A belt conveyor of a printing-material sheet processing machine includes a belt for transporting the printing-material sheets, the belt having openings, and a roller, which has pins for engaging in the openings. At least one ring is rotatably mounted on the roller, relative to the pins, the belt lying on the ring. This belt conveyor is suited for conveying a printing-material sheet, wherein the belt is driven by the roller virtually exclusively via a form lock between the pins and the openings and virtually without a friction lock between the inner surface of the belt and the peripheral surface of the roller. The belt conveyor may be, for example, a sheet brake of a delivery of a printing press.
METHOD FOR CONVEYING PRINTING-MATERIAL SHEET BY A BELT CONVEYOR, AND A BELT CONVEYOR SUITED THEREFOR

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a method for conveying printing-material sheets by a belt conveyor, which includes a belt for transporting the printing-material sheets, the belt having openings, and a roller for guiding the belt, the roller having pins for engaging in the openings. The present invention furthermore relates to a belt conveyor of a printing-material sheet processing machine, including a belt for transporting the printing-material sheets, the belt having openings, and a roller, which has pins for meshing in the openings.

[0002] A belt conveyor is described in German published patent application DE 40 17 931 A1. There, the openings in the belt conveyor are stabilized by metal eyelets. The eyelets are supposed to minimize the stress on the openings when the pins engage therein. It is thereby undesirable, on the one hand, that the manufacturing costs of the belt are increased by the metal eyelets, and on the other hand, that the metal eyelets can loosen or separate from the belt due to the stress or strain. The reason for the stress was apparently not recognized in that prior art.

SUMMARY OF THE INVENTION

[0003] It is accordingly an object of the invention to provide a method of transporting printing sheets with a belt conveyor and a suitable belt conveyor which overcome the above-mentioned disadvantages of the heretofore-known devices and methods of this general type and wherein the wear of the belt is reduced more effectively.

[0004] With the foregoing and other objects in view there is provided, in accordance with the invention, a method of conveying printing-material sheets, which comprises:

[0005] providing a belt conveyor with a belt for transporting the printing-material sheets, the belt having openings formed therein, and with a roller for guiding the belt, the roller having pins disposed and formed for engaging in the openings formed in the belt;

[0006] driving the belt with the roller substantially exclusively via a form lock between the pins and the openings and substantially not by friction between an inner surface of the belt and a peripheral surface of the roller; and

[0007] transporting the printing-material sheets on the belt.

[0008] With the above and other objects in view there is also provided, in accordance with the invention, a belt conveyor of a printing-material sheet processing machine, comprising:

[0009] a belt for transporting printing-material sheets, the belt having openings formed therein;

[0010] a roller having pins disposed to engage in said openings in said belt;

[0011] at least one ring mounted on said roller rotatably relative to said pins, with said belt lying on said ring.

[0012] In other words, the method according to the invention for conveying printing-material sheets by a belt conveyor, including a belt for transporting the printing-material sheets, the belt having openings, and a roller for guiding the belt, the roller having pins for engaging in the openings, is primarily distinguished in that the belt is driven by the roller substantially exclusively via a form lock, i.e., a positive connection, between the pins and the openings and virtually without any friction lock between the inner surface of the belt and the peripheral surface of the roller.

[0013] A form-locking connection, which is also referred to in the art as a positive connection, is one that connects two elements together due to the shape of the elements themselves. This is opposed to a force-locking connection, which is also referred to as a friction-lock.

[0014] The belt conveyor according to the invention of a printing-material sheet processing machine, including a belt for transporting the printing-material sheets, the belt having openings, and a roller having pins for engaging in the openings, is characterized in that at least one ring is mounted rotatably on the roller, relative to the pins, the belt lying on the ring. The belt conveyor according to the invention is suited for performing the method according to the invention.

[0015] The invention is based upon the realization that, for the wear of the belt, there was originally a difference in speed, which could occur between the rotational speed of the neutral fiber of the belt and the rotational speed of the peripheral surface of the roller as a result of a change in the radial position of the neutral fiber. The radial position of the neutral fiber may vary, for example, due to an aging-conditioned decline in the prestressing of the belt. The neutral fiber determines an effective radius of the torque form lockingly or positively transferred from the pins to the belt. With the belt of the state of the art (German published patent application DE 40 17 931 A1), the peripheral surface of the roller, as well, determined an effective radius with respect to the torque transfer, when the peripheral surface cooperated frictionally with the inner surface of the belt lying on the peripheral surface and, accordingly, as well, transferred a torque to the belt. Both of the effective radii are different in size from one another, so that the aforementioned difference in speed occurred.

[0016] This difference in speed and the belt wear resulting therefrom are avoided in the present invention, in that the friction lock effective between the inner surface of the belt and the peripheral surface of the roller is neutralized to such an extent that essentially no torque can be transferred any longer from the roller to the belt over (by means of?) this friction lock. With regard to the belt conveyor according to the invention, the difference in speed is compensated for by the rotational movement of the ring occurring relative to the pins. During the contact between the ring and the belt, which lies with the inner surface thereof on the peripheral surface of the ring, friction occurs between both surfaces essentially without slippage, i.e., essentially static friction. The rotative slippage, due to which the difference in speed is compensated for, occurs either between the ring and a structural member of the roller carrying the ring or within the ring. The slippage occurs between the ring and the structural member, when the ring, for example, is constructed as a sliding or
journal bearing sliding on the structural member. The structural member may be, for example, a shaft of the roller or a sleeve-shaped hollow shaft of the roller seated on the shaft. For example, the slippage occurs within the ring, when the ring is a roller bearing having a multiparticle construction.

[0017] In a refinement, the pins are arranged in a row along the periphery of the roller and the row is arranged between the ring and a further ring, which is mounted rotatably on the roller, relative to the pins, and wherein the belt lies. A substantial friction lock exists between the rings and the inner surface of the belt.

[0018] In a further refinement, the initially mentioned ring, as a single existing ring, is formed as a sliding bearing or the initially mentioned ring and the further ring are formed as sliding bearings.

[0019] In a further refinement, the initially mentioned ring, as a single existing ring, is formed as a roller bearing or the initially mentioned ring and the further ring are formed as roller bearings.

[0020] In a further refinement, the roller is provided with a step wherein the initially mentioned ring, as a single existing ring, is rotatably seated, or the roller is provided with a step wherein the initially mentioned ring is rotatably seated, and a further step wherein the further ring is rotatably seated.

[0021] Also belonging to the invention is a sheet delivery of a printing-material sheet processing machine, which is furnished with a belt conveyor constructed in accordance with the invention or one of the refinements. Also belonging, as well, to the invention is a printing press, which is furnished with a belt conveyor constructed in accordance with the invention or one of the refinements.

[0022] Other features which are considered as characteristic for the invention are set forth in the appended claims.

[0023] Although the invention is illustrated and described herein as embodied in method for conveying a printing-material sheet by a belt conveyor, and a belt conveyor suited therefor, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

[0024] The construction and method of operation of the invention, however, together with additional objects and advantages thereof will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0025] **FIG. 1** is a side view of a printing press with a belt conveyor forming a sheet brake;

[0026] **FIG. 2** is an enlarged side view of a sheet conveyor;

[0027] **FIG. 3** is a section, taken along the line III-III in **FIG. 2**, of a first exemplary embodiment of the belt conveyor according to the invention;

[0028] **FIG. 4** is a section, taken along the line IV-IV in **FIG. 2**, of a second exemplary embodiment of the belt conveyor according to the invention;

[0029] **FIG. 5** is a radial end view showing a modification of the second exemplary embodiment of the invention;

[0030] **FIG. 6** is an axial side view thereof; and

[0031] **FIG. 7** is a section, taken along the line VII-VII in **FIG. 6**, of the pin wheel of the belt conveyor.

**DESCRIPTION OF THE PREFERRED EMBODIMENTS**

[0032] Referring now to the figures of the drawing in detail and first, particularly, to **FIG. 1** thereof, there is shown a machine for processing a sheet 4 of printing material, that is, a printing press 1. The press 1 has printing units 2 for lithographic offset printing and a delivery 3 for delivering printed sheets 4. The delivery 3 includes a chain conveyor 5 for transporting the sheets 4 and a belt conveyor 7, which is arranged underneath the chain conveyor 5 and in front of a delivery pile or stack 6 formed of the laid down sheets 4. The belt conveyor 7 is a sheet brake. The sheet brake is configured to brake an arrival speed of the sheets 4 released from the chain conveyor 5 and to transport these sheets 4 to the delivery pile 6.

[0033] **FIG. 2** shows that the belt conveyor 7 has a first roller 8, a second roller 9 and an endless belt 11 slung around both rollers 8 and 9. The first roller 8 is a drive roller for actuating the revolving movement of the belt 11, and the second roller 9 is a deflector roller driven via the belt 11 for deflecting the belt 11. The two rollers 8 and 9 are of similar construction, so that the following description of the structural conditions of the first roller 8 serves in the transfer sense also for the second roller 9.

[0034] The first roller 8 has pins 10 or sprockets 10, which engage in openings 12 of the belt 11 for driving the belt 11. The pins 10 are arranged in a row 17 extending in the peripheral direction of the first roller 8, wherein the constant spacing existing between the pins 10 is measured exactly as great as the existing constant spacing between the openings 12. The openings 12 are suction openings for aspirating the sheets 4 at an outer surface 23 of the belt 11. A suction air box lying at an inner surface 22 of the belt 11 for acting upon the openings 12 with a vacuum is not illustrated graphically shown for reasons of better clarity. The neutral fiber of the belt 11 is identified by the reference numeral 25, and the roller peripheral surface of the first roller 8 by the reference numeral 24.

[0035] **FIG. 3** shows that the pins 10 are tightly fitted or seated in a shaft 13 forming the core of the first roller 8.

[0036] Deviating therefrom, the pins 10 and the shaft 13 might be constructed in one piece, for example, by an injection molding process. In that case, the pins or sprockets 10 would be integrally formed on the shaft 13.

[0037] As is apparent in **FIG. 3**, to the left-hand and right-hand sides of the row 17, a first supporting ring 14 and a second supporting ring 15 are slipped onto the shaft 13. Both supporting rings 14, 15 are formed as a respective roller bearing, the inner bearing ring of which is seated on the shaft 13 fixed against rotation relative thereto and, on the outer bearing ring of which the belt 11 lies on the peripheral side, the outer bearing ring forming the peripheral surface of the roller 24 (see **FIG. 2**). The belt 11 lies with its inner surface 22, with respect to the first roller 8, only on both supporting
rings 14, 15 and on no other element of the first roller 8. The rolling bodies, for example, balls or needles, arranged between both bearing rings, permit a rotary motion about the geometric axis 26 occurring within the respective supporting rings 14 or 15 and relatively to the pins 10. Both of the supporting rings 14, 15 are axially secured by the pins 10 and by guard rings 16 against displacements occurring along the shaft 13.

[0038] FIG. 4 shows an exemplary embodiment which differs from the exemplary embodiment shown in FIG. 5 only by constructing the shaft 13 with a first step 19, a second step 20 and a crosspiece 21 as well as by the construction of both of the supporting rings 14, 15 as sliding or friction bearings. The first supporting ring 14 is rotatably seated on the first step 19, and the second supporting ring 15 is rotatably seated on the second step 20. The pins 10 project out of the crosspiece 21 disposed between the two steps 19, 20. The belt 11 lies with its inner surface not only on the bearing outer surfaces of the box-shaped supporting rings 14, 15, but also on the crosspiece 21, the peripheral surface of which is flush with the bearing outer surfaces. Because the width of the crosspiece 21 to be measured in the direction of the rotational axis 26 is essentially smaller than the width of both of the supporting rings 14, 15 together to be measured in this direction, a friction lock, occurring between the peripheral surface of the crosspiece 21 and the inner surface 22 of the belt 11, is negligibly small with respect to its force action on the belt 11. This friction lock is capable of generating virtually no disruptive difference in speed between the neutral fiber 25 and the roller peripheral surface 24.

[0039] If necessary, the diameter of the crosspiece 21 can be slightly reduced, so that the bearing outer surfaces no longer close radially flush with the crosspiece 21, but rather project somewhat over the crosspiece 21, so that no contact whatsoever exists anymore between the inner surface 22 of the belt 11 and the crosspiece or web 21.

[0040] FIGS. 5 to 7 show an exemplary embodiment, which differs from the exemplary embodiment shown in FIG. 4 primarily in that the shaft 13 is constructed as a sleeve-shaped hollow shaft, wherein a further shaft 18 is seated so as to be fixed against relative rotation therewith.

[0041] This application claims the priority, under 35 U.S.C. § 119, of German application DE 10 2005 015 096.9, filed Apr. 1, 2005; the prior application is herewith incorporated by reference in its entirety.

We claim:

1. A method of conveying printing-material sheets, which comprises:
   providing a belt conveyor with a belt for transporting the printing-material sheets, the belt having openings formed therein, and with a roller for guiding the belt, the roller having pins disposed and formed for engaging in the openings formed in the belt;
   driving the belt with the roller substantially exclusively via a form lock between the pins and the openings and substantially not by friction between an inner surface of the belt and a peripheral surface of the roller; and
   transporting the printing-material sheets on the belt.

2. A belt conveyor of a printing-material sheet processing machine, comprising:
   a belt for transporting printing-material sheets, the belt having openings formed therein;
   a roller having pins disposed to engage in said openings in said belt;
   at least one ring mounted on said roller rotatably relative to said pins, with said belt lying on said ring.

3. The belt conveyor according to claim 2, wherein said ring is one of a plurality of rings including a first ring and a second ring supporting said belt on said roller, and said pins are arranged along a row on a periphery of said roller between said first ring and said second ring.

4. The belt conveyor according to claim 3, wherein each of said first and second rings is formed as a sliding bearing.

5. The belt conveyor according to claim 3, wherein each of said first and second rings is formed as a roller bearing.

6. The belt conveyor according to claim 3, wherein said roller is formed with two steps each rotatably supporting a respective one of said first and second rings.

7. The belt conveyor according to claim 2, wherein at least one ring forms a sliding bearing on said roller.

8. The belt conveyor according to claim 2, wherein at least one ring is formed with a roller bearing on said roller.

9. The belt conveyor according to claim 2, wherein said roller is formed with a step, and said ring is rotatably seated on said step.

10. In combination with a sheet delivery of a printing-material sheet processing machine, the belt conveyor according to claim 2 disposed in the sheet delivery.

11. In combination with a printing press, a belt conveyor according to claim 2.

12. A belt conveyor for conveying printing-material sheets, comprising:
   a belt for transporting printing-material sheets, the belt having openings formed therein;
   a roller having pins disposed thereon to engage in said openings in said belt;
   one or more rings rotatably supported on said roller,
   wherein, when said belt is driven via a form lock between said pins and said openings in said belt, said belt lies on said one or more rings and said one or more rings rotate about said roller.

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