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Inventor(s)	Chesaux; Stéphane et al.

Sheet processing machine

Abstract

A sheet processing machine with a transfer mechanism for moving sheets along a handling direction of the sheet processing machine and with a waste evacuation device (**36**) for releasing the sheets. The transport mechanism comprises at least one sheet handling element (**28**) for moving a sheet. The waste evacuation device (**36**) further comprises a passage (**46**) formed between an opening surface (**48**) and a restraint surface (**50**). The at least one sheet handling element (**28**) comprises a first sliding element (**68**) and a second sliding element (**70**) being in contact with the opening surface (**48**) and the restraint surface (**50**), respectively, when passing the waste evacuation device (**36**).

Inventors: **Chesaux; Stéphane (Echallens, CH), Mitjana; Carles Sagués (Villars-sous-Yens, CH)**

Applicant: **BOBST MEX SA** (Mex, CH)

Family ID: **1000008766105**

Assignee: **BOBST MEX SA (Mex, CH)**

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Primary Examiner: Severson; Jeremy R

Attorney, Agent or Firm: Bookoff McAndrews, PLLC

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION(S)

(1) This application is a National Stage Application under 35 U.S.C. § 371 of International Application No. PCT/EP2021/085754, filed on Dec. 14, 2021, which claims priority to European Application No. 20215040.5, filed on Dec. 17, 2020, the entireties of which are incorporated herein by reference.

(2) The invention relates to a sheet processing machine with a waste evacuation device.

(3) Sheet processing machines, also known as converting machines, are used in the packaging industry for processing raw materials, e.g. cardboard, paper or foils, into intermediate or finished

products, typically in the form of sheets. Converting operations can e.g. include printing, cutting, creasing, blanking, stamping and/or folding-gluing. Typically, the individual operations are done in subsequent processing stations of the sheet processing machine with the sheets being conveyed from one processing station to the subsequent one by a transfer mechanism.
(4) E.g. in die-cutting machines, so-called blanks are obtained from the sheets made of raw material. Blanking operations e.g. involve breaking nicks in sheets by blanking tools, wherein the nicks have been formed in a previous processing step, thereby pushing the blanks downwards into a piling area for collecting the blanks. Accordingly, after the blanking operation, waste sheets remain connected to the transfer mechanism and need to be removed in a subsequent waste evacuation station (also known as waste ejection station).
(5) Modern sheet processing machines enable a high throughput of sheets, i.e. a high processing speed. To achieve such processing speeds, it is desirable to release the waste sheets from the transfer mechanism in a dynamic manner, i.e. it is desired to release the waste sheets without the need to stop the transfer mechanism.
(6) However, the high processing speeds can lead to unwanted rotations and/or misalignment of components of the transfer mechanism in the waste evacuation station which can lead to damages and unplanned downtimes of the sheet processing machine.
(7) This effect becomes more pronounced, the larger the size of the sheets to be processed are due to the necessary larger sizes of the components of the sheet processing machine.
(8) DE 60 2004 011 618 T2 discloses a sheet processing machine comprising a conveyor belt with which a multitude of gripper bars are moved to transport sheets within the sheet processing machine. In a blanking station of the sheet processing machine, the sheets can be released by tilting the gripper bar around a transverse shaft within the blanking station, resulting in a downwards motion of grippers of the gripper bar and the sheets attached to said grippers, such that the sheets are held back by front stops of a comb and are collected in the blanking station while the grippers can pass the comb. However, the presented system is only suited when the sheet is moved along a straight horizontal passage, e.g. in a blanking station, as the tilting motion can lead to unwanted rotations of the gripper bar.
(9) The object of the invention is to provide a robust and simple means for waste ejection in a sheet processing machine. Preferably, the provided solution is also suitable for processing sheets of large size.
(10) The object of the invention is solved by a sheet processing machine with a transfer mechanism for moving sheets along a handling direction of the sheet processing machine and with a waste evacuation device for releasing the sheets. The transport mechanism comprises at least one sheet handling element for moving a sheet. The waste evacuation device further comprises a passage formed between an opening surface and a restraint surface. The at least one sheet handling element comprises a first sliding element and a second sliding element being in contact with the opening surface and the restraint surface, respectively, when passing the waste evacuation device.
(11) The at least one sheet handling element is adapted to release the sheet when passing the waste evacuation device, wherein especially the interaction of the opening surface and the first sliding element is responsible for releasing the sheet.
(12) The invention is based on the idea to provide a passage for the sheet handling element resulting in a well-defined trajectory of the sheet handling element when passing the waste evacuation device. With other words, rotations of the sheet handling element can effectively be suppressed in the passage of the waste evacuation device. Accordingly, the orientation of the sheet handling element when passing the waste evacuation device remains within a well-defined range.
(13) Therefore, according to the invention the at least one sheet handling element is adapted to remain aligned with its trajectory along the course of the passage formed between the opening surface and the restraint surface. With other words, the at least one sheet handling element does not rotate or tilt within the passage.

(14) The sliding interactions between the first sliding element and the opening surface and the second sliding element and the restraint surface enable the sheet handling element to pass the waste evacuation device in a dynamic manner, i.e. without any interruptions and/or stops of the transfer mechanism, while at the same time wear of the involved components can be minimized. This allows for high processing speeds of the sheet processing machine.
(15) Preferably, the at least one sheet handling element has a leading edge defining a length direction of the sheet handling element and a trailing edge being opposite to the leading edge along a width direction of the sheet handling element, the width direction being perpendicular to the length direction. Additionally, the first sliding element and the second sliding element are arranged at the same side of the sheet handling element with respect to a central axis of the width direction, the central axis being perpendicular to both the length direction and the width direction.
(16) With other words, in this variant of the sheet processing machine according to the invention, the first sliding element and the second sliding element are positioned at the same half of the sheet handling element with respect to the central axis. This arrangement is preferable to correlate the forces acting on the first and second sliding element, respectively, in the passage such that rotations of the sheet handling element are effectively suppressed.
(17) With the term “leading edge” the part of the sheet handling element is denoted which is arranged at the front of the sheet handling element relative to a handling direction of the sheets being processed in the sheet processing machine.
(18) To further prevent or at least minimize deformations of the at least one sheet handling element when passing the waste evacuation device, caused e.g. due to centrifugal forces acting on the at least one sheet handling element, at least one stabilizing slider can be arranged on the leading edge.
(19) The stabilizing sliders can interact with alignment elements of the waste evacuation device, e.g. cams providing sliding surfaces for the interaction with the at least one stabilizing sliders.
(20) The sheet handling element especially has a length along the length direction of 106 cm or more, e.g. the length direction has a length of from 140 to 170 cm.
(21) The length of the sheet handling element along the length direction especially corresponds to the size of the sheets to be processed by the sheet processing machine. Accordingly, the sheet processing machine according to the invention especially allows for processing sheets of large size as the sheet handling element can be stabilized by interaction of the first and second sliding elements and the opening surface and the restraint surface, respectively.
(22) The first sliding element and the second sliding element can be arranged at the trailing edge of the at least one sheet handling element. Such an arrangement is especially preferable to further compensate with the first and second sliding element for forces acting on the leading edge of the sheet handling element to prevent or at least minimize any rotations of the sheet handling element.
(23) Preferably, the first sliding element and the second sliding element are at least partially arranged at opposite side surfaces of the at least one sheet handling element.
(24) With other words, the interaction between the first sliding element and the opening surface and the interaction between the second sliding element and the restraint surface preferably take place at opposite sides of the sheet handling element for stabilizing the alignment of the sheet handling element.
(25) The side surfaces especially connect the leading edge and the trailing edge of the sheet handling element.
(26) To minimize any rotations of the sheet handling element due to the interaction of the first sliding element and the opening surface, the restraint surface can apply a restraint force on the second sliding element which is at least of the size of an opening force applied by the opening surface on the first sliding element.
(27) The direction of the restraint force is especially essentially opposite to the direction of the opening force.
(28) Accordingly, the restraint force and the opening force are such that the at least one sheet

handling element does not rotate or tilt within the passage of the waste evacuation device.
(29) The passage formed between the opening surface and the restraint surface is curved.
(30) E.g., the passage can be arranged such to be in line with a travel direction of the sheet handling element when passing the waste evacuation station. This means that the transfer mechanism can travel around a loop in which the sheet is moved along the handling direction by the sheet handling element for essentially one half of the loop and can travel back to a starting position without the sheet along a reverse direction for essentially the other half of the loop for gripping a next sheet to be processed. The passage can be arranged at the turning point between the two halves of the loop at the waste evacuation device.
(31) Preferably, the first sliding element and/or the second sliding element is a roller. By using rollers as first and/or second sliding element, any forces acting on the first and/or second sliding element can be translated into a circular motion of the roller, thereby eliminating or at least minimizing the risk of damaging the first and sliding element, respectively, when interacting with the opening surface and the restraint surface, respectively.
(32) The opening surface can be part of an opening cam and the restraint surface can be part of an anti-rotating cam of the waste evacuation device. Cams are cheap and are available in a variety of sizes and shapes to provide a desired course of the passage of the waste evacuation device. Further, they can be designed such to minimize the needed space.
(33) For interaction with the sheets being processed in the sheet processing machine, the at least one sheet handling element can comprise at least one gripping element being displaceable between a sheet gripping state and a sheet releasing state, the at least one gripping element especially being arranged at the trailing edge of the at least one sheet element.
(34) Accordingly, the at least one sheet handling element can especially be a gripper bar, preferably a gripper bar comprising a plurality of gripping elements.
(35) The first sliding element can be adapted to control the state of the at least one gripping element. E.g., the first sliding element and the at least one gripping element can be connected by an opening mechanism, wherein the opening force experienced by the first sliding element when passing the waste evacuation device is transferred from the first sliding element to the opening mechanism resulting in displacing the at least one gripping element from the sheet gripping state to the sheet releasing state. As soon as the opening force is not acting anymore on the first sliding element, the at least one gripping element can be displaced back to the sheet gripping state by the opening mechanism.
(36) The waste evacuation device can further comprise a comb comprising a plurality of teeth. The comb is used to retain the waste sheet delivered by the transfer mechanism to the waste evacuation device while allowing the sheet handling element to pass by. Accordingly, the teeth of the comb are especially arranged such that the at least one gripping element of the at least one sheet handling element can pass the comb.
(37) Preferably, the at least one sheet handling element comprises a first and a second set of sliding elements, each set comprising a first sliding element and a second sliding element, wherein the first and second set of sliding elements are arranged at a first end section and a second end section, respectively, the first end section and the second end section being at opposite ends of the at least one sheet handling element along the length direction of the at least one sheet handling element.
(38) In this variant, the sheet handling element can be stabilized against rotations at the two peripheral ends of the sheet handling element, resulting in an especially stable orientation of the sheet handling element when passing the waste evacuation device.
(39) Accordingly, the waste evacuation device preferably comprises a first passage for the first set of sliding elements and a second passage for the second set of sliding elements. The first and second passages each correspond to the passage as described before.
(40) To allow faster processing speeds of the sheet processing machine, the transfer mechanism preferably comprises a plurality of sheet handling elements connected by chain linker elements, i.e.

the plurality of sheet handling elements essentially form a chain of linked sheet handling elements. This results in a tension in the individual sheet handling elements which can already minimize the extent of rotations of the individual sheet handling elements by restricting the movement of the sheet handling elements.
(41) With other words, the plurality of sheet handling elements is aligned with the chain linker elements, i.e. each of the plurality of the sheet handling elements travels along the same path as the chain linker elements including the path when travelling through the passage of the waste evacuation device.
(42) The transfer mechanism preferably moves the sheets from a loading station of the sheet processing machine to a waste evacuation station of the sheet processing machine comprising the waste evacuation device.

Description

(1) Further advantages and features of the invention will become apparent from the following description of the invention and from the appended figures which show a non-limiting exemplary embodiment of the invention and in which:
(2) FIG. **1** schematically shows a sheet processing machine according to the invention;
(3) FIG. **2** shows a perspective view of a waste evacuation device of the sheet processing machine of FIG. **1**;
(4) FIG. **3** shows another perspective view of selected parts of the waste evacuation device of FIG. **2**;
(5) FIG. **4** shows a detail of the waste evacuation device of FIG. **2**;
(6) FIG. **5** shows a perspective view of additional components of the waste evacuation device of FIG. **2**; and
(7) FIG. **6**. illustrates schematically the mode of action of the waste evacuation device of FIG. **2**.
(8) FIG. **1** schematically shows a sheet processing machine **10** making it possible to cut blanks from a succession of sheets **12**. These blanks are usually intended to be subsequently folded and bonded to form packaging boxes. However, the sheets **12** might generally be made of e.g. paper, cardboard, foil, a composite material thereof or any other material routinely used in the packaging industry.
(9) The sheet processing machine **10** comprises a series of processing stations that are juxtaposed but interdependent one another in order to form a unitary assembly. The processing machine **10** includes a loading station **14** followed by a cutting station **16** (also usually named punching station) comprising for example a die or platen press **18** where the sheets **12** are transformed by cutting, a waste removal station **20** wherein most of the waste parts are stripped, a blank separation station **22** (also usually named reception station) for separation of the blanks (or blanking operation) by means of a blanking tool **23** and a waste evacuation station **24** for removing the residual waste sheets of the punched sheets **12**.
(10) The number and nature of the processing stations may vary depending on the nature and the complexity of the converting operations to be carried out on the sheets **12**.
(11) The sheet processing machine **10** also has a transfer mechanism **26**, which in the shown embodiment is a conveyor, to make it possible to individually move each sheet **12** from an outlet of the loading station **14** to the waste evacuation station **24**.
(12) The conveyor uses a series of sheet handling elements **28** that are mounted so as to be moveable by means of two loops of chains **30** one placed laterally on each side of the sheet processing machine **10**. Each loop of chains **30** travels around a loop which allows the sheet handling elements **28** to follow a trajectory passing successively by the cutting station **16**, the waste removal station **20**, the blank separation station **22** and the evacuation station **24**.

(13) Each sheet handling element **28** travels for essentially the first half of its passage on an outward path in a substantially horizontal plane of passage between a driven wheel **32** and an idler wheel **34**, and then for essentially the second half of its passage on a return path in the top portion of the sheet processing machine **10**. Once returned to the driven wheel **32**, each sheet handling element **28** is then able to grip a new sheet **12** at a front edge of the sheet **12**.
(14) In the shown embodiment, the sheet handling elements **28** are so-called gripper bars.
(15) In FIG. **1**, each processing station is illustrated in the form of two rectangles symbolizing respectively its top portion and its bottom portion that are positioned on each side of the plane of movement of the sheets **12**.
(16) In FIG. **1**, a transverse (or lateral), longitudinal and vertical direction are indicated by the orthogonal spatial system (T, L, V).
(17) The terms “upstream” and “downstream” are defined with reference to the direction of movement of sheets **12** in a handling direction as illustrated by the arrow D in FIG. **1**.
(18) The waste evacuation station **24** further comprises a waste evacuation device **36** for releasing sheets **12** having been moved from the loading station **14** to the waste evacuation station **24**, i.e. for removing the waste sheets.
(19) FIG. **2** shows a perspective view of the waste evacuation device **36**.
(20) The waste evacuation device **36** comprises an opening cam **38** and an anti-rotating cam **40**.
(21) The opening cam **38** is fixed to a frame **42** while the anti-rotating cam **40** is fixed to connection bars **44** of the idler wheel **34**.
(22) The opening cam **38** and the anti-rotating cam **40** define a passage **46** formed between an opening surface **48** of the opening cam **38** and a restraint surface **50** of the anti-rotating cam **40**.
(23) As easily seen in FIG. **2**, the passage **46** is curved with a curvature adjusted to the curvature of the idler wheel **34**.
(24) Accordingly, the passage **46** essentially forms a turning point in the loop of chains **30** of the transfer mechanism **26** (see FIG. **1**).
(25) FIG. **2** depicts a state in which one of the sheet handling elements **28** is passing the waste evacuation device **36**.
(26) The sheet handling element **28** is a gripper bar with a leading edge **52** defining a length direction of the sheet handling element **28**.
(27) The length direction extends along the transverse direction T and defines the size of the sheets **12** along the transverse direction T being manageable by the sheet processing machine **10**.
(28) At the leading edge, two stabilizing sliders **54** are arranged which are used to prevent or at least minimize deformations of the sheet handling element **28** when passing the waste evacuation device **36**, e.g. due to centrifugal forces acting on the sheet handling element **28**.
(29) The stabilizing sliders **54** are interacting with alignment elements **56** of the waste evacuation device **36** which are cams providing sliding surfaces **58** for the stabilizing sliders **54** (see FIG. **5**).
(30) Opposite to the leading edge **52**, the sheet handling element **28** comprises a plurality of gripping elements **60** at a trailing edge **62** of the sheet handling element **28**.
(31) The gripping elements **60** are displaceable between a sheet gripping state and a sheet releasing state, wherein each of the gripping elements **60** comprise two arms **63** which are pressed against each other in the gripping state (see FIG. **3**). In the sheet releasing state, the arms **63** of the gripping elements **60** are being moved apart of each other to allow a sheet **12** to be placed between the arms **63**. When displaced back to the gripping state, the sheet **12** is accordingly pressed between the arms **63** and becomes fixed.
(32) The sheet handling element **28** has a first end section **64** and a second end section **66** at opposite ends of the sheet handling element **28** along the length direction (see also FIG. **5**).
(33) As shown in FIG. **2**, the waste evacuation device **36** comprises an opening cam **38** and an anti-rotating cam **40** both at the first end section **64** and at the second end section **66** of the sheet handling element **28**. Accordingly, the passages **46** shown in FIG. **2** can also be differentiated as

being a first passage and a second passage, respectively.
(34) As shown in FIGS. **3** and **4**, the sheet handling element **28** further comprises a first sliding element **68** and a second sliding element **70**. Both the first sliding element **68** and the second sliding element **70** are rollers.
(35) The first sliding element **68** and the second sliding element **70** are arranged such that when the sheet handling element **28** is passing the waste evacuation device **36**, the first sliding element **68** interacts with the opening surface **48** and the second sliding element **70** interacts with the restraint surface **50**.
(36) Further, as becomes especially evident from FIG. **4**, the first sliding element **68** and the second sliding element **70** are arranged at the trailing edge **62** of the sheet handling element **28**.
(37) Further, both the first sliding element **68** and the second sliding element **70** are arranged at the same side of the sheet handling element **28** relative to a central axis A-A (see FIG. **6**).
(38) The central axis A-A is perpendicular to both the length direction and a width direction of the sheet handling element **28**, wherein the width direction is perpendicular to the length direction.
(39) The sheet handling element **28** comprises another first sliding element **68** and another second sliding element **70** at the second end section **66**. Accordingly, the sheet handling element **28** comprises a first set of sliding elements at the first end section **64** and a second set of sliding elements at the second end section **66**.
(40) The waste evacuation device further comprises a comb **72** with a plurality of (not shown) teeth (see FIG. **5**).
(41) In the following, the mode of action of the waste evacuation device **36** will be described in more detail.
(42) During operation of the sheet processing machine **10**, the gripping elements **60** of the sheet handling element **28** are used to grip a front edge of the sheet **12** at an outlet of the loading station **14** (see FIG. **1**), i.e. the gripping elements **60** are brought into their gripping state.
(43) The sheet **12** is then moved by the movement of the sheet handling element **28** along the handling direction D through the processing stations, resulting in a waste sheet being gripped by the gripping elements **60** when the sheet handling element **28** reaches the waste evacuation station **24** with the waste evacuation device **36**.
(44) As described above, the chain **30** of the transfer mechanism **26** defines an outward path and a return path. The transition between the outward path and the return path is defined by passing the turning point defined by the passage **46** and the idler wheel **34** at the waste evacuation device **36**.
(45) Therefore, the first end section **64** and the second end section **66** of the sheet handling element **28** are drawn into the respective passage **46** of the waste evacuation device **36** by the movement of the chain **30**.
(46) This results in bringing the first sliding element **68** into contact with the opening surface **48** which applies an opening force F.sub.1 on the first sliding element **68**.
(47) The opening force F.sub.1 is transferred by the first sliding element **68** by a (not shown) opening mechanism to the gripping elements **60**. E.g., the opening force F.sub.1 is transferred by a spring mechanism to the arms **63** of the gripping elements **60**, resulting in the arms **63** moving apart of each other, i.e. the gripping elements **60** are displaced into their sheet releasing state.
(48) Accordingly, the waste sheet which has been moved along with the sheet handling element **28**, is released by the gripping elements **60** but impacts on the comb **72**. Therefore, the waste sheet is retained while the sheet handling element **28** can pass the waste evacuation device **36**. The retained waste sheets can be collected in the waste evacuation station **24** and discarded.
(49) However, the opening force F.sub.1 acting on the first sliding element **68** and used for displacing the gripping elements **60**, could cause unwanted rotations of the sheet handling element **28**.
(50) This effect is illustrated in FIG. **6** which is a schematic depiction of the waste evacuation device **36**. In FIG. **6**, the opening cam **38**, the anti-rotating cam **40** and the sheet handling element

28 are depicted in a flattened manner for simplification.
(51) The double-arrow P shown in FIG. **6** illustrates the rotational movements of the sheet handling element **28** to be prevented by the waste evacuation device **36**.
(52) Further, the opening force F.sub.1 acting on the first sliding element **68** is indicated by an arrow, too.
(53) According to the invention, the second sliding element **70** is in contact with the restraint surface **50** of the anti-rotating cam **40**, resulting in a restraint force F.sub.2 acting on the second sliding element **70** and indicated by an arrow in FIG. **6**, too.
(54) The restraint force F.sub.2 is preferably at least of the size of the opening force F.sub.1, thus ideally eliminating or at least minimizing rotational movements of the sheet handling element **28**.
(55) Further, the first sliding element **68** and the second sliding element **70** are arranged at the same side of the sheet handling element **28** relative to the central axis A-A.
(56) This arrangement is especially advantageous to minimize a distance d depicted in FIG. **6**. As long as the distance d is smaller than the distance between the first sliding element **68** and the location of the central axis A-A along the width direction of the sheet handling element **28**, the restraint force F.sub.2 can effectively reduce the rotational movements of the sheet handling element **28**.
(57) Additionally, the roller **54** that rolls on element **56** generates a force F.sub.3 to reduce further the rotational movements of the sheet handling element **28**, by compensating the torque induced by forces F.sub.1, F.sub.2, and distance d, which is small but non-zero in the current embodiments. This compensation is effective when the processing machine runs at high speed; the forces F.sub.1 and F.sub.2 being strong and cause a critical torque. At a lower speed, the chain drive is able to compensate for the torque.
(58) Additionally, in FIG. **6** chain linker elements **74** are indicated with dashed lines. The chain linker elements **74** connect the depicted sheet handling element **28** with the other sheet handling elements **28** of the transfer mechanism **26** (see FIG. **1**), thereby providing a base level tension which, limits the extent of rotational movements of the sheet handling element **28**.
(59) The sheet processing machine **10** according to the invention allows to prevent any unwanted rotations of the sheet handling element **28** when passing the waste evacuation device **36**. This enables the sheet processing machine **10** to release the waste sheets dynamically, i.e. without any stops of the transfer mechanism **26**, even in the case of relatively large sheets **12**. Further, no moving parts are needed in the waste evacuation device **36** for removing the waste sheets.

Claims

1. A sheet processing machine comprising: a transfer mechanism for moving sheets along a handling direction of the sheet processing machine; and a waste evacuation device for releasing the sheets, the transfer mechanism comprising at least one sheet handling element for moving a sheet, the waste evacuation device comprising a passage formed between an opening surface and a restraint surface, and the at least one sheet handling element comprising a first sliding element and a second sliding element being in contact with the opening surface and the restraint surface, respectively, when passing the waste evacuation device, wherein the transfer mechanism is adapted to travel in a loop with the at least one sheet handling element being moved along the handling direction for one half of the loop and being moved along a reverse direction for the other half of the loop, the passage being arranged at a turning point between the two halves of the loop.
2. The sheet processing machine according to claim 1, wherein the at least one sheet handling element is adapted to remain aligned with its trajectory along a course of the passage formed between the opening surface and the restraint surface.
3. The sheet processing machine according to claim 1, wherein the at least one sheet handling element has a leading edge defining a length direction of the sheet handling element and a trailing

edge being opposite to the leading edge along a width direction of the sheet handling element, the width direction being perpendicular to the length direction, the first sliding element and the second sliding element being arranged at a same side of the sheet handling element with respect to a central axis of the width direction, the central axis being perpendicular to both the length direction and the width direction.

4. The sheet processing machine according to claim 3, wherein the first sliding element and the second sliding element are arranged at the trailing edge of the at least one sheet handling element.

5. The sheet processing machine according to claim 3, wherein the at least one sheet handling element comprises at least one gripping element being displaceable between a sheet gripping state and a sheet releasing state, the at least one gripping element being arranged at the trailing edge of the at least one sheet handling element.

6. The sheet processing machine according to claim 1, wherein the first sliding element and the second sliding element are at least partially arranged at opposite side surfaces of the at least one sheet handling element.

7. The sheet processing machine according to claim 1, wherein the restraint surface applies a restraint force on the second sliding element which is at least of a size of an opening force applied by the opening surface on the first sliding element.

8. The sheet processing machine according to claim 1, wherein the passage formed between the opening surface and the restraint surface is curved.

9. The sheet processing machine according to claim 1, wherein a curvature of the passage is adjusted to a curvature of an idler wheel of the transfer mechanism being arranged at the turning point.

10. The sheet processing machine according to claim 1, wherein the first sliding element and/or the second sliding element is a roller.

11. The sheet processing machine according to claim 1, wherein the opening surface is part of an opening cam and the restraint surface is part of an anti-rotating cam of the waste evacuation device, respectively.

12. The sheet processing machine according to claim 1, wherein the waste evacuation device further comprises a comb comprising a plurality of teeth.

13. The sheet processing machine according to claim 1, wherein the at least one sheet handling element comprises a first and a second set of sliding elements, each set comprising a first sliding element and a second sliding element, wherein the first and second set of sliding elements are arranged at a first end section and a second end section, respectively, the first end section and the second end section being at opposite ends of the at least one sheet handling element along a length direction of the at least one sheet handling element.

14. The sheet processing machine according to claim 13, wherein the waste evacuation device comprises a first passage for the first set of sliding elements and a second passage for the second set of sliding elements.

15. The sheet processing machine according to claim 1, wherein the transfer mechanism comprises a plurality of sheet handling elements connected by chain linker elements.

16. The sheet processing machine according to claim 1, wherein the transfer mechanism moves the sheets from a loading station of the sheet processing machine to a waste evacuation station comprising the waste evacuation device.