roller 20, so that it will be taken over and removed by the take-over roller 20, a controlling unit 50, which is linked to the monitoring device 10, the take-over roller 20 and the dabbing roller 40, and a collection roller 60 being in an effective connection with the take-over roller 20 for the collection of faulty transponders.

In the following, the operation of the device 1 is described. In the operational status of the device 1 depicted in Fig. 1, all shown transponders 2 are faultless, i.e. there is no elimination of a transponder 2.

The transponders 2 are fed to the device 1 in the transport direction x on the conveyor belt 3 continuously, with constant high speed, e.g. 1.5 m/s. The reading gadget 10 reads the status of a transponder 2 wireless and communicates it to the controlling unit 50. Since all transponders are faultless in the shown design version, there is no elimination, i.e. the dabbing roller 40 is not triggered.

The conveyor belt 3 runs over the detachment device in form of the first deflection facility 30, the deflection roller 32 and the second deflection facility 31. The first deflection facility 30 has a first flat layer 34 in the transport direction x of the belt 3 and the second deflection facility 31 has a second flat layer 35 in the transport direction x of the belt 3, whereby there is a gap 33 between the first layer 34 and the second layer 35. The edges bordering the gap 33 of the first and the second layer run parallel.

The rotation axis of the deflection roller 32 runs parallel to edges, in horizontal orientation in the gap centre and in vertical orientation shifted downwards by the distance to the layers 34 and 35, which is roughly double as big as a diameter of the deflection roller 32.

As shown in Fig. 1, the detaching device causes (via its first deflection facility 30 by deflecting the conveyor belt 3 from the transport direction x into a detaching direction a) the partial detachment of the transponder 2 in the transport direction x at the beginning of gap 33. A downwards tilted side or layer 36 respectively of the deflection facility 30 generates an acute angle with the layer 34, whereby the gradient of the conveyor belt has the effect that in this sector the transponder 2 peels off from the conveyor belt 3 and due to its bending stiffness moves in the transport direction x over the gap 33 to the second deflection facility 31. The transponder 2 is longer than the

gap 33, so that it will peel off from the conveyor belt at most by a portion defined by the gap 33.

After the transponder 2 has moved across the gap 33, it will reach with its front part the second deflection facility 31 in a deflection sector, in which a re-deflection of the conveyor belt 3 into the transport direction  $x$  occurs. As soon as the transponder 2 has reached the conveyor belt 3 in the deflection sector, a putting up (shifted as compared to its initial position) of the transponder (detached from the conveyor belt 3 in the sector of gap 33) re-occurs. This putting up may be supported by a pressing-on roller (not shown) causing the pressing-on of a transponder being reattached on the belt 3 and thus increases the adhesion roughly up to a value like before the detachment.

If a transponder 2 is faultless, then it will move under a partial detachment from the conveyor belt 3 over the gap 33 and is reattached shifted on the conveyor belt 3. This process can be done in high, constant belt speed.

Fig. 2 shows a case at two different points of time, at which a transponder 2 moved over the gap 33 is eliminated, i.e. not reattached on the conveyor belt 3.

The reading gadget 10 reads the status of a transponder 2 wireless and communicates it to the controlling unit 50. Since in the shown design version the transponder moved over the gap 33 is faulty, it must be eliminated, i.e. it must not be reattached on the conveyor belt 3 after the partial detachment.

For that, the controlling unit 50 triggers the dabbing roller 40, so that it will press from bottom against a detached part of the transponder 2 while the faulty transponder 2 moves over the gap 33. Thus, the transponder 2 is deflected from its transport direction  $x$  or bended and pressed against the take-over roller 20.

The take-over roller 20 has air circulation openings 21 allocated over its perimeter acting for the generation of a controllable low or high pressure, whereby the controlling unit 50 provides a compressed air regulation. In the case shown, low pressure is generated causing the adhesion of the faulty transponder 2 at the perimeter of the take-over roller 20. As shown, the transponder 2 is continuously detached from the conveyor belt 3 and taken over by the take-over roller 20. Finally, the transponder 2 adheres completely on the take-over roller 20 due to the low pressure and is removed towards the collection roller 60 being in effective connection with the take-over roller 20.

If the transponder 2 enters the perimeter of the collection roller 60 with the adhesive layer (applied on its bottom side), a detachment of the transponder 2 from the take-over roller 20 towards the collection roller 60 happens due to the adhesive forces. As a support, the low pressure generated near the openings 21 may be deactivated or converted into high pressure.

The collection roller 60 is suspended from a wing 61, which is mounted revolvable in a rotation axis 62. The faulty transponders are continuously put up or stuck on the collection roller 60, so that several layers of transponders may lie on top of each other. An increasing layer diameter is automatically compensated by the rotation of the wing 61. If the layer diameter exceeds a certain amount, the collection roller 60 may be replaced by a new collection roller 60.

After the elimination, there will be a gap on the conveyor belt 3, into which subsequently a faultless transponder must be inserted. This is described with reference to Fig. 3.

Fig. 3 shows a device 80 for the continuous generation of a faultless conveyor belt with the device 1 for the continuous elimination of Fig. 1. The device 80 includes besides the device 1 (already shown in Fig. 1) a supply device 70, which inserts a faultless transponder 2 into the gaps or sectors of the conveyor

belt 3, from where a faulty transponder 2 has been removed.

The supply device 70 includes a storage roll 71, on which another conveyor belt 72 is wound up, on which only faultless transponders 2 are put up. The conveyor belt 72 runs over a return shaft 73 and a deflection device 74. The deflection device 74 generates due to its shape a belt deflection in a sector 75, that a transponder 2 (fed by the storage roll 71) is detached from the other conveyor belt 72 and put up on the conveyor belt 2 precisely into a gap of a transponder removed afore. Then the other conveyor belt 72 is wound up on a wind-up device 76. The supply device 70 is not operated continuously, but exactly at the time activated, when a transponder 2 was removed afore by the device 1 from the conveyor belt 2.

In the transport direction x behind the supply device 70, a programming device (not shown) may be provided for the programming of the faultless transponders 2. For instance, information of the manufacturer or a product code may be written here in a transponder memory.

For the enhancement of the capacity of the device 80 (shown in Fig. 3), the transponders 2 may be arranged in multiple rows on the conveyor belt 2.

Fig. 4 shows a device 80a modified for that viewed in transport direction x. The device 80a is suitable for the processing of a conveyor belt 3' with three rows of transponders 2. Generally, the device 80a is configured in the same way as device 80 and functions correspondingly. However, the device 80a has three selection devices each in form of a compressed-air device 40a, 40b and 40c, which are assigned to a row each of the conveyor belt 3'. In addition, a collection roller 60a, 60b and 60c is provided for each row.

The compressed-air devices 40a, 40b and 40c function independently from each other, because cases may arise, where a transponder must be removed

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*[translator's note: apparently there are some typing errors in the original text]*

in a row (related to the same position in transport direction x) and in another not. If a transponder is selected or removed, the associated compressed-air device 40a, 40b or 40c generates a compressed-air stream causing a deflection of the transponder to be removed into the direction of the take-over roller 20. A take-over and removal of the faulty transponder 2 happens in the same way as with the device 80 shown in Fig. 3.

A faulty transponder 2 is subsequently put up on a collection roller 60a, 60b or 60c associated to its row.

The design versions shown facilitate a safe generation of faultless conveyor belts concurrently at high speeds, whereby the potential capacity is optimised.

### **Patent Claims**

1. Device (1) for the continuous elimination of faulty modules from a bulk of modules (2), which are continuously arranged to be detachable on at least one conveyor belt (3) in at least one row, with

- a monitoring device (10) for the identification of faulty modules and

- a facility (20) for the take-over of faulty modules to be eliminated (2),

2. **characterised by**

- at least one detachment device (30, 31, 32), which detaches each module (2) at least partly from the conveyor belt (3) and puts up again on the conveyor belt (3) shifted as compared to previous position, and

- at least one selection device (40), which selects a module (2) identified by the monitoring device (10) as faulty, and at least partly detached from the conveyor belt (3), so that it will be taken over by the take-over device (20).

3. Device according to claim 1, **characterised**, that the detachment device includes a first deflection facility (30), whereby the conveyor belt (3) runs over the first deflection facility (30), and the first deflection facility (30) causes the partial detachment of the module (2) in the transport direction (x) by deflecting the conveyor belt (3) from the transport direction (x) into a detaching direction (a).

4. Device according to claim 2, **characterised**, that the detachment device includes a second deflection facility (31), whereby the conveyor belt (3) runs over the first deflection facility (30) and second deflection facility (31),

the second deflection facility (31) causes a deflection of the conveyor belt (3) into the transport direction (x) in an associated deflection sector and in the deflection sector the module (2) at least partly detached from the conveyor belt (3) is reattached on the conveyor belt (3).

5. Device according to claim 3, **characterised**, that the detachment device includes a deflection roller (32), whereby the conveyor belt (3) runs over the first deflection facility (30), the deflection roller (32) and the second deflection facility (31).
6. Device according to claim 4, **characterised**, that the first deflection facility (30) has a first layer (34) in the transport direction of the conveyor belt (3) and the second deflection facility (31) has a second layer (35) in the transport direction of the conveyor belt (3), whereby there is a gap (33) between the first layer (34) and the second layer (35) and a rotation axis of the deflection roller (32) is outside the transport level.
7. Device according to one of the aforementioned claims, **characterised**, that the selection device includes a dabbing roller (40), with which a faulty module (2) at least partly detached from the belt (3) is deflected for selection into the direction of the take-over device (20).
8. Device according to one of the aforementioned claims, **characterised**, that the selection device includes a compressed-air device (40a, 40b, 40c), with which a faulty module (2) at least partly detached from the belt (3) is blown for selection into the direction of the take-over device (20).
9. Device according to one of the aforementioned claims, **characterised**, that the take-over device includes a take-over roller (20) for taking-over of faulty modules (2).

10. Device according to claim 8, **characterised**, that the take-over roller (20) has air circulation openings (21) over its perimeter acting for the generation of a controllable low or high pressure, which causes the adhesion or detachment of a faulty, taken module (2).
11. Device according to claim 8 or 9, **characterised** by a collection roller (60) being in effective connection with the take-over roller for the collection of faulty modules (2), whereby a faulty module (2) is transferred from the take-over roller (20) to the collection roller (60).
12. Device according to one of the aforementioned claims, **characterised** by a pressing-on roller causing a pressing-on of a module being reattached on the belt.
13. Device according to one of the aforementioned claims, **characterised**, that the modules are arranged on the conveyor belt 3' in several rows and a selection device (40a, 40b, 40c) is assigned to a row each.
14. Device (80, 80a) for the continuous generation of a faultless conveyor belt (3) from a conveyor belt (3) with modules (2) placed on it and arranged continuously in at least one row, whereby the conveyor belt (3) has faulty and faultless modules.
15. **characterised by**
  - a device (1) for the continuous elimination of the faulty modules according to one of the claims 1 to 12, and
  - at least one supply device (70), which inserts a faultless module (2) into sectors of the conveyor belt (3), from where a faulty module (2) has been removed.

16. Device according to claim 13, **characterised**, that the supply device is assigned to another conveyor belt (72), which contains only faultless modules (2).
17. Device according to one of the aforementioned claims, **characterised**, that the modules are transponders (2).
18. Device according to claim 15, **characterised** by a programming unit, which programs the transponders on the faultless belt.
19. Method for the continuous generation of a faultless conveyor belt (3) from a conveyor belt (3) with modules (2) placed on it and arranged continuously in at least one row, whereby the conveyor belt (3) has faulty and faultless modules, **characterised** by the steps:
  - at least partial detachment of each module (2) from the conveyor belt (3)
  - removal of a faulty, at least partly detached module (2),
  - shifted reattachment of a faulty module (2) on the conveyor belt (3), and
  - replacement of a removed module (2) by a faultless module (2).
20. Method according to claim 17, **characterised**, that the conveyor belt speed is constant.