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(54) **OBJECT TRACKING IN PACKAGING SYSTEMS**

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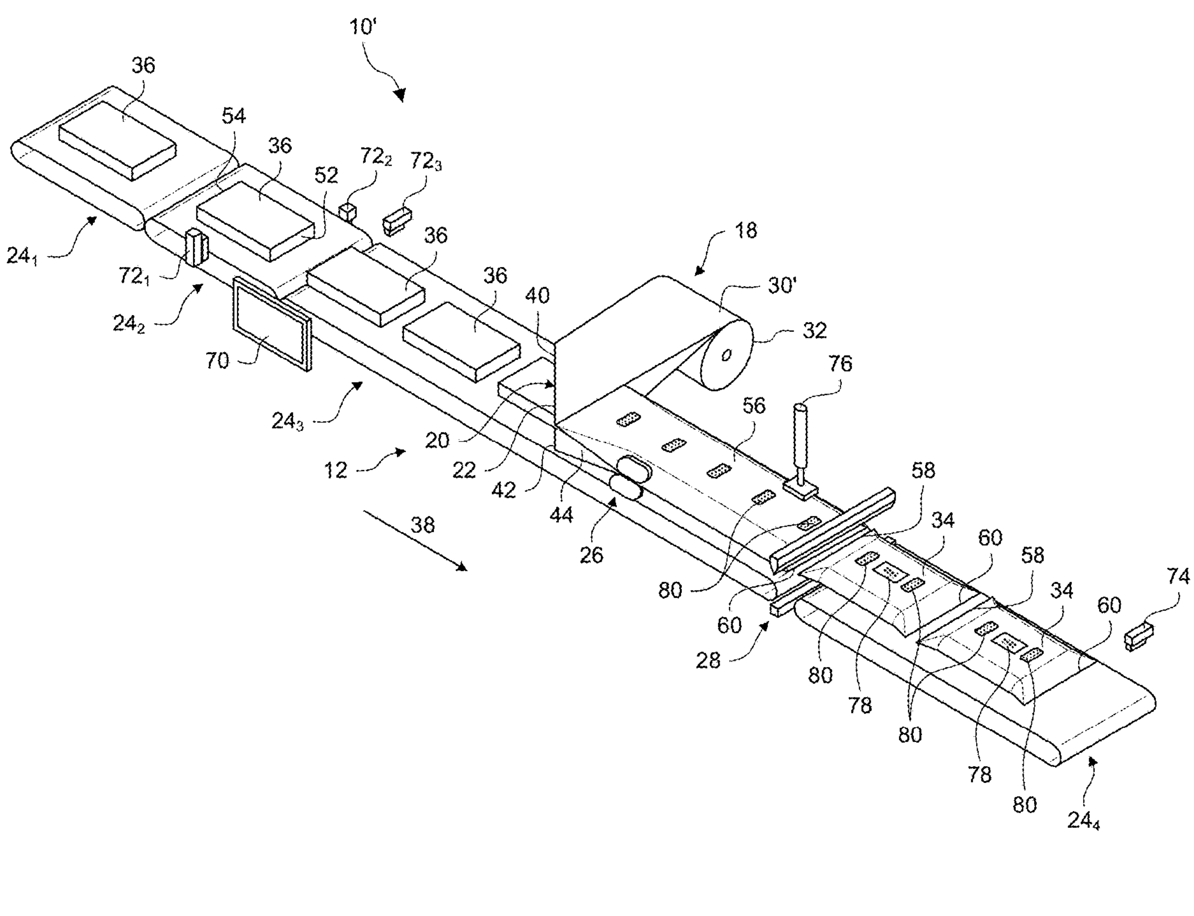
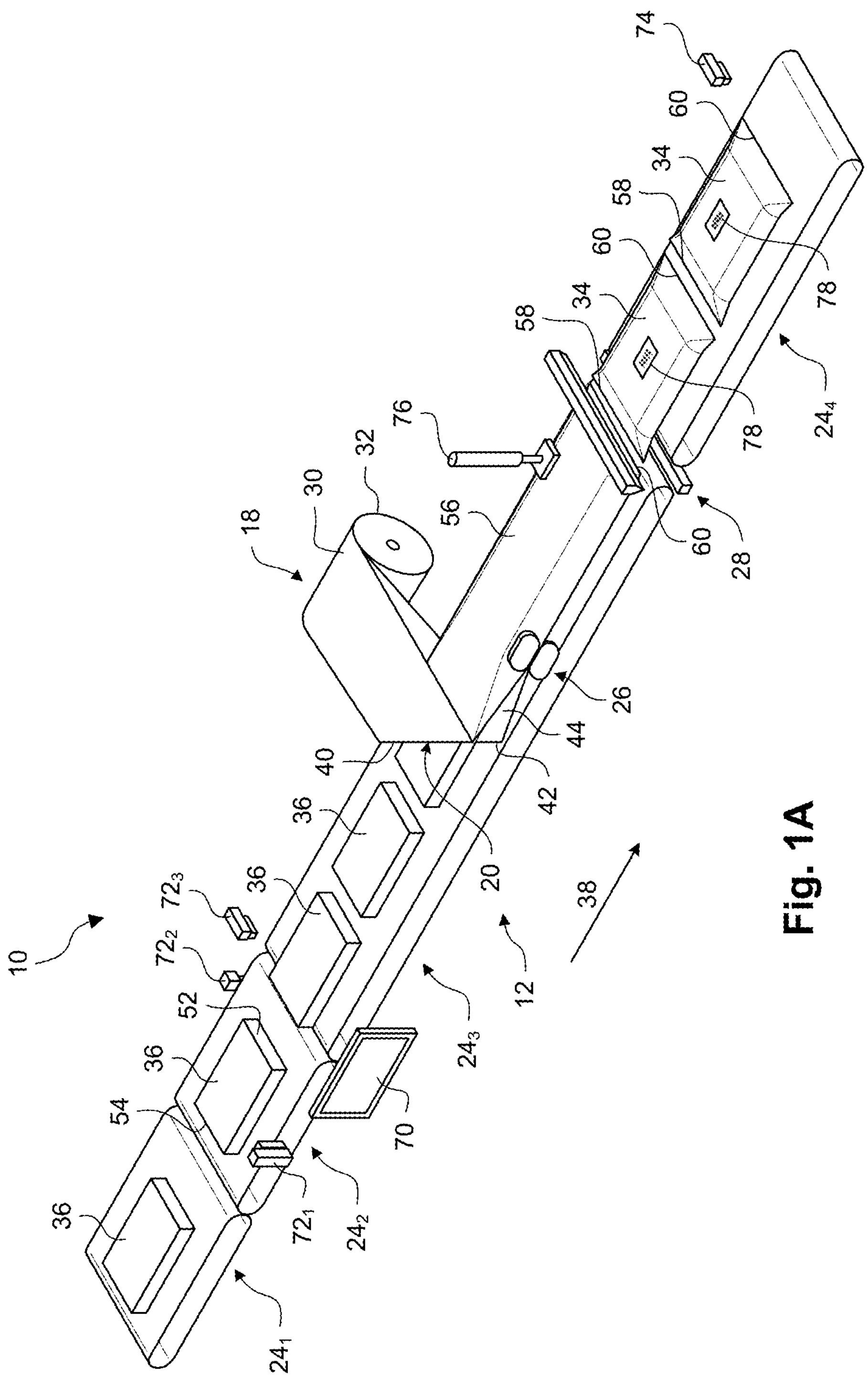
CPC ***B65B 57/14*** (2013.01); ***B65B 9/06*** (2013.01); ***B65B 57/06*** (2013.01)

(57) **ABSTRACT**

A packaging system includes a conveyance system, a package forming system, and a tracking system. The conveyance system is configured to receive objects and to convey the objects through the packaging system. Spacing between the objects is non-uniform as the objects are received by the conveyance system. The package forming system is configured to feed a packaging material to form a tube of the packaging material and to seal the tube of the packaging material around the objects to form packages of the packaging material around the objects. The tracking system configured to track locations of the objects as the objects are conveyed through the packaging system on the conveyance system. In some cases, the tracking system is configured to track locations of the objects independently of any marks on the packaging material and/or independently of the location of inducting documents placed on the objects.

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72_1
72_2
72_3
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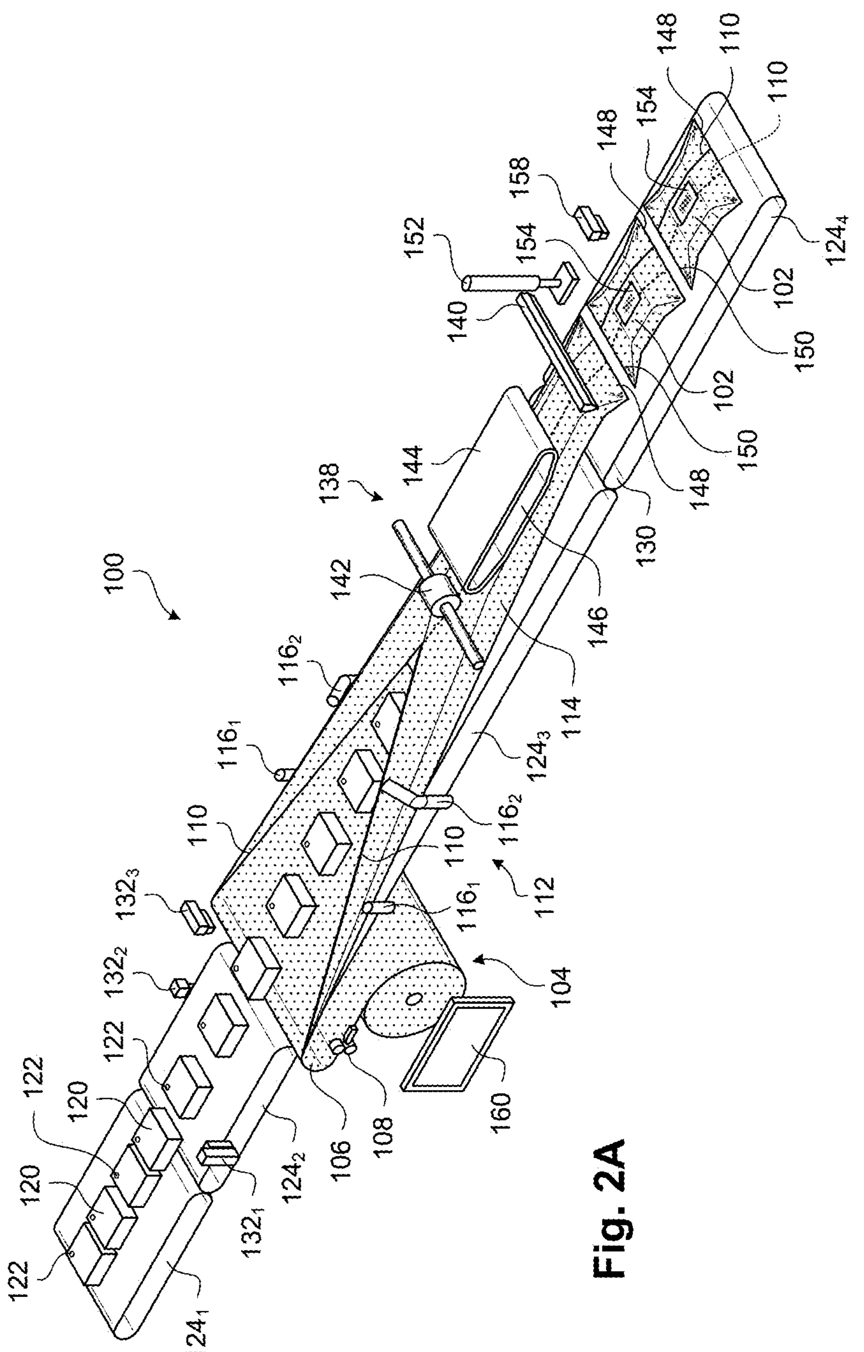
78

Fig. 1A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124_1
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160

Fig. 2A

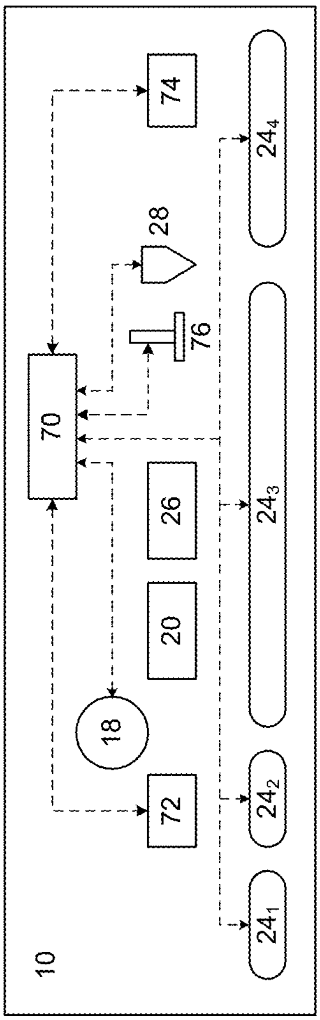
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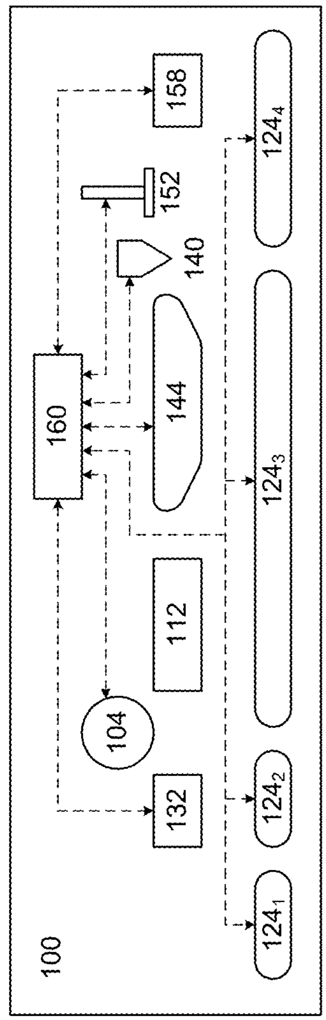
Fig. 1B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124_4

Fig. 2B

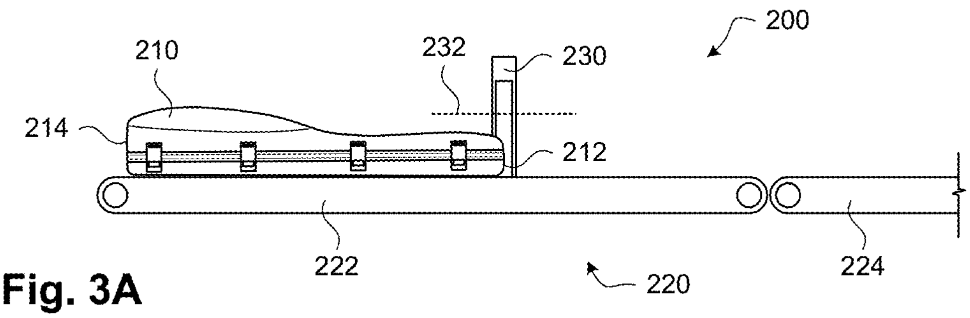

Fig. 3A

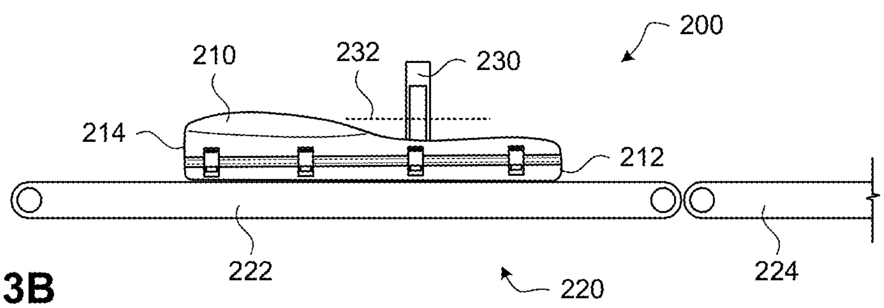

Fig. 3B

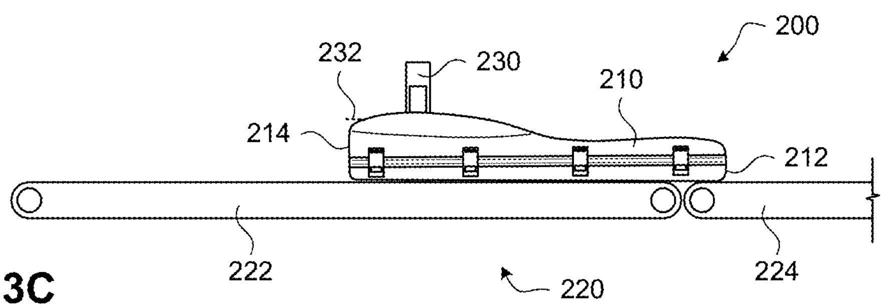

Fig. 3C

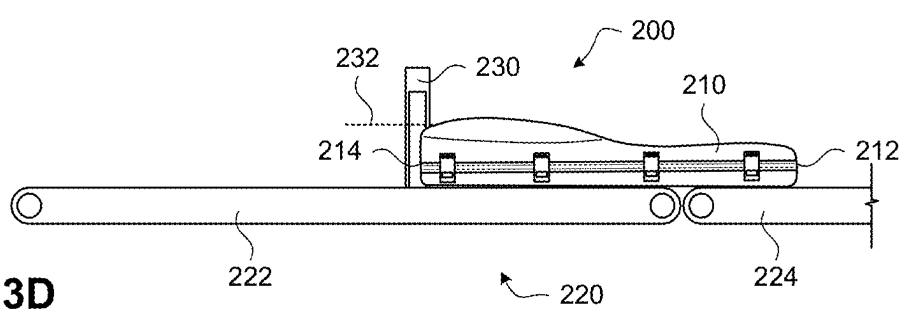

Fig. 3D

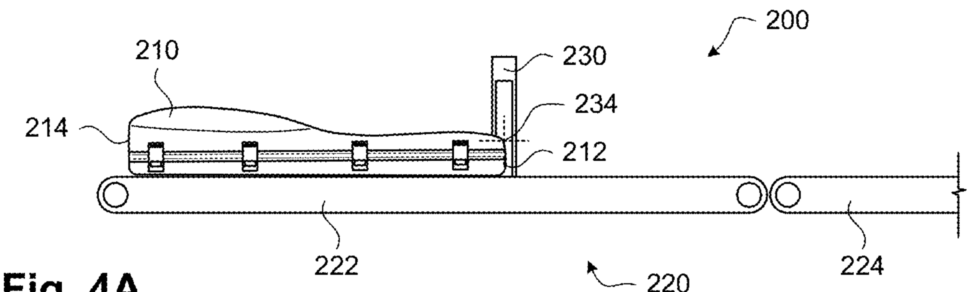

Fig. 4A

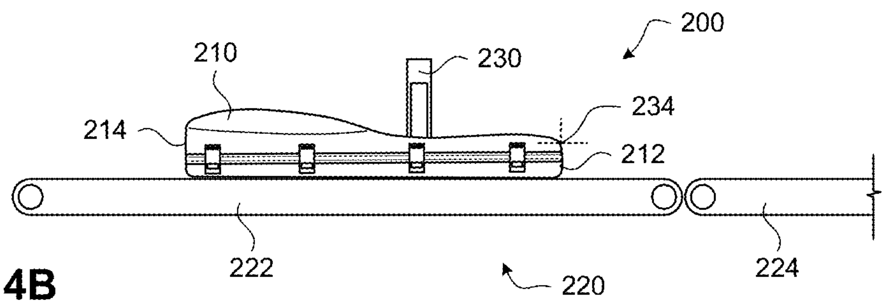

Fig. 4B

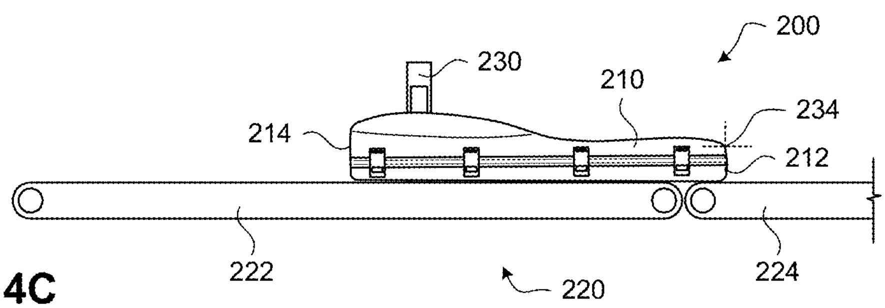

Fig. 4C

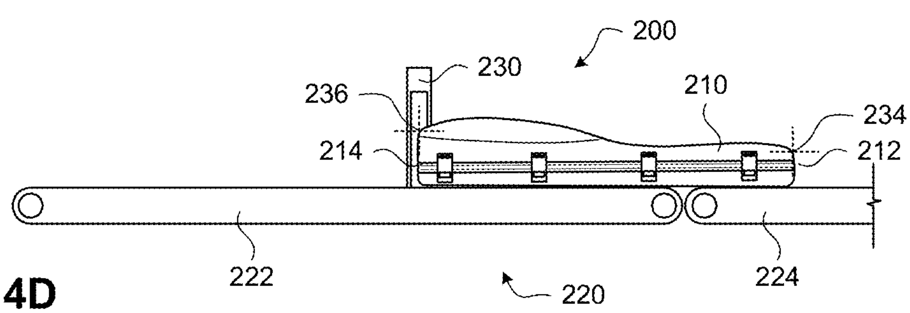

Fig. 4D

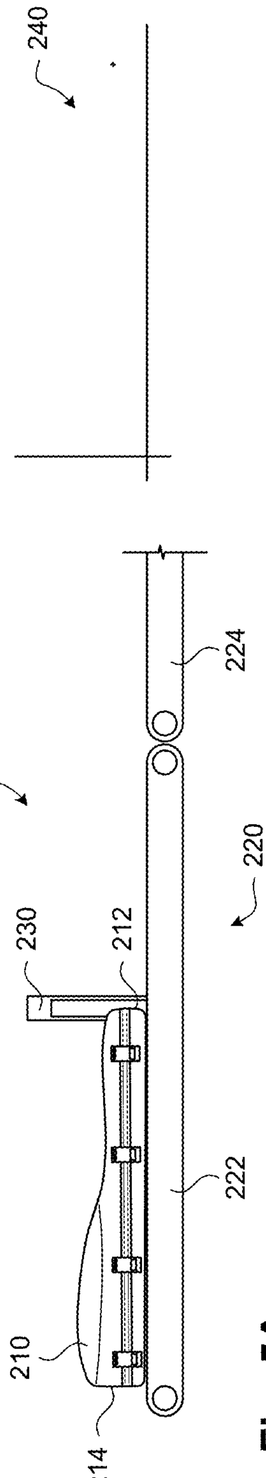
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Fig. 5A

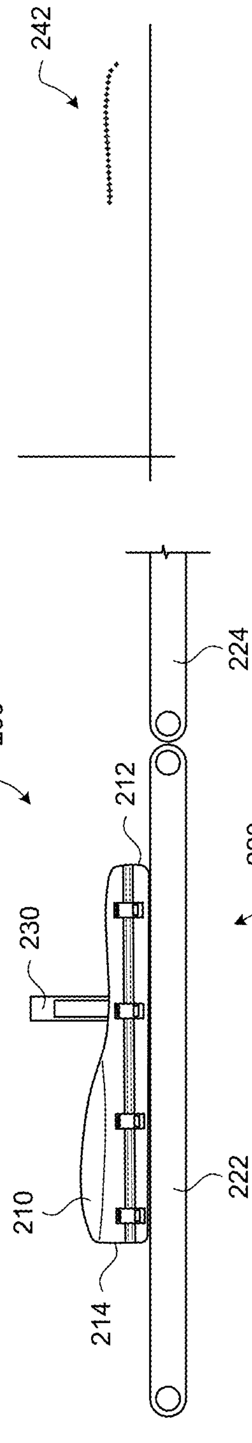
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Fig. 5B

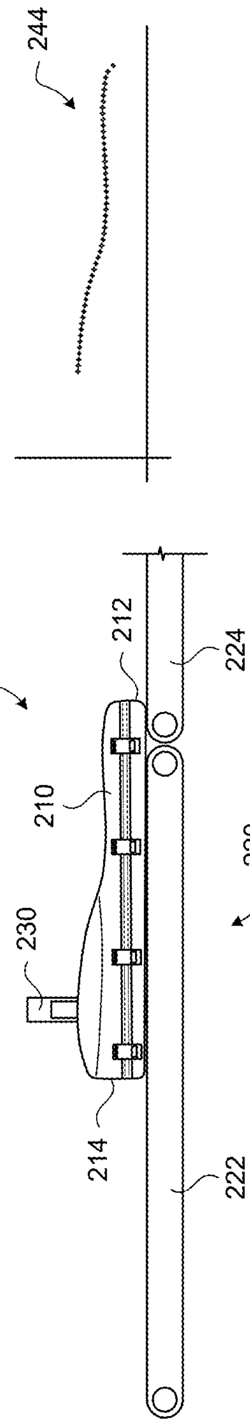
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Fig. 5C

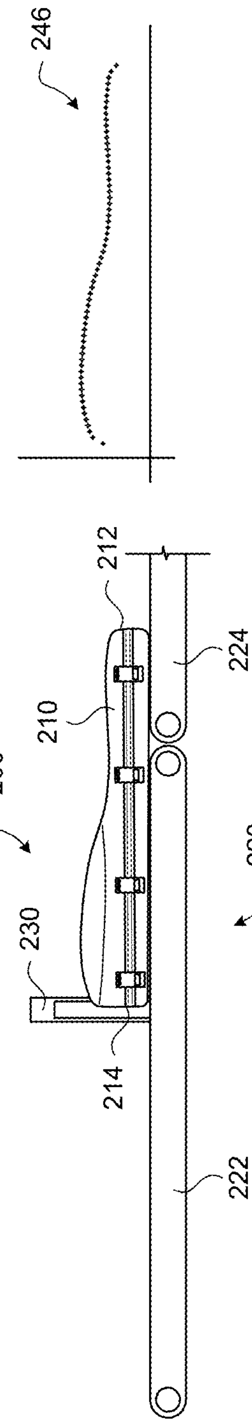
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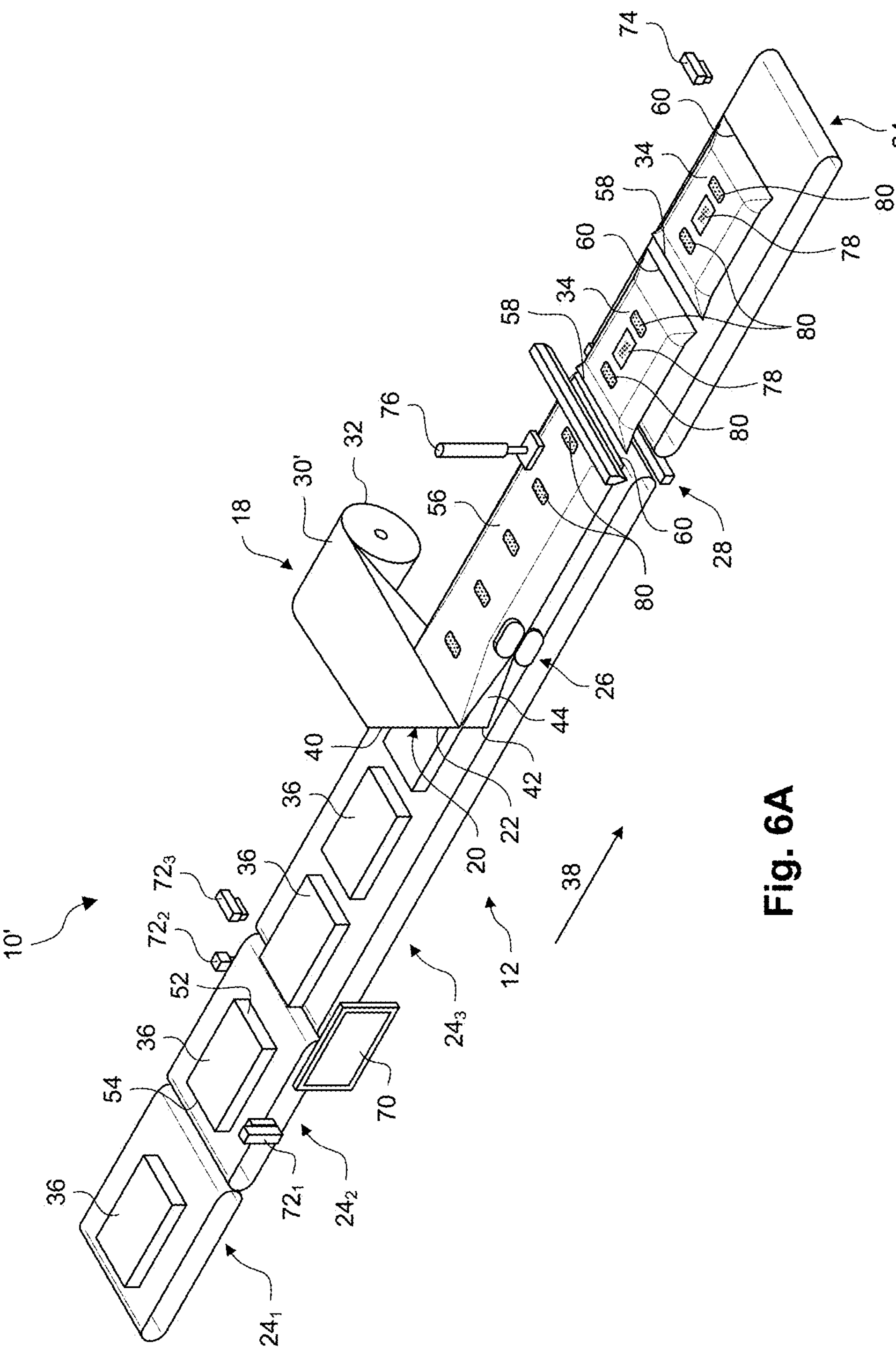
Fig. 5D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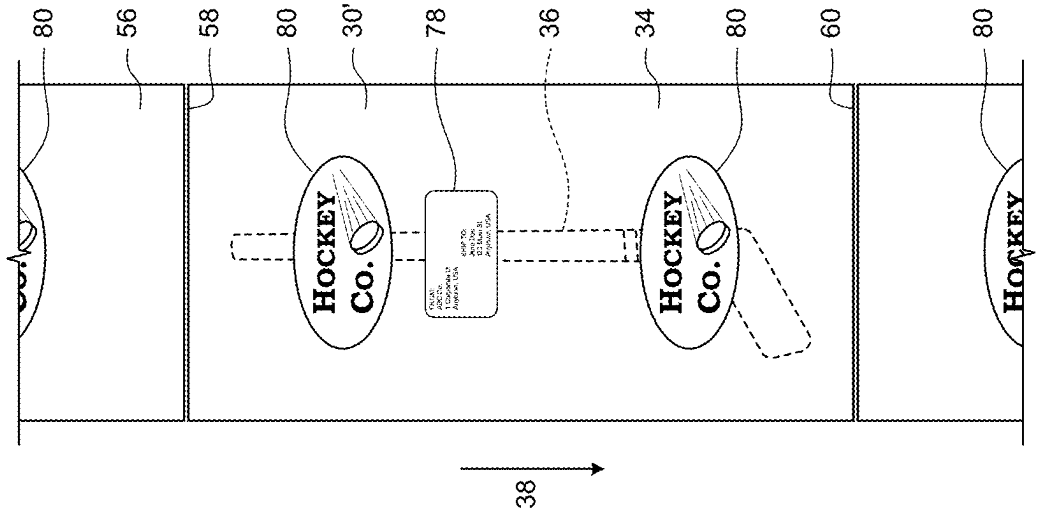
24_2
24_1

Fig. 6A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HOCKEY Co.
HOCKEY
38

Fig. 6C

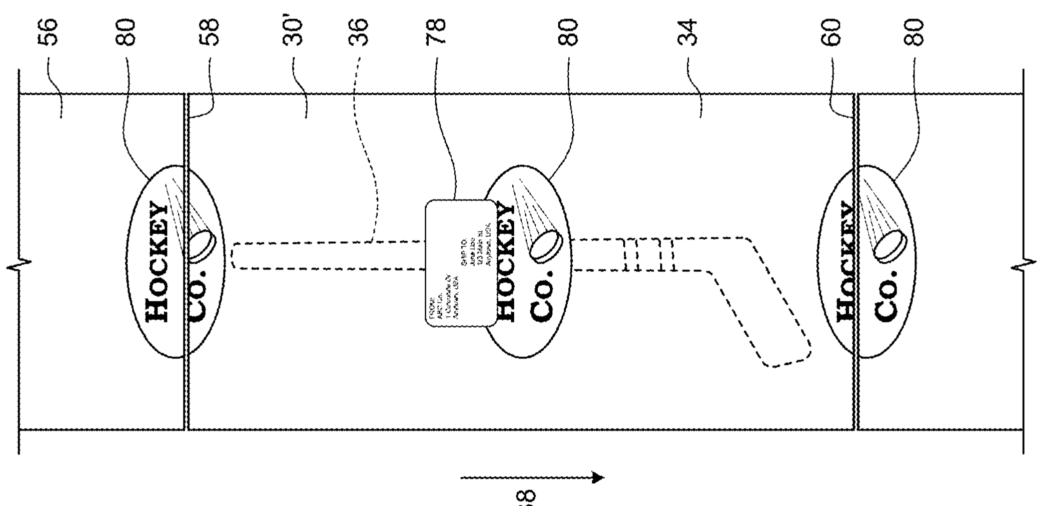
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Fig. 6B

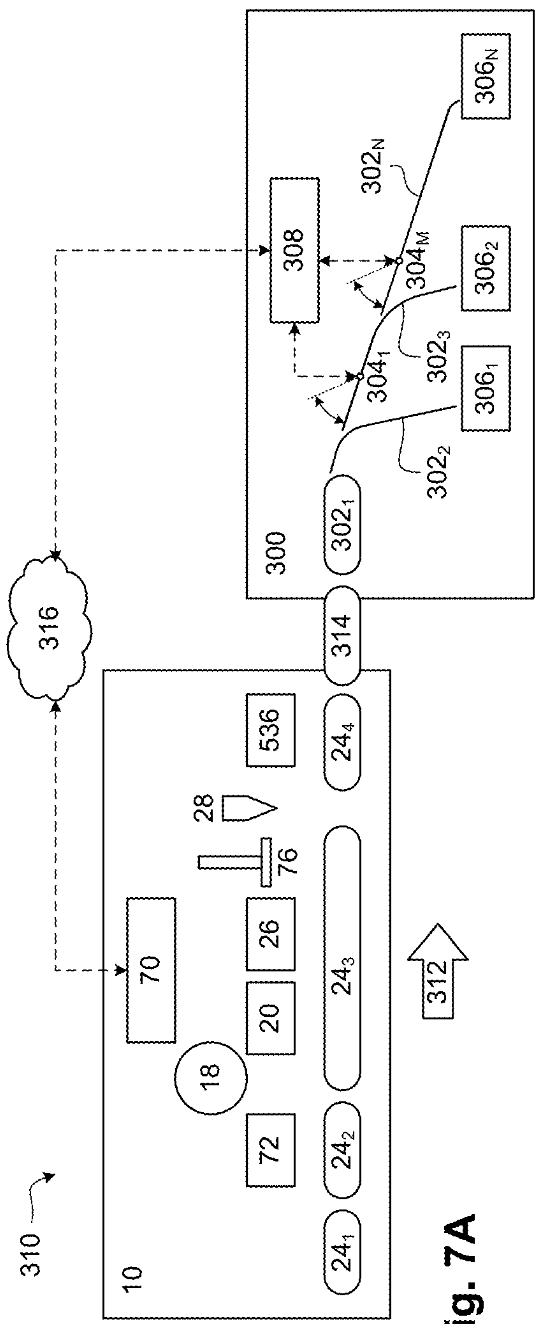
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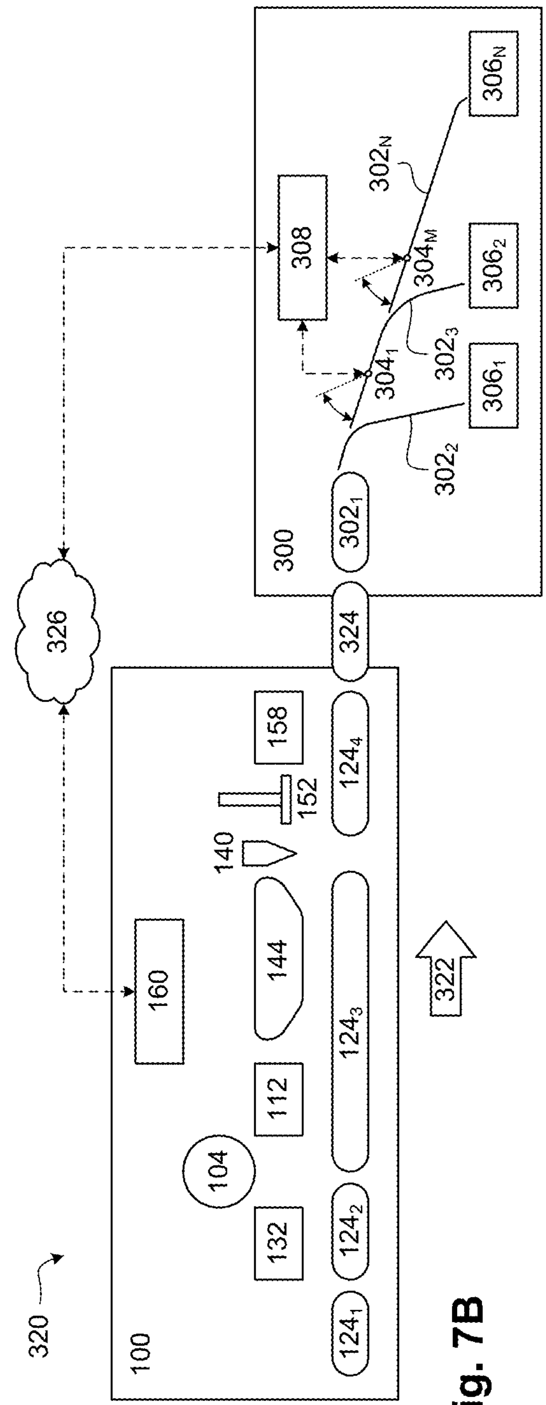
Fig. 7A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306_N
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Fig. 7B

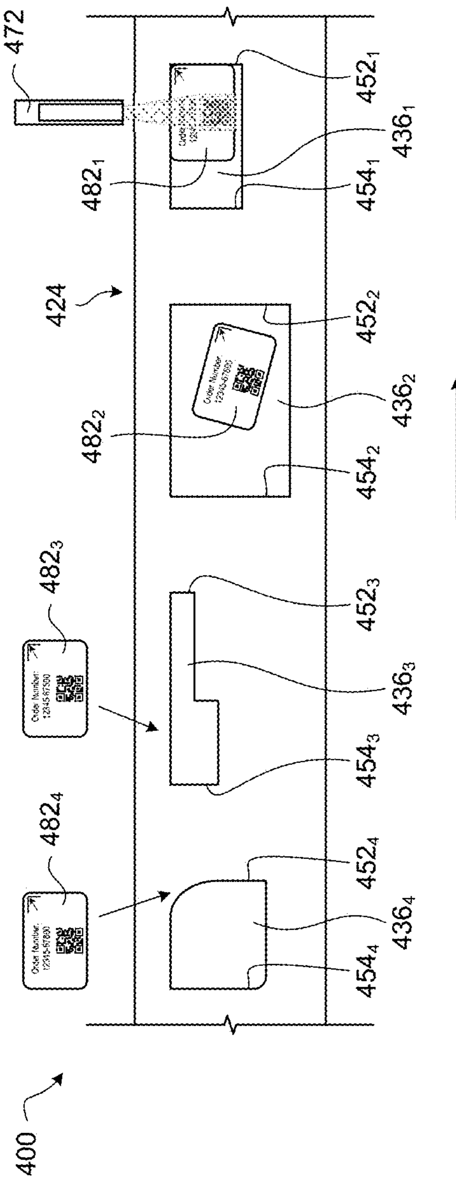
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Fig. 8A

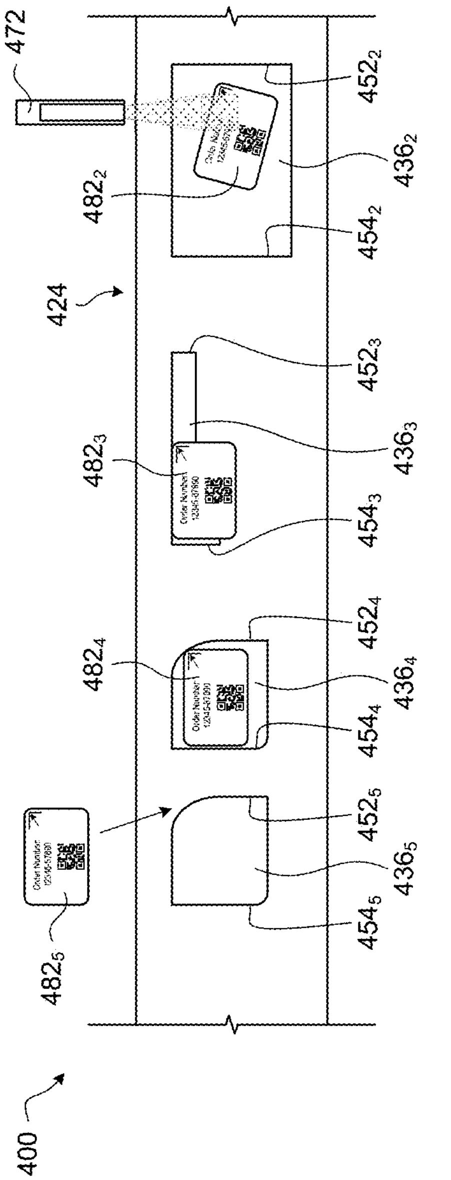
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Fig. 8B

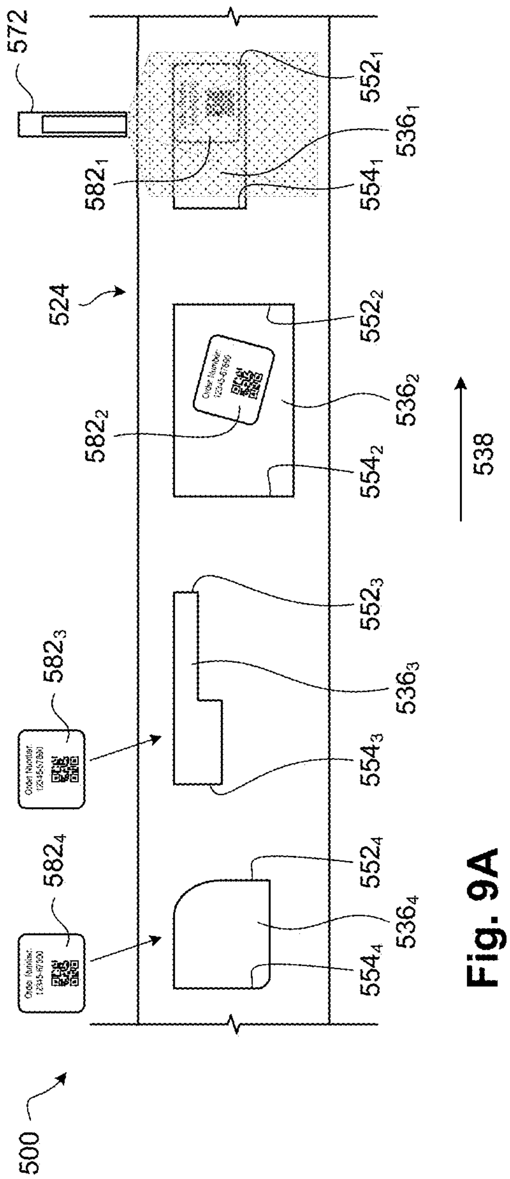

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Fig. 9A

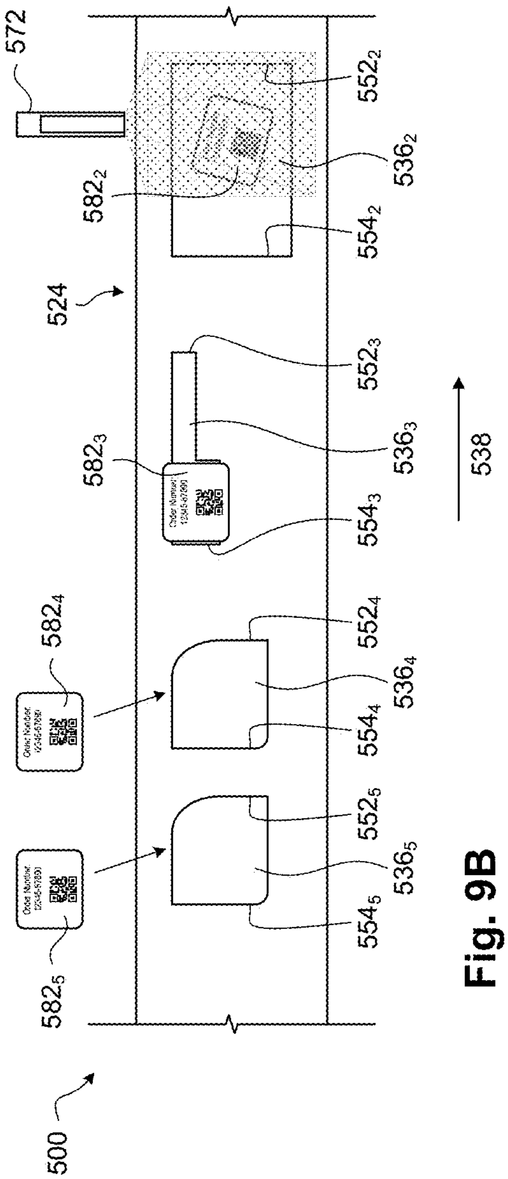

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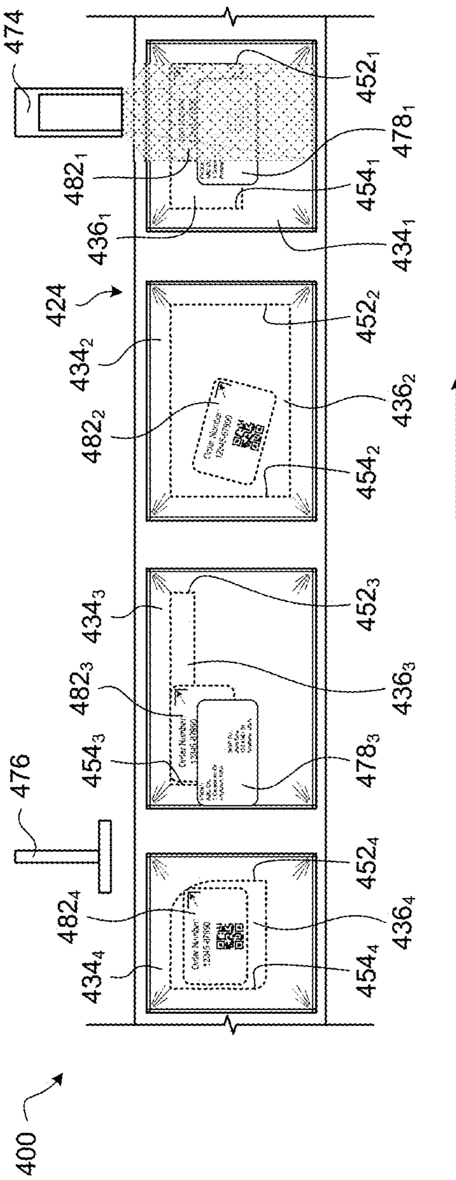
Fig. 9B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452_4

Fig. 8C

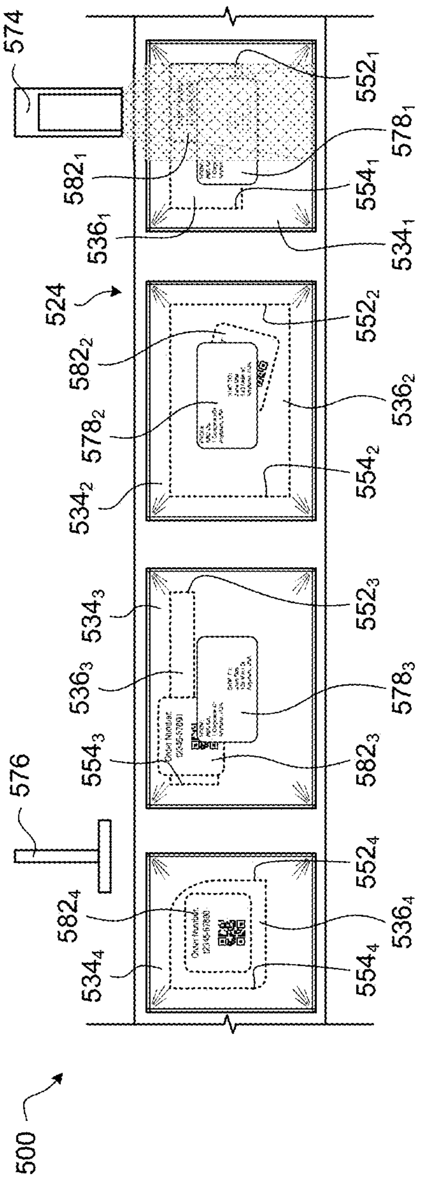
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Fig. 9C

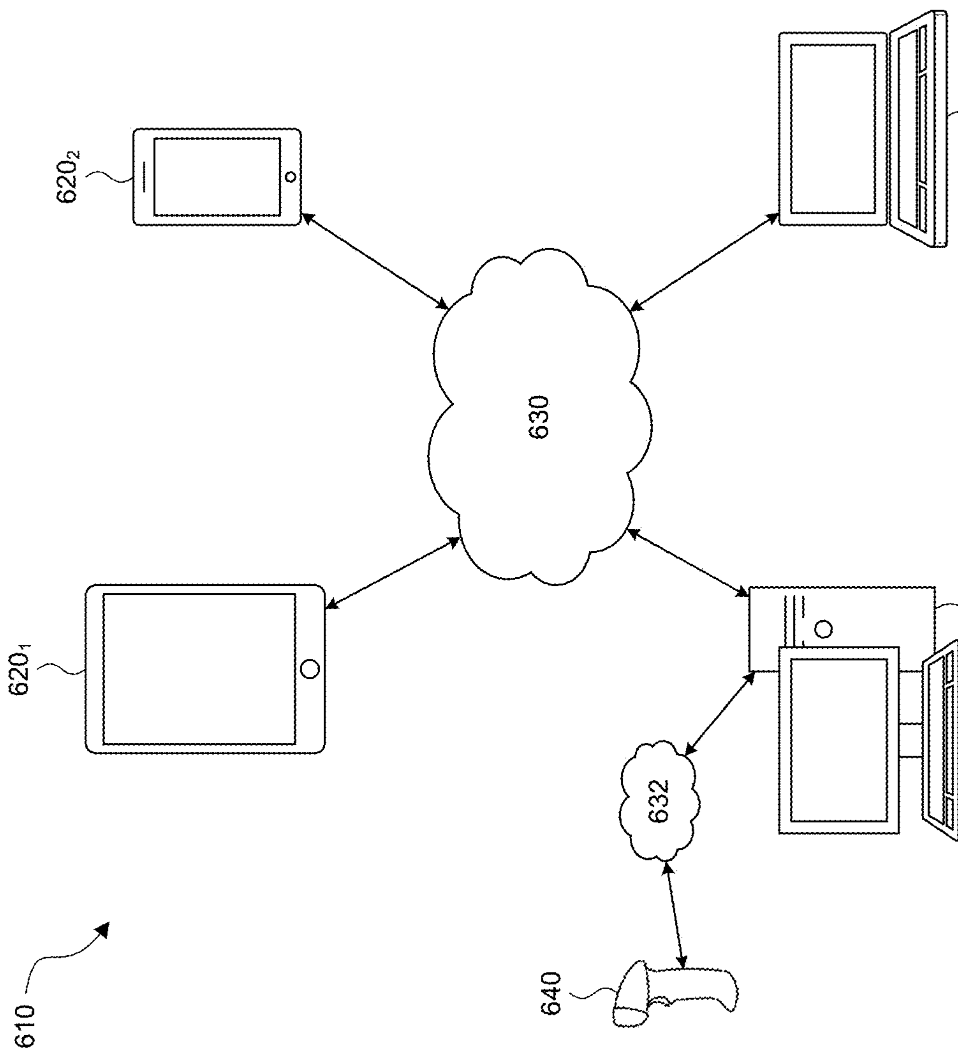
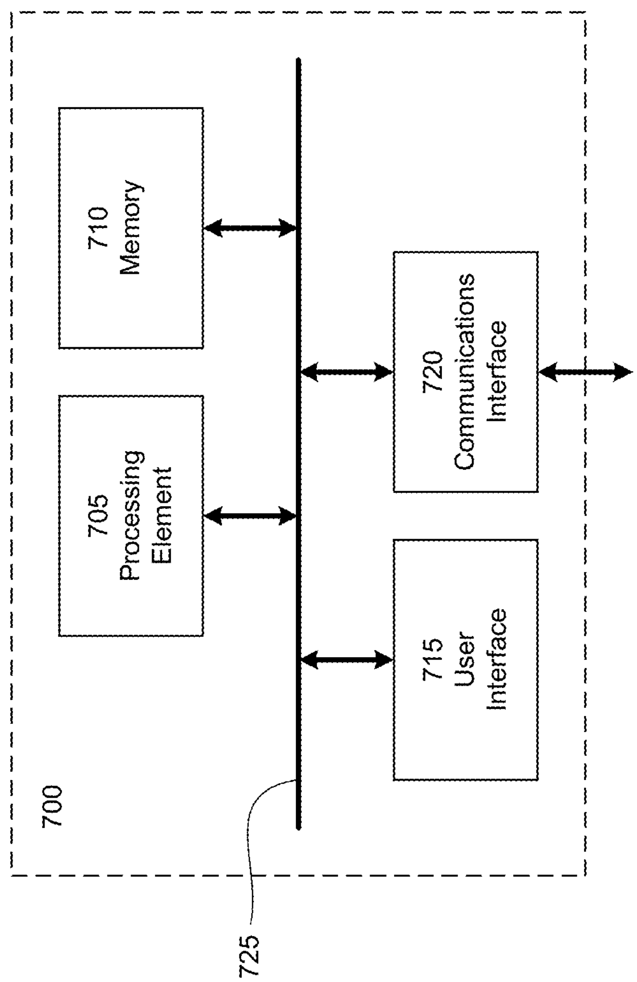


Fig. 10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710
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705
Processing
Element
720
Communications
Interface
715
User
Interface
725

Fig. 11

OBJECT TRACKING IN PACKAGING SYSTEMS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a continuation of U.S. patent application Ser. No. 16/813,857, filed Mar. 10, 2020, which is (1) a continuation of International Application No. PCT/US2018/047625, filed Aug. 23, 2018, which claims the benefit of U.S. Provisional Patent Application No. 62/558,902, filed Sep. 15, 2017, and (2) a continuation-in-part of U.S. patent application Ser. No. 15/571,533, filed Nov. 3, 2017, which is a national stage entry under 35 U.S.C. § 371 of International Application No. PCT/US2016/030630, filed May 4, 2016, which claims the benefit of U.S. Provisional Patent Application No. 62/157,164, filed May 5, 2015. The contents of each patent application referenced in this paragraph are hereby incorporated by reference in their entirety.

BACKGROUND

[0002] The present disclosure is in the technical field of object packaging. More particularly, the present disclosure is directed to tracking object locations as the objects are conveyed through a packaging system.

[0003] Consumers frequently purchase goods from mail-order or internet retailers, which package and ship the goods to the purchasing consumer via a postal service or other carrier. Millions of such packages are shipped each day. These items are normally packaged in small containers, such as a box or envelope. To protect the items during shipment, they are typically packaged with some form of protective dunnage that may be wrapped around the item or stuffed into the container to prevent movement of the item and to protect it from shock.

[0004] A common type of packaging envelope is known as a "padded mailer." Padded mailers are generally shipping envelopes that have padded walls to protect the contents of the mailer. Padded mailers generally include a single or double wall envelope, with paper dunnage or air cellular cushioning material to protect the packaged object. While such padded mailers have been commercially successful, they are not without drawbacks. For instance, because trapped or confined air is generally the cushioning medium, the space required to store such mailers is not insignificant. Further, in order not to require an inordinately large amount of storage space, the padded mailers are typically limited to having relatively thin padding. In another example, inflatable mailers (i.e., mailers that have an integral inflatable cushioning material) can be inflated just prior to packaging and shipment, but inflation of these inflatable mailers can be a slow, cumbersome, and labor-intensive process. Moreover, padded mailers are typically used to protect objects during shipment, but are typically not used at other times, such as times when objects are stored in inventory.

[0005] Some packaging systems, called form-fill-seal machines, form a tube of packaging material (e.g., polyethylene foam, inflatable cushioning material, etc.) into which the objects are fed. The packaging systems them seal the package material around the objects to form packages around the objects. These systems have a number of benefits, such as the speed with which they are able to form packages around objects. However, existing form-fill-seal machines can be improved to reduce the number of flawed packages created and to increase the appearance of the formed packages.

SUMMARY

[0006] This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0007] In one embodiment, a packaging system includes a conveyance system, a package forming system, and a tracking system. The conveyance system is configured to receive objects and to convey the objects through the packaging system. Spacing between the objects is non-uniform as the objects are received by the conveyance system. The package forming system is configured to feed a packaging material to form a tube of the packaging material and further configured to seal the tube of the packaging material around the objects to form packages of the packaging material around the objects. The tracking system is configured to track locations of the objects as the objects are conveyed through the packaging system on the conveyance system. The tracking system is configured to track locations of the objects independently of any marks on the packaging material.

[0008] In one example, the tracking system includes an infeed scanner configured to detect an infeed location of each of the objects as the objects are fed through an infeed portion of the conveyance system. In another example, the infeed scanner is configured to detect the infeed location of each of the objects by detecting a leading edge and a trailing edge of each of the objects as the objects are fed through the infeed portion of the conveyance system. In another example, the tracking system is configured to calculate a longitudinal length of each of the objects based on the leading edge and the trailing edge of each of the objects. In another example, the package forming system is configured to seal the tube of the packaging material around one of the objects at locations based on the longitudinal length of the one of the objects. In another example, the infeed scanner is further configured to generate a height indication for each of the objects as the objects are fed through the infeed portion of the conveyance system; the height indication for an object includes at least one of an indication whether any portion of the object exceeds a predetermined height, an indication of a height of the leading edge of the object and a height of the trailing edge of the object, or a height profile of the object from a transverse side of the object; and the package forming system is configured to seal the tube of the packaging material around one of the objects at locations based on a combination of the longitudinal length of the one of the objects and the height indication of the one of the objects.

[0009] In another example, the tracking system further includes at least one conveyor sensor configured to detect movements of the conveyance system. In another example, the tracking system is configured to track locations of the objects as the objects pass through the packaging system on the conveyance system based on a combination of the infeed location of each of the objects and the movements of the conveyance system detected by the at least one conveyor sensor. In another example, the at least one conveyor sensor includes a plurality of encoders configured detect movements of each of a plurality of conveyor belts in the conveyance system.

[0010] In another example, the packaging system further includes a labeling mechanism configured to apply a label on the packaging material, where the label is associated with one of the objects, and where the packaging system is configured to cause the labeling mechanism to apply the label to the packaging material based on the tracked location of the one of the objects. In another example, the labeling mechanism is configured to apply the label to the packaging material after the packaging material is formed into the tube and before the tube of the packaging material is sealed around the one of the objects. In another example, the packaging materials include one or more of a polyethylene-based film, an inflatable cushioning material, or an inflated cushioning material.

[0011] In another embodiment, a method includes a conveyance system of a packaging system receiving objects that are non-uniformly spaced as the objects are received by the conveyance system and conveying the objects through the packaging system. The method further includes a package forming system of the packaging system feeding a packaging material to form a tube of the packaging material and forming seals in the tube of the packaging material around the objects to form packages of the packaging material around the objects. The method further includes a tracking system in the packaging system tracking locations of the objects independently of any marks on the packaging material as the objects are conveyed through the packaging system.

[0012] In one example, the method further includes an infeed scanner of the tracking system detecting an infeed location of each of the objects as the objects are fed through an infeed portion of the conveyance system. In another example, detecting the infeed location of each of the objects includes detecting a leading edge and a trailing edge of each of the objects as the objects are fed through the infeed portion of the conveyance system. In another example, the method further includes the tracking system calculating a longitudinal length of each of the objects based on the leading edge and the trailing edge of each of the objects. In another example, the package forming system is configured to seal the tube of the packaging material around one of the objects at locations based on the longitudinal length of the one of the objects.

[0013] In another example, the method further includes the infeed scanner generating a height indication for each of the objects as the objects are fed through the infeed portion of the conveyance system; where the height indication for an object includes at least one of an indication whether any portion of the object exceeds a predetermined height, an indication of a height of the leading edge of the object and a height of the trailing edge of the object, or a height profile of the object from a transverse side of the object; and where the package forming system is configured to seal the tube of the packaging material around one of the objects at locations based on a combination of a longitudinal length of the one of the objects and the height indication of the one of the objects. In another example, the method further includes at least one conveyor sensor of the tracking system detecting movements of the conveyance system, where tracking the locations of the objects as the objects are conveyed through the packaging system on the conveyance system is based on a combination of the infeed location of each of the objects and the movements of the conveyance system detected by the at least one conveyor sensor. In another example, the at least one conveyor sensor includes a plurality of encoders configured detect movements of each of a plurality of conveyor belts in the conveyance system.

[0014] In another example, the method further includes a labeling mechanism applying a label to the packaging material, where the label is associated with one of the objects, and where the packaging system is configured to cause the labeling mechanism to apply the label to the packaging material based on the tracked location of the one of the objects. In another example, applying the label to the packaging material occurs after the packaging material is formed into the tube and before sealing the tube of the packaging material around the one of the objects. In another example, the packaging materials include one or more of a polyethylene-based film, an inflatable cushioning material, or an inflated cushioning material.

[0015] In another embodiment, a packaging system includes a conveyance system, a package forming system, and a tracking system. The conveyance system is configured to receive objects and to convey the objects through the packaging system, where spacing between the objects is non-uniform as the objects are received by the conveyance system. The package forming system is configured to feed a packaging material to form a tube of the packaging material and further configured to form transverse seals in the tube of the packaging material around at least one of the objects to form a package of the packaging material around the at least one of the objects, where the packaging material includes graphic regions intermittently spaced in a longitudinal direction of the packaging material. The tracking system is configured to track locations of the objects as the objects are conveyed through the packaging system on the conveyance system. The conveyance system is configured to position the at least one of the objects in the tube with respect to the packaging material such that the transverse seals do not intersect any of the graphic regions.

[0016] In one example, the packaging system is configured to control operation of the conveyance system based on the tracked location of the at least one of the objects such that the conveyance system positions the at least one of the objects with respect to the packaging material such that the transverse seals formed in the packaging material do not intersect any of the graphic regions. In another example, the tracking system includes an infeed scanner configured to detect an infeed location of each of the objects as the objects are fed through an infeed portion of the conveyance system. In another example, the tracking system is configured to calculate a longitudinal length of each of the objects. In another example, the positioning of the at least one of the objects is based on the longitudinal length of the at least one of the objects.

[0017] In another example, the infeed scanner is further configured to generate a height indication for each of the objects as the objects are fed through the infeed portion of the conveyance system. In another example, the positioning of the at least one of the objects is based on the height indication of the at least one of the objects. In another example, the height indication for the at least one of the objects includes at least one of an indication whether any portion of the at least one of the objects exceeds a predetermined height, an indication of a height of the leading edge of the object and a height of the trailing edge of the at least one of the objects, or a height profile of the at least one of the objects from a transverse side of the at least one of the objects.

[0018] In another embodiment, a method includes a conveyance system of a packaging system receiving objects that are non-uniformly spaced as the objects are received by the conveyance system. The method further includes a tracking system of the packaging system tracking locations of the objects as the objects pass through the packaging system on the conveyance system. The method further includes a package forming system of the packaging system forming a tube of packaging material, where the packaging material includes graphic regions intermittently spaced in a longitudinal direction of the packaging material. The method further includes the conveyance system feeding at least one of the objects into the tube of the packaging material. The method further includes the package forming system forming transverse seals in the tube of the packaging material to form a package of the packaging material around the at least one of the objects. The feeding of the at least one of the objects into the tube of the packaging material includes positioning, by the conveyance system, the at least one of the objects in the tube with respect to the packaging material such that the transverse seals formed in the packaging material do not intersect any of the graphic regions.

[0019] In one example, the method further includes the packaging system controlling operation of the conveyance system based on the tracked location of the at least one object such that the conveyance system positions the at least one of the objects with respect to the film such that the transverse seals in the packaging material do not intersect any of the graphic regions. In another example, the tracking includes the tracking system detecting an infeed location of each of the objects as the objects are fed through an infeed portion of the conveyance system. In another example, the tracking includes the tracking system determining a longitudinal length of each of the objects. In another example, the positioning of the at least one of the objects is based on the longitudinal length of the at least one of the objects. In another example, the tracking includes the tracking system determining a height indication for the at least one of the objects. In another example, the positioning of the at least one of the objects is based on the height indication of the at least one of the objects. In another example, the height indication for the at least one of the objects includes at least one of an indication whether any portion of the at least one of the objects exceeds a predetermined height, an indication of a height of the leading edge of the object and a height of the trailing edge of the at least one of the objects, or a height profile of the at least one of the objects from a transverse side of the at least one of the objects.

[0020] In another embodiment, a packaging system includes a conveyance system, a package forming system, and a tracking system. The conveyance system is configured to receive objects, where spacing between the objects is non-uniform as the objects are received by the conveyance system. The package forming system is configured to feed a packaging material to form a tube of the packaging material and to form transverse seals in the tube of the packaging material. The tracking system is configured to track locations of the objects as the objects are conveyed through the packaging system on the conveyance system. The conveyance system is configured to feed the objects into the tube of the packaging material. At least one of the objects is located between two of the transverse seals to form a package of the packaging material around the at least one of the objects. The tracking system is configured to track the locations of the objects at least by tracking the location of the at least one of the objects while the at least one of the objects is inside of the tube of the packaging material and inside of the package. The packaging system is configured to pass the package to a downstream package handling system and to communicate, to the downstream package handling system, the location of the at least one object.

[0021] In one example, the packaging system is configured to determine that the package is flawed and to communicate, to the downstream package handling system, an indication that the package is flawed. In another example, the downstream package handling system is configured to sort the package from other packages that are not flawed based at least on the location of the package and the indication that the package is flawed received from the packaging system. In another example, the packaging system is configured to determine that the package is flawed is based on at least one of a determination that the package is lacking one of the objects, a determination that the package includes an extra one of the objects, a faulty reading of a label on the package, a lack of a label on the package, an improper dimension of the package, a transverse seal on the package that crosses a graphic region, a user input indicating that the package is flawed, or any combination thereof. In another example, the packaging system is communicatively coupled to the downstream package handling system via one or more of a serial connection, a communication bus, a wired network, or a wireless network.

[0022] In another embodiment, a method includes a packaging system receiving objects that are non-uniformly spaced as the objects are received by a conveyance system, forming a tube of packaging material, and conveying the objects through the packaging system, where the conveying includes feeding the objects into the tube of the packaging material. The method further includes the packaging system forming transverse seals in the tube of the packaging material, where at least one of the objects is located between two of the transverse seals to form a package of the packaging material around the at least one of the objects. The method further includes the packaging system tracking locations of the objects during the conveying of the objects through the packaging system independently of the packaging material, where tracking the locations of the objects includes tracking the location of the at least one of the objects while the at least one of the objects is inside of the tube of the packaging material and inside of the package. The method further includes the packaging system passing the package to a downstream package handling system, where passing the package includes communicating, from the packaging system to the downstream package handling system the location of the at least one object.

[0023] In one example, the method further includes the packaging system determining that the package is flawed, where passing the package further includes communicating, from the packaging system to the downstream package handling system an indication that the package is flawed. In another example, the downstream package handling system is configured to sort the package from other packages that are not flawed based at least on the location of the package and the indication that the package is flawed received from the packaging system. In another example, determining that the package is flawed is based on at least one of a determination that the package is lacking one of the objects, a determination that the package includes an extra one of the objects, a faulty reading of a label on the package, a lack of a label on the package, an improper dimension of the package, a transverse seal on the package that crosses a graphic region, a user input indicating that the package is flawed, or any combination thereof. In another example, the packaging system is communicatively coupled to the downstream package handling system via one or more of a serial connection, a communication bus, a wired network, or a wireless network.

BRIEF DESCRIPTION OF THE DRAWING

[0024] The foregoing aspects and many of the attendant advantages of the disclosed subject matter will become more readily appreciated as the same become better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

[0025] FIG. **1**A depicts an embodiment of a packaging system, in accordance with the embodiments described herein;

[0026] FIG. **1**B depicts a block diagram of portions of the packaging system shown in FIG. **1**A, in accordance with the embodiments described herein;

[0027] FIG. **2**A depicts another embodiment of a packaging system, in accordance with the embodiments described herein;

[0028] FIG. **2**B depicts a block diagram of portions of the packaging system shown in FIG. **2**A, in accordance with the embodiments described herein;

[0029] FIGS. **3**A-**3**D depict instances of a system that determines a height indication of an object based on whether any portion of the object exceeds a predetermined height, in accordance with the embodiments described herein;

[0030] FIGS. **4**A-**4**D depict instances of a system that determines a height indication of an object based on a height of the leading edge of the object and a height of the trailing edge of the object, in accordance with the embodiments described herein;

[0031] FIGS. **5**A-**5**D depict instances of a system that determines a height indication of an object based on height profile of the object from a transverse side of the object, in accordance with the embodiments described herein;

[0032] FIG. **6**A depicts an example of a packaging system that uses a packaging material having intermittently-spaced graphic regions to form packages, in accordance with the embodiments described herein;

[0033] FIGS. **6**B and **6**C depict, respectively, some of the difficulties with the use of the packaging material with the intermittently-spaced graphic regions and an embodiment of a package formed so that graphic regions are not intersected or covered by seals, cuts, or labels, in accordance with the embodiments described herein;

[0034] FIGS. **7**A and **7**B depict embodiments of systems that include one packaging system upstream from a downstream package handling system, in accordance with the embodiments described herein;

[0035] FIGS. **8**A and **8**B depict two instances of an infeed portion of a packaging system that scans inducting documents on objects, in accordance with the embodiments described herein;

[0036] FIG. **8**C depicts an outfeed portion of the packaging system shown in FIGS. **8**A and **8**B where labels are placed on packages based on the location of the inducting documents with respect to the objects, in accordance with the embodiments described herein;

[0037] FIGS. **9**A and **9**B depict two instances of an infeed portion of a packaging system that scans inducting documents on objects, in accordance with the embodiments described herein;

[0038] FIG. **9**C depicts an outfeed portion of the packaging system shown in FIGS. **9**A and **9**B where labels are placed on packages based on the location of the inducting documents with respect to the objects, in accordance with the embodiments described herein;

[0039] FIG. **10** depicts an example embodiment of a system that may be used to implement some or all of the embodiments described herein; and

[0040] FIG. **11** depicts a block diagram of an embodiment of a computing device, in accordance with the embodiments described herein.

DETAILED DESCRIPTION

[0041] The present disclosure describes embodiments of form-fill-seal packaging systems that include tracking systems to track locations of objects as the objects are conveyed through the packaging systems. It may be difficult to track the locations of objects in form-fill-seal packaging systems in particular because the objects are inserted into a tube of packaging material that is then sealed and cut to form a package around the objects. Sensors that rely on line-of-sight to detect the objects (e.g., cameras) are typically not able to detect the objects while the objects are in the tube of packaging material and after the packages are formed around the object. In some examples described herein, the tracking system includes a controller that maintains a digital table of locations of objects in the packaging system based on an initial location of the object before it entered the tube of the packaging material and then adjusts the digital table of locations based on sensed motion of a conveyance system in the packaging system.

[0042] As will be described in greater detail below, the ability of the tracking system to track the locations of objects as the objects are conveyed through the packaging system has a number of advantages. In one example, the packaging material used to form the tube and the packages does not need to have regularly-spaced print marks to gage relative locations of the packaging material and the objects. This lack of regularly-spaced print marks improves the appearance of the final packages. In another example, the packaging material includes regularly-space graphic regions (e.g., a company's logo) on the exterior of the package and the packaging system can control the location of the objects with respect to the packaging material so that none of the graphic regions are intersected by a seal or cut in the packaging material when the packages are formed. In another example, the packaging system is able to control placement and/or printing of labels on the exterior of the packages based on the locations of the objects instead of the locations of inducting documents placed on the objects. There are a number of other benefits to the use of a tracking system in a packaging system, some of which are further described herein.

[0043] FIG. **1**A depicts an embodiment of a packaging system **10**. In the depicted embodiment, the packaging system **10** is a continuous flow wrap machine (e.g., a form-fill-seal wrapper). In other embodiments, the packaging system **10** is a non-continuous packaging system. In the depicted embodiment, the packaging system **10** includes a supply **18**, a transfer head **20** including an inverting head **22**, conveyors $\mathbf{24}_1$, $\mathbf{24}_2$, $\mathbf{24}_3$, and $\mathbf{24}_4$ (collectively, conveyance system **24**), a longitudinal sealer **26**, and a sealing mechanism **28**, as will be described in more detail herein. Examples of continuous flow wrap machines are described, for example, in U.S. Pat. No. 4,219,988, U.S. Patent Application No. 62/157,164, and PCT Application No. PCT/US2016/030630, the contents of which are incorporated herein by reference in their entirety, and are available from Sealed Air Corporation (Charlotte, NC) under the Shanklin FloWrap Series trademark.

[0044] The supply **18** of the continuous flow wrap machine supplies a web of packaging material **30** from roll **32**. In some embodiments, the packaging material **30** is a polyethylene-based film. Systems for supplying webs of packaging material are known in art and may include unwind mechanisms and other features. In some embodiments, the packaging material **30** on the roll **32** is a center folded film. In other embodiments, the packaging material **30** on roll **32** is a flat wound film. In some embodiments, the packaging material **30** includes any sheet or film material suitable for packaging objects **36**, in particular for packages **34** for use as a mailer containing an object. Suitable materials include polymers, for example thermoplastic polymers (e.g., polyethylene), that are suitable for heat sealing. In some embodiments, the packaging material **30** has a thickness of any of at least 2, 3, 5, 7, 10, and 15 mils; and/or at most any of 25, 20, 16, 12, 10, 8, 6 and 5 mils. In some embodiments, the packaging material **30** is multilayered, and has an outer layer adapted for heat sealing the film to itself to form a seal.

[0045] The transfer head **20** of the packaging system **10** receives the web of packaging material **30** from the supply **18**. The transfer head **20** is adapted to manage (e.g., form) the web of packaging material **30** into a configuration for eventual sealing into a tube. In the depicted embodiment, the transfer head **20** is an inverting head **22** of continuous flow wrap that receives a center folded web of packaging material **30** from the supply **18** and redirects the web of film over the top and bottom inverting head arms **40**, **42** to travel in a conveyance direction **38** by turning the web of film inside out. In this manner, the transfer head **20** is adapted to manage the web of packaging material **30** to provide an interior space **44** bounded by the packaging material **30**.

[0046] In some embodiments, the transfer head **20** in the configuration of a forming box receives the lay flat web of packaging material **30** from the supply **18** and redirects the web of film over the forming head to travel in the conveyance direction **38** by turning the web of film inside out. In this manner, the transfer head **20** is adapted to manage the web of packaging material **30** to provide an interior space **44** bounded by packaging material **30**.

[0047] The infeed conveyor $\mathbf{24}_1$ of packaging system **12** is adapted to transport a series of objects **36** and sequentially deliver them in the conveyance direction **38**. In some embodiments, the infeed conveyor $\mathbf{24}_1$ is adapted to convey a series of objects **36** that are non-uniformly spaced when received by the conveyance system **24**. In the embodiment depicted in FIG. **1**A, the objects **36** have a similar size. In other embodiments, the objects have varied or differing sizes. Within the series of objects **36** in sequential order, a "preceding" object is upstream from a "following" object. The infeed conveyor $\mathbf{24}_1$ is configured to deliver in repeating fashion a preceding object upstream from a following object into the interior space **44** of the web of packaging material **30**. In some embodiments, the objects **36** are delivered in spaced or gapped arrangement from each other.

[0048] An "object," as used herein, may comprise a single item for packaging, or may comprise a grouping of several distinct items where the grouping is to be in a single package. Further, an object may include an accompanying informational item, such as a packing slip, tracking code, a manifest, an invoice, or printed sheet comprising machine-readable information (e.g., a bar code) for sensing by an object reader (e.g., a bar code scanner).

[0049] Downstream from the infeed conveyor $\mathbf{24}_1$ is an infeed spacing conveyor $\mathbf{24}_2$, which is adapted to convey objects by one or more infeed sensors. Downstream from the infeed spacing conveyor $\mathbf{24}_2$ is an object conveyor $\mathbf{24}_3$, which is adapted to support and transport the web of packaging material **30** and the object **36** downstream together to the sealing mechanism **28**. A discharge conveyor **50** transports the series of packages **34** from the sealing mechanism **28**. In the depicted embodiment, the packaging system **10** includes a sizing sensor $\mathbf{72}_1$, a spacing sensor $\mathbf{72}_2$, and an identifier sensor $\mathbf{72}_3$ (collectively infeed sensors **72**). The sizing sensor $\mathbf{72}_1$ is configured to determine one or more dimensions of the objects **36**, such as a longitudinal length of the objects **36**, a height of the objects **36**, or a transverse width of the objects **36**. The spacing sensor $\mathbf{72}_2$ is configured to determine a longitudinal spacing between consecutive objects **36**. In some examples, the sizing sensor $\mathbf{72}_1$, the spacing sensor $\mathbf{72}_2$, and the identifier sensor $\mathbf{72}_3$ are configured to send signals to the controller or other computing device, and the controller or other computing device is configured to control the infeed spacing conveyor $\mathbf{24}_2$ and/or any other component of the packaging system **10**. In some embodiments, each of the infeed sensors **72** includes one or more of an optical sensor (e.g., a visible light sensor, a laser sensor, or any other electromagnetic sensor), an RFID tag reader, a barcode reader, a camera, an acoustic sensor (e.g., an ultrasonic sensor), a mechanical sensor (e.g., a plunger), or any other type of sensor.

[0050] As each object **36** of the series of objects sequentially travels through the packaging system **12**, its position within the machine is tracked. This is accomplished, for example, by an infeed eye system (horizontal or vertical) determining the location of the leading edge **52** of each object and the location of the trailing edge **54** of each object as the object travels along the conveyance system **24**. This location information is communicated to a controller (e.g., a programmable logic controller or "PLC"). A system of encoders and counters, also in communication with the PLC, determines the amount of travel of the conveyor on which the object is positioned. In this manner, the position of the object **36** itself is determined and known by the PLC. The PLC is also in communication with the sealing mechanism **28** to provide the object position information for a particular object.

[0051] In the depicted embodiment, the packaging system **10** includes a longitudinal sealer **26** adapted to continuously seal a longitudinal side of the packaging material **30** together to form a tube **56** enveloping the objects **36**. In the depicted embodiment, the longitudinal sealer **26** is located at one side of the tube **56**, where the longitudinal sealers **26** forms a side seal between two edge portions of the packaging material **30**. In other embodiments, another longitudinal sealer may be located beneath the tube **56**, where the sealer may form, for example, a center fin seal between two edge portions of the web of packaging material **30**. As two edge portions of packaging material **30** are brought together at the longitudinal sealer **26** to form the tube **56**, they are sealed together, for example, by a combination of heat and pressure, to form a continuous fin or a side seal. Appropriate longitudinal sealers are known in the art, and include, for example, heat sealers.

[0052] The packaging system **10** includes an sealing mechanism **28**, which is adapted to provide or perform in repeating fashion, while the tube **56** is traveling: (i) a trailing edge seal **58** that is transverse to tube **56** and upstream from a preceding object to create package **34** and (ii) a leading edge seal **60** transverse to the tube **56** and downstream from a following object. Further, the sealing mechanism **28** is adapted to sever the package **34** from the tube **56** by cutting between the trailing edge seal **58** and the leading edge seal **60**. Generally, the sealing mechanism **28** uses temperature and pressure to make two seals (trailing edge seal **58** and leading edge seal **60**) and cuts between them, thus creating the final, trailing seal of one finished, preceding package and the first, leading edge seal of the following package. Advantageously, the end sealer unit may be adapted to simultaneously sever the package **34** from the tube **56** while providing the trailing edge seal **58** and leading edge seal **60**.

[0053] Useful end sealer units are known in the art. These include, for example, rotary type of end sealer units, having matched heated bars mounted on rotating shafts. As the film tube passes through the rotary type, the rotation is timed so it coincides with the gap between objects. A double seal is produced and the gap between the two seals is cut by an integral blade to separate individual packs. Another type of end seal unit is the box motion type, having a motion that describes a "box" shape so that its horizontal movement increases the contact time between the seal bars and the film. Still another type of end sealer unit is the continuous type, which includes a sealing bar that moves down with the tube while sealing.

[0054] The packaging system **10** includes a labeling mechanism **76** that is capable of printing and/or applying labels **78** to exteriors of the packages **34**. In some embodiments, the labels **78** include indications of the objects **36** inside the packages **34**, indications of shipping destinations of the objects **36** inside the packages **34**, and/or indications of orders associated with the objects **36** inside the packages **34**. In some embodiments, the labeling mechanism **76** includes a printer that prints the labels **78**. In some cases, the printer prints the labels **78** directly on the exterior of the packages **34**. In other cases, the printer prints the labels **78** on an adhesive medium and labeling mechanism **76** applies the adhesive medium to the exterior of the packages **34**. In the depicted embodiment, the labeling mechanism **76** is located upstream of the sealing mechanism **28**. In other embodiments, the labeling mechanism **76** can be located downstream of the sealing mechanism **28**.

[0055] In the depicted embodiment, the packaging system **10** includes a discharge scanner **74**. The discharge scanner **74** is configured to scan one or more of the packages **34** themselves, the labels **78** on the packages **34**, or object identifiers on the objects **36** inside of the packages **34**. The data generated by the discharge scanner **74** may be used to verify that the objects **36** have been wrapped in one of the packages **34**. In some embodiments, the data generated by the discharge scanner **74** may be communicated from the packaging system **10** to other systems that may process the packages **34**, as will be discussed in greater detail below.

[0056] The packaging system **10** also includes a controller **70**. In the depicted embodiment, the controller **70** is in the form of a tablet with a touchscreen. In other embodiments, the controller **70** may be any other type of computing device having any type of input and/or output devices. The controller **70** is configured to receive information from and/or send control signals to various individual components of the packaging system **10**. One embodiment of the operation of the controller **70** is depicted in a block diagram of portions of the packaging system **10** shown in FIG. **1**B. As shown by the dashed lines in FIG. **1**B, the controller **70** is communicatively coupled to each of the supply **18**, the conveyors $\mathbf{24}_1$, $\mathbf{24}_2$, $\mathbf{24}_3$, and $\mathbf{24}_4$, the sealing mechanism **28**, the infeed sensors **72**, the discharge scanner **74**, and the labeling mechanism **76**. The controller **70** may not be communicatively coupled to every component in the packaging system **10** (e.g., the transfer head **20** and the longitudinal sealer **26** in the depiction in FIG. **1**B), especially where those components are passive components that operate without any external control.

[0057] In some embodiments, the controller **70** is a part of a tracking system configured to track locations of the objects **36** as the objects **36** are conveyed through the packaging system **10** on the conveyance system **24**. In particular, the tracking system is configured to track locations of the objects **36** before the objects **36** enter the tube **56**, while the objects **36** are in the tube **56**, and after the packages **34** are formed by transversely cutting the tube **56**. For example, the controller **70** can maintain a digital table of the objects **36** that are being conveyed through the packaging system **10** along with an indication of the location of each of the objects **36** in the packaging system **10** at any given time. The controller **70** changes the indications of the locations of each of the objects **36** as the objects **36** are moved through the packaging system **10** by the conveyance system **24**. In this way, the controller **70** "knows" where every one of the objects **36** in the packaging system **10** is located, even when the objects **36** are located inside of the tube **56** and/or inside of one of the packages **34**.

[0058] In existing packaging systems, the film has regularly-spaced printed marks that serve as location markers. After an object enters a tube of film or a package, the locations of the printed marks are tracked and the location of the objects is estimated based on the location of the printed marks on the film and the respective positions of the printed marks and the object when the object entered the tube of film. However, using printed marks on the film to estimate the location of the object can be problematic because the objects can move relative to the film while the objects are inside of the tube such that the object is no longer in the same position with respect to the printed marks on the film.

[0059] In some embodiments, the tracking system in the packaging system **10** is configured to track locations of the objects **36** independently of any marks on the packaging material. In some embodiments, the tracking system also includes at least one position detector in the infeed sensors **72** and at least one conveyor sensor (e.g., encoders on one or more of the conveyors in the conveyance system **24**). In some examples, the at least one conveyor sensor includes a plurality of encoders configured detect movements of each of a plurality of conveyor belts in the conveyor system. The position detector detects an infeed location of each of the objects **36** at an infeed portion of the conveyance system **24** (e.g., positions of leading edges of the objects **36** as they pass along a portion of the infeed spacing conveyor $\mathbf{24}_2$, positions of leading and trailing edges of the objects **36** as they pass along a portion of the infeed spacing conveyor $\mathbf{24}_2$) and communicate that information to the controller **70**. The encoders detect motions of the conveyors in the conveyance system **24** and communicate that information to the controller **70**. The controller **70** maintains a location of each of the objects **36** in the packaging system **10** based on the infeed location of the object **36** read by the position detector and subsequent motions of the conveyors in the conveyance system **24** as the conveyance system **24** moves the object **36**. In this manner, the locations of the objects **36** can be tracked independently of any marks on the packaging material **30** even when the objects **36** are in the tube **56** and/or in the packages **34**.

[0060] In some embodiments, the infeed sensors **72** are configured to detect leading and trailing edges of the objects **36** as they pass along a portion of the infeed spacing conveyor $\mathbf{24}_2$. In some of these embodiments, the tracking system (e.g., the infeed sensors **72** and/or the controller **70**) is configured to calculate a longitudinal length of each of the objects **36** based on the leading edge and the trailing edge of each of the objects **36**. The tracking system of the packaging system **10** may be further configured to cause the sealing mechanism **28** to seal the tube **56** of the packaging material **30** around one of the objects **36** at locations based on physical characteristics of the objects **36**, such as the longitudinal length of the one of the objects **36**. In some examples, the packaging system **10** is configured to cause the sealing mechanism **28** to seal the tube **56** of the packaging material **30** around one of the objects **36** at locations based on a combination of the longitudinal length of the one of the objects **36** and a height indication of the one of the objects **36**. As will be discussed in greater detail below, the height indication of the one of the objects **36** may be generated by the infeed sensors **72** as the objects **36** are fed through the infeed portion of the conveyance system **24**, and the height indication may include at least one of an indication whether any portion of the object **36** exceeds a predetermined height, an indication of a height of the leading edge of the object **36** and a height of the trailing edge of the object **36**, or a height profile of the object **36** from a transverse side of the object **36**.

[0061] The controller **70** may be configured to function in a variety of ways to control operations of the packaging system **10** based on information received from components of the packaging system **10**. In one example, the controller **70** receives information from the infeed sensors **72** about dimensions of the objects, sends control signals to the conveyance system **24** for properly conveying the objects, and sends control signals to the sealing mechanism **28** for properly spacing transverse seals around the objects. In another example of operation of the controller **70**, the controller **70** receives information from the infeed sensors **72** about spacing of the objects, sends control signals to the conveyance system **24** for properly conveying the objects, and sends control signals to the supply **18** for properly advancing the packaging material **30**. It will be apparent that the controller **70** can operate in any number of other ways to control operation of the packaging system **10**.

[0062] Depicted in FIG. **2**A is another embodiment of a packaging system **100** for creating packages **102**. The packaging system **100** includes a supply **104** of packaging material **106**. In some embodiments, the packaging material **106** is a cushion material, such as an inflated or an inflatable air cellular material. In the depicted embodiment, the supply **104** is a roll of the packaging material **106**. In other embodiments, the supply **104** could be sheets of the packaging material **106**, fanfolded stacks of the packaging material **106**, or any other supply of the packaging material **106**. In the depicted embodiment, the packaging material **106** is a flexible sheet material.

[0063] In some examples, the packaging material **106** is an inflated air cellular material. As used herein, the term "air cellular material" herein refers to bubble cushioning material, such as BUBBLE WRAP® air cushioning material sold by Sealed Air Corporation, where a first film or laminate is formed (e.g., thermoformed, embossed, calendared, or otherwise processed) to define a plurality of cavities and a second film or laminate is adhered to the first film or laminate in order to close the cavities. Examples of air cellular materials are shown in U.S. Pat. Nos. 3,142,599, 3,208,898, 3,285,793, 3,508,992, 3,586,565, 3,616,155, 3,660,189, 4,181,548, 4,184,904, 4,415,398, 4,576,669, 4,579,516, 6,800,162, 6,982,113, 7,018,495, 7,165,375, 7,220,476, 7,223,461, 7,429,304, 7,721,781, and 7,950,433, and U.S. Published Patent Application Nos. 2014/0314978 and 2015/0075114, the disclosures of which are hereby incorporated by reference in their entirety.

[0064] In some examples, the packaging material **106** is a foamed material. Methods for manufacturing such foamed materials are well known, as disclosed in e.g., U.S. Pat. Nos. 5,348,984, 5,462,974, and 5,667,728, the contents of all of which are incorporated herein by reference in their entirety. A common material used to form foamed materials is low density polyethylene (LDPE). In some embodiments, foamed materials have a density ranging from about 0.5 to about 15 pounds/ft^3. Foamed materials may be in the form of a sheet or plank having a thickness ranging from about 0.015 to about 5 inches. In producing the sheets of foamed materials, any conventional chemical or physical blowing agents may be used, such as a physical blowing agent (e.g., carbon dioxide, ethane, propane, n-butane, isobutane, pentane, hexane, butadiene, acetone, methylene chloride, any of the chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, or any mixture thereof). If desired or necessary, various additives may also be included with the polymer, such as a nucleating agent (e.g., zinc oxide, zirconium oxide, silica, talc, etc.) and/or an aging modifier (e.g., a fatty acid ester, a fatty acid amide, a hydroxyl amide, etc.).

[0065] In one particular embodiment, the supply **104** includes a roll of an inflatable web of air cellular material in a deflated state. As the inflatable web is unrolled, it is fed through an inflation and sealing machine **108**. The inflation and sealing machine **108** inflates and seals cells in the air cellular material so that the air cellular material is in an inflated state. In this embodiment, the packaging material **106** is the inflated air cellular material. Examples of inflation and sealing machines are described in U.S. Pat. No. 7,721,781 and U.S. Published Patent Application No. 2014/0314978, the contents of which are hereby incorporated by reference in their entirety.

[0066] The packaging material **106** has longitudinal edges **110**. The packaging system **100** also includes a folding system **112**. In the depicted embodiment, the folding system **112** includes two pairs of rollers: rollers $\mathbf{116}_1$ and rollers $\mathbf{116}_2$. In the depicted embodiment, the rollers $\mathbf{116}_1$ are oriented vertically and the rollers $\mathbf{116}_2$ are oriented at a non-vertical and non-horizontal angle; however, the rollers $\mathbf{116}_1$ and $\mathbf{116}_2$ could be oriented at any desired angle. The folding system **112** folds the packaging material **106** from an unfolded state (e.g., the state of the packaging material **106** when it is unrolled from the supply **104**) into a tube **114** of the packaging material **106**. In the tube **114** of the packaging material **106**, the longitudinal edges **110** of the packaging material **106** are in an overlapping position.

[0067] In the depicted embodiment, each of the objects **120** includes an object identifier **122**. In some examples, the object identifier includes one or more of a barcode, a quick response (QR) code, a radio frequency identification (RFID) tag, any other form a machine-readable information, human-readable information, or any combination thereof.

[0068] The packaging system **100** also includes a conveyance system **124** that is configured to feed objects **120** and/or the packaging material **106**. In the depicted embodiment, the conveyor system includes an infeed conveyor $\mathbf{124}_1$, an infeed spacing conveyor $\mathbf{124}_2$, a machine conveyor $\mathbf{124}_3$, and an end conveyor $\mathbf{124}_4$ (collectively conveyance system **124**). The infeed conveyor $\mathbf{124}_1$ is configured to feed the objects **120**. The objects **120** are at an uncontrolled spacing on the infeed conveyor $\mathbf{124}_1$. The infeed spacing conveyor $\mathbf{124}_2$ is configured to feed the objects **120** after they leave the infeed conveyor $\mathbf{124}_1$. The infeed spacing conveyor $\mathbf{124}_2$ is configured to be controlled by a controller or other computing device (not shown) to provide a particular spacing between the objects **120**. In the depicted embodiment, the packaging system **100** includes a sizing sensor $\mathbf{132}_1$, a spacing sensor $\mathbf{132}_2$, and an identifier sensor $\mathbf{132}_3$ (collectively infeed sensors **132**). The sizing sensor $\mathbf{132}_1$ is configured to determine one or more dimensions of the objects **120**, such as a longitudinal length of the objects **120**, a height of the objects **120**, or a transverse width of the objects **120**. The spacing sensor $\mathbf{132}_2$ is configured to determine a longitudinal spacing between consecutive objects **120**. In some examples, the sizing sensor $\mathbf{132}_1$, the spacing sensor $\mathbf{132}_2$, and the identifier sensor $\mathbf{132}_3$ are configured to send signals to the controller or other computing device, and the controller or other computing device is configured to control the infeed spacing conveyor $\mathbf{124}_2$ and/or any other component of the packaging system **100**. In some embodiments, each of the infeed sensors **132** includes one or more of an optical sensor (e.g., a visible light sensor, a laser sensor, or any other electromagnetic sensor), an RFID tag reader, a barcode reader, a camera, an acoustic sensor (e.g., an ultrasonic sensor), a mechanical sensor (e.g., a plunger), or any other type of sensor.

[0069] As shown in FIG. **2**, the packaging material **106** is configured to be fed over the machine conveyor $\mathbf{124}_3$ so that the objects **120** are fed onto the packaging material **106**. The machine conveyor $\mathbf{124}_3$ supports and feeds both the packaging material **106** and the objects **120**. In the depicted embodiment, the objects **120** are fed onto the packaging material **106** while the packaging material **106** is in an unfolded state (e.g., before the longitudinal edges **110** are in the overlapping position). The conveyance system **124** is configured to feed the objects **120** onto the packaging material **106** so that the tube **114** of the packaging material **106** is formed around the objects **120**.

[0070] In the depicted embodiment, the packaging system **100** includes a holding mechanism **138** configured to hold the longitudinal edges **110** in the overlapping position as the packaging material **106** is fed between the folding system **112** and a sealing mechanism **140**. In some embodiments, the holding mechanism **138** includes a roller **142** located above the longitudinal edges **110** in the overlapping position, and the roller **142** holds the longitudinal edges **110** in the overlapping position after the packaging material **106** has been folded. In some embodiments, the holding mechanism **138** includes an overhead conveyor **144** that has a hanging underside **146**. The hanging underside **146** is configured to contact the tube **114** of the packaging material **106** where the longitudinal edges **110** are in the overlapping position. In some embodiments, such as the embodiment depicted in FIG. **2**A, the holding mechanism **138** includes both the roller **142** and the overhead conveyor **144**.

[0071] The sealing mechanism **140** is configured to provide or perform, in repeating fashion, while the tube **114** is traveling: (i) a leading edge seal **148** that is transverse to tube **114**, (ii) a trailing edge seal **150** transverse to the tube **114**, and (iii) a transverse cut between the leading edge seal **148** and the trailing edge seal **150**. Each of the leading edge seal **148** and the trailing edge seal **150** seals the packaging material **106** with the longitudinal edges **110** in the overlapping position. Preferably, one or more of the objects **120** are located inside of each of the packages **102** between one of the leading edge seals **148** and one of the leading trailing edge seals **150**. In some embodiments, the sealing mechanism **140** uses temperature and/or pressure to make two transverse seals (leading edge seal **148** and trailing edge seal **150**) and transversely cuts between them. These transverse cuts create packages **102** separated from the tube **114** of the packaging material **106**. Advantageously, the sealing mechanism **140** may be adapted to simultaneously sever the packages **102** from the tube **114** while forming the leading edge seal **148** and trailing edge seal **150**.

[0072] Various forms of sealing mechanisms **140** are known in the art. These include, for example, rotary end sealer units that have matched heated bars mounted on rotating shafts. As the film tube passes through the rotary type, the rotation is timed so it coincides with the gap between products. A double seal is produced and the gap between the two seals is cut by an integral blade to separate individual packages. Another type of sealing mechanisms **140** is the box motion type, having a motion that describes a "box" shape so that its horizontal movement increases the contact time between the seal bars and the film. Still another type of sealing mechanisms **140** is the continuous type, which includes a sealing bar that moves down with the tube **114** while sealing. In some cases, the packaging system **100** feeds packaging material **106** from the supply **104** intermittently in order to form packages **102** intermittently. In these cases, the sealing mechanisms **140** may not need to move in a downstream direction to form the transverse seals and cuts. In other cases, the packaging system **100** feeds packaging material **106** from the supply **104** continuously in order to form packages **102** continuously. In these cases, the sealing mechanisms **140** may move in a downstream direction while forming the transverse seals and cuts.

[0073] The packaging system **100** includes a labeling mechanism **152** that is capable of applying labels **154** to exteriors of the packages **102**. In some embodiments, the labels **154** include indications of the objects **120** inside the packages **102**, indications of shipping destinations of the objects **120** inside the packages **102**, and/or indications of orders associated with the objects **120** inside the packages **102**. In some embodiments, the labeling mechanism **152** includes a printer that prints the labels **154**. In some cases, the printer prints the labels **154** directly on the exterior of the packages **102**. In other cases, the printer prints the labels **154** on an adhesive medium and labeling mechanism **152** applies the adhesive medium to the exterior of the packages **102**. In the depicted embodiment, the labeling mechanism **152** is located downstream of the sealing mechanism **140**. In other embodiments, the labeling mechanism **152** can be located upstream of the sealing mechanism **140**.

[0074] In the depicted embodiment, the packaging system **100** includes a discharge scanner **158**. The discharge scanner **158** is configured to scan one or more of the packages **102** themselves, the labels **154** on the packages **102**, or the object identifiers **122** on the objects **120** insides of the packages **102**. The data generated by the discharge scanner **158** may be used to verify that the objects **120** have been wrapped in one of the packages **102**. In some embodiments, the data generated by the discharge scanner **158** may be communicated from the packaging system **100** to other systems that may process the packages **102**, as will be discussed in greater detail below.

[0075] The packaging system **100** also includes a controller **160**. In the depicted embodiment, the controller **160** is in the form of a tablet with a touchscreen. In other embodiments, the controller **160** may be any other type of computing device having any type of input and/or output devices. The controller **160** is configured to receive information from and/or send control signals to various individual components of the packaging system **100**. One embodiment of the operation of the controller **160** is depicted in a block diagram of portions of the packaging system **100** shown in FIG. 2B. As shown by the dashed lines in FIG. 2B the controller **160** is communicatively coupled to each of the supply **104**, the conveyors $\mathbf{124}_1$, $\mathbf{124}_2$, $\mathbf{124}_3$, and $\mathbf{124}_4$, the sealing mechanism **140**, the infeed sensors **132**, the discharge scanner **158**, and the labeling mechanism **152**. The controller **160** may not be communicatively coupled to every component in the packaging system **100** (e.g., the folding system **112** in the depiction in FIG. 2B), especially where those components are passive components that operate without any external control.

[0076] In some embodiments, the controller **160** is a part of a tracking system configured to track locations of the objects **120** as the objects **120** are conveyed through the packaging system **100** on the conveyance system **124**. In particular, the tracking system is configured to track locations of the objects **120** before the objects **120** enter the tube **114**, while the objects **120** are in the tube **114**, and after the packages **102** are formed by transversely cutting the tube **114**. For example, the controller **160** can maintain a table of the objects **120** that are being conveyed through the packaging system **100** along with an indication of the location of each of the objects **120** in the packaging system **100**. The controller **160** changes the indications of the locations of each of the objects **120** over time as the objects **120** are moved through the packaging system **100** by the conveyance system **124**. In this way, the controller **160** "knows" where every one of the objects **120** in the system is located, even when the objects **120** are located inside of the tube **114** and/or inside of one of the packages **102**.

[0077] In some embodiments, the tracking system in the packaging system **100** is configured to track locations of the objects **120** independently of any marks on the packaging material. In some embodiments, the tracking system also includes at least one position detector in the infeed sensors **132** and at least one conveyor sensor (e.g., encoders on one or more of the conveyors in the conveyance system **124**). In some examples, the at least one conveyor sensor includes a plurality of encoders configured detect movements of each of a plurality of conveyor belts in the conveyor system. The position detector detects an infeed location of each of the objects **120** at an infeed portion of the conveyance system **124** (e.g., positions of leading edges of the objects **120** as they pass along a portion of the infeed spacing conveyor $\mathbf{124}_2$, positions of leading and trailing edges of the objects **120** as they pass along a portion of the infeed spacing conveyor $\mathbf{124}_2$) and communicate that information to the controller **160**. The encoders detect motions of the conveyors in the conveyance system **124** and communicate that information to the controller **160**. The controller **160** maintains a location of each of the objects **120** in the packaging system **100** based on the infeed location of the object **120** read by the position detector and subsequent motions of the conveyors in the conveyance system **124** as the conveyance system **124** moves the object. In this manner, the locations of the objects **120** can be tracked even when the objects **120** are in the tube **114** and/or in the packages **102** independently of any marks on the packaging material **106**.

[0078] In some embodiments, the infeed sensors **132** are configured to detect leading and trailing edges of the objects **120** as they pass along a portion of the infeed spacing conveyor $\mathbf{124}_2$. In some of these embodiments, the tracking system (e.g., the infeed sensors **132** and/or the controller **160**) is configured to calculate a longitudinal length of each of the objects **120** based on the leading edge and the trailing edge of each of the objects **120**. The tracking system of the packaging system **100** may be further configured to cause the sealing mechanism **140** to seal the tube **114** of the packaging material **106** around one of the objects **120** at locations based on physical characteristics of the one of the objects **120**, such as the longitudinal length of the one of the objects **120**. In some examples, the packaging system **100** is configured to cause the sealing mechanism **140** to seal the tube **114** of the packaging material **106** around one of the objects **120** at locations based on a combination of the longitudinal length of the one of the objects **120** and a height indication of the one of the objects **120**. As will be discussed in greater detail below, the height indication of the one of the objects **120** may be generated by the infeed sensors **132** as the objects **120** are fed through the infeed portion of the conveyance system **124**, and the height indication may include at least one of an indication whether any portion of the object **120** exceeds a predetermined height, an indication of a height of the leading edge of the object **120** and a height of the trailing edge of the object **120**, or a height profile of the object **120** from a transverse side of the object **120**.

[0079] The controller **160** may be configured to function in a variety of ways to control operations of the packaging system **100** based on information received from components of the packaging system **100**. In one example, the controller **160** receives information from the infeed sensors **132** about dimensions of the objects, sends control signals to the conveyance system **124** for properly conveying the objects, and sends control signals to the sealing mechanism **140** for properly spacing transverse seals around the objects. In another example of operation of the controller **160**, the controller **160** receives information from the infeed sensors **132** about spacing of the objects, sends control signals to the conveyance system **124** for properly conveying the objects, and sends control signals to the supply **104** for properly advancing the packaging material **106**. It will be apparent that the controller **160** can operate in any number of other ways to control operation of the packaging system **100**.

[0080] As noted above with respect to both the packaging system **10** and the packaging system **100**, an infeed scanner can detect a longitudinal length and/or a height indication of each object at an infeed portion of a conveyance system. In some embodiments, the height indication for an object includes at least one of an indication whether any portion of the object exceeds a predetermined height, an indication of a height of the leading edge of the object and a height of the trailing edge of the object, or a height profile of the object from a transverse side of the object. These embodiments of height indications are depicted in FIGS. **3**A-**3**D, FIGS. **4**A-**4**D, and FIGS. **5**A-**5**D.

[0081] In FIGS. **3**A-**3**D, FIGS. **4**A-**4**D, and FIGS. **5**A-**5**D, a system **200** determines a height indication of an object **210** that has a leading edge **212** and a trailing edge **214**. In the depicted embodiment, the object **210** is a case for a musical instrument; however, the object **210** may be another other type of object or groups of objects. The system **200** includes a conveyance system **220**. In the depicted embodiment, the conveyance system **220** includes a first conveyor **222** and a second conveyor **224**. The conveyance system **220** may also include additional conveyors. In some embodiments, the conveyance system **220** may be configured to receive objects (including the object **210**) that are non-uniformly spaced onto the first conveyor **222**. The first and second conveyors **222** and **224** may be controlled independently to control the spacing between the objects as the objects are moved from the first conveyor **222** to the second conveyor **224**.

[0082] The system **200** includes an infeed scanner **230**. In some embodiments, the infeed scanner **230** includes one or more of an optical sensor (e.g., a visible light sensor, a laser sensor, or any other electromagnetic sensor), an RFID tag reader, a barcode reader, a camera, an acoustic sensor (e.g., an ultrasonic sensor), a mechanical sensor (e.g., a plunger), or any other type of sensor. In the depicted embodiment, the infeed scanner **230** is arranged in a transverse direction across the conveyance system **220**, substantially perpendicular to the direction of movement of objects on the conveyance system **220**. As objects pass by the infeed scanner **230**, the infeed scanner **230** is capable of detecting one or more of the leading edge **212** of the object **210**, the trailing edge **214** of the object **210**, or a height of the object **210** at any point between the leading edge **212** and the trailing edge **214**.

[0083] In the embodiment depicted in FIGS. **3**A-**3**D, the infeed scanner **230** is configured to detect whether any portion of an object exceeds a predetermined height **232** (depicted as a dotted line in FIGS. **3**A-**3**D). At the instance depicted in FIG. **3**A, the leading edge **212** of the object **210** is at the infeed scanner **230**. The infeed scanner **230** can detect the leading edge **212** of the object **210** and begin detecting whether any portion of the object **210** exceeds the predetermined height **232**. At the instance depicted in FIG. **3**A, the height of the object **210** does not exceed the predetermined height **232**. As the object **210** is moved forward by the conveyance system **220** from the instance depicted in FIG. **3**A to the instance depicted in FIG. **3**B, the height of the object **210** still does not exceed the predetermined height **232**.

[0084] As the object **210** is moved forward by the conveyance system **220** from the instance depicted in FIG. **3**B to the instance depicted in FIG. **3**C, the height of the object **210** does exceed the predetermined height **232**. At that point, the infeed scanner **230** may generate a height indication that at least a portion of the object **210** exceeds the predetermined height **232**. This height indication can be communicated to a controller (e.g., the controller **70**, the controller **160**, or any other computing device) for controlling placement of the object **210** in a tube of film or packaging material, controlling locations of transverse seals in the film or packaging material around the object **210**, or controlling any other function of a packaging system.

[0085] The object **210** continues to be moved by the conveyance system **220** from the instance depicted in FIG. **3**C to the instance depicted in FIG. **3**D. In FIG. **3**D, the trailing edge **214** of the object **210** is at the infeed scanner **230** and the infeed scanner **230** stops detecting whether any portion of the object **210** exceeds the predetermined height **232**. The height of the trailing edge **214** does not exceed the predetermined height **232**. Even though the height of the trailing edge **214** does not exceed the predetermined height **232**, the height indication for the object **210** remains that at least a portion of the object **210** exceeds the predetermined height **232**. In some embodiments, the infeed scanner **230** is capable of determining a longitudinal length of the object **210** based on the distance between the leading edge **212** and the trailing edge **214**. The infeed scanner **230** may communicate the longitudinal length to a controller (e.g., the controller **70**, the controller **160**, or any other computing device) for controlling placement of the object **210** in a tube of film or packaging material, controlling locations of transverse seals in the film or packaging material around the object **210**, controlling any other function of a packaging system. In some embodiments, the controller is configured to control any of the functions of the packaging system based on a combination of the longitudinal length and the height indication.

[0086] In the embodiment depicted in FIGS. **4**A-**4**D, the infeed scanner **230** is configured to detect an indication of a height of the leading edge **212** of the object **219** and a height of the trailing edge **214** of the object **210**. At the instance depicted in FIG. **4**A, the leading edge **212** of the object **210** is at the infeed scanner **230**. The infeed scanner **230** detects the leading edge **212** of the object **210** and the height **234** of the object **210** at the leading edge **212**. The object **210** is moved forward by the conveyance system **220** from the instance depicted in FIG. **4**A. As the object **210** passes the instances depicted in FIGS. **4**B and **4**C, the infeed scanner **230** does not record any height of the object **210**. In the instance depicted in FIG. **4**D, the trailing edge **214** of the object **210** is at the infeed scanner **230**. The infeed scanner **230** detects the trailing edge **214** of the object **210** and the height **236** of the object **210** at the trailing edge **214**.

[0087] The infeed scanner **230** is capable of generating a height indication that includes an indication of the height **234** of the leading edge **212** and the height **236** of the trailing edge **214**. The infeed scanner **230** is also capable of determining a longitudinal length of the object **210** based on the distance between the leading edge **212** and the trailing edge **214**. The height indication and/or the longitudinal length can be communicated to a controller (e.g., the controller **70**, the controller **160**, or any other computing device) for controlling placement of the object **210** in a tube of film or packaging material, controlling locations of transverse seals in the film or packaging material around the object **210**, or controlling any other function of a packaging system.

[0088] In the embodiment depicted in FIGS. **5**A-**5**D, the infeed scanner **230** is configured to detect a height profile of the object **210** from a transverse side of the object **210**. At the instance depicted in FIG. **5**A, the leading edge **212** of the object **210** is at the infeed scanner **230**. The infeed scanner **230** detects the height of the leading edge **212** and adds a point to the height profile indicative of the height of the leading edge **212**. A depiction of the height profile up until the instance shown in FIG. **5**A is depicted in the chart **240** that is also shown in FIG. **5**A. The object **210** is moved forward by the conveyance system **220** from the instance depicted in FIG. **5**A. At various times, as the object **210** passes the instances depicted in FIGS. **5**B and **5**C, the infeed scanner **230** periodically determines heights of the object **210** from the transverse side of the object **210**. Depictions of the height profiles up until the instances shown in FIGS. **5**B and **5**C are depicted, respectively, in the charts **242** and **244** that are also shown in FIGS. **5**B and **5**C.

[0089] In the instance depicted in FIG. **5**D, the trailing edge **214** of the object **210** is at the infeed scanner **230**. The infeed scanner **230** detects the height of the trailing edge **214** of the object **210**. A depiction of the height profile up until the instance shown in FIG. **5**D is depicted in the chart **246** that is also shown in FIG. **5**D. As can be seen by the chart **246**, the height profile of the object **210** forms an outline of the object **210** from a transverse side of the object **210**. In the depicted embodiment, the indications of the heights in FIG. **5**D are uniformly-spaced along the longitudinal length of the object. The resolution of the data points (e.g., the spacing between data points in the chart **246**) can be selected or adjusted as desired. In other embodiments, the data points in a height profile can be non-uniformly-spaced. While the height profile generated during the process shown from FIG. **5**A to FIG. **5**D is in the form of charts **240**, **242**, **244**, and **246**, it will be apparent that the height profile data can be generated in any form, such as sets of Cartesian coordinate points, sets of polar coordinate points, or any other manner of defining points in a two- or three-dimensional space.

[0090] The infeed scanner **230** is capable of communicating the height indication, including the height profile depicted in the chart **246**, to a controller (e.g., the controller **70**, the controller **160**, or any other computing device). The controller can determine any number of characteristics of the object **210** from the height profile. For example, the controller can determine one or more of a longitudinal length of the object **210**, a height of the object **210** at any particular longitudinal position of the object **210**, a contour or slope of the object **210** near the leading edge **212** and/or the trailing edge **214**, an average height of the object **210**, or any other characteristic of the object **210**. The controller is capable of controlling any function of a packaging system based at least on one or more of the characteristics determined from the height profile. For example, the controller can control one or more of placement of the object **210** in a tube of film or packaging material, locations of transverse seals in the film or packaging material around the object **210**, or any other function of a packaging system based at least on one or more of the characteristics determined from the height profile.

[0091] In some instances packaging material used in a form-fill-seal packaging systems can include intermittently-spaced graphic regions. These intermittently-spaced graphic regions can include a combination of text and images, such as a logo, a word mark, a trademark, a word, a name, a picture, or any combination thereof. For example, when the form-fill-seal packaging system is used to package objects that are sold by a company for shipment to the company's customers, each of the intermittently-spaced graphic regions can include the company's logo, the company's name, and/or the company's slogan. The spacing of these intermittent graphic regions can be selected such that, as packages are formed from the packaging material, one or more of the graphic regions will typically be visible on the exterior of the package to identify the seller. For example, the graphic regions can be spaced at intervals of 15 inches. In this example, the form-fill-seal packaging system may also be configured to make packages of not less than 15 inches in length, thereby assuring that at least a portion of one of the graphic regions is located on the outer side of packages formed from the packaging material.

[0092] FIG. **6**A depicts an example of a packaging system **10'** that uses a packaging material **30'** having intermittently-spaced graphic regions **80** to form packages **34**. Aside from those aspects, the packaging system **10'** is substantially similar to the packaging system **10**. As can be seen in FIG. **6**A, after the packaging material **30'** is inverted to form the tube **56**, the graphic regions **80** are on the exterior of the tube **56**. The graphic regions **80** are intermittently-spaced in a longitudinal direction of the packaging material **30'**. In addition, as the packages **34** are formed, the graphic regions **80** remain on the exterior of the packages **34**.

[0093] FIG. **6**B depicts some of the difficulties with the use of the packaging material **30'** with the intermittently-spaced graphic regions **80**. In this example, the object **36** is in the form of a hockey stick and each of the graphic regions **80** includes a name and logo of a hockey gear company. As the sealing mechanism **28** (not shown in FIG. **6**B) formed the leading seal **60** and the trailing seal **58** to form the package **34**, each of the leading seal **60** and the trailing seal **58** intersected the one of the graphic regions **80**. In addition, the label **78** applied by the labeling mechanism **76** (not shown in FIG. **6**B) covers one of the graphic regions **80**. Thus, even though a portion of each of three of the graphic regions **80** is located on the package **34**, none of the graphic regions **80** on the exterior of the package **34** is whole and entirely visible. This reduces the benefit of having the graphic regions **80** on the exterior of the package **34**.

[0094] As described above, embodiments of tracking systems described herein include a controller that tracks the locations of the objects being conveyed by a conveyance system and controls functions of the packaging system based on the locations of the objects in the packaging system. In some embodiments, the controller controls the placement of the objects in the tube of the packaging material and/or the feeding of the packaging material such that the objects are located at particular locations with respect to the packaging material so that transverse cuts and seals are made in the packaging material without intersecting the graphic regions. In some embodiments, the controller controls operation of the sealing mechanism that forms transverse seals and cuts in the tube of the film so that transverse cuts and seals are made in the packaging material without intersecting the graphic regions. In some embodiments, the controller controls operation of the labeling mechanism to cause labels to be placed on the packaging material so that the labels do not overlap any of the graphic regions.

[0095] FIG. **6**C depicts an embodiment of a package **34** formed so that graphic regions are not intersected or covered by seals, cuts, or labels. In the depicted embodiment, the location of the object **36** with respect to the packaging material **30'** and/or the operation of the longitudinal sealer **26** was controlled so that the leading seal **60** and the trailing seal **58** do not intersect any of the graphic regions **80**. In addition, the operation of the labeling mechanism was controlled so that the label **78** was placed in a location that does not overlap any of the graphic regions **80**. In this way, the resulting package **34** includes two graphic regions **80** that are not intersected or covered by seals, cuts, or labels.

[0096] Another difficulty with form-fill-seal packaging systems is the handling of flawed packages. Packages can be flawed if the package lacks one of the objects that should be in the package, the package includes an extra object that should not be in the package, a label on the package cannot be read, the package lacks a label, the package has an improper dimension, a transverse seal on the package intersects a graphic region, a user input indicates that the package is flawed, any other flaw, or any combination thereof. If a flawed package is created, it may not be possible for an operator of the packaging system to know that the package is flawed without opening the package to see what object or objects are inside of the package. To address this issue, when traditional form-fill-seal packaging systems detect a flawed package, the packaging system stops all operation and signals an alert that the packaging system has identified a flaw. This alert signals an operator to investigate the flaw and either fix the flaw or remove the objects associated with the flawed package. After the person addresses the flaw, the person can restart the packaging machine. The result is that no flawed packages are created. However, this signaling of the alert also has drawbacks in the amount of downtime of the packaging system while the operator is addressing the flaw. If no operator is available to address the flaw immediately, there could be a significant amount of down time for the packaging machine.

[0097] In the embodiment of packaging systems described herein that track locations of the objects, the tracked locations of the object can be used when a flawed package is detected. In particular, the packaging systems can be configured to pass packages to a downstream package handling system and to communicate, to the downstream package handling system, the location of the objects and an indication whether the package is flawed. An example of a downstream package handling system **300** is depicted in embodiments of systems shown in FIGS. **7**A and **7**B, which depict, respectively, a system **310** that includes the packaging system **10** and the downstream package handling system **300** and a system **320** that includes the packaging system **100** and the downstream package handling system **300**.

[0098] The downstream package handling system **300** includes conveyors **302**$_1$, **302**$_2$, **302**$_3$, and **302**$_4$ (collectively, conveyance system **302**). The conveyance system **302** is configured to receive packages and to convey they packages through the downstream package handling system **300**. The downstream package handling system **300** also includes routing elements **304**$_1$ and **304**$_M$ (collectively routing system **304**). The routing elements **304**$_1$ and **304**$_M$ are selectively operable to selectively route the packages along various paths through the downstream package handling system **300**. The routing elements **304**$_1$ and **304**$_M$ may be gates, as depicted in FIGS. **7**A and **7**B, directional rollers, conveyor belts, doors, robotic arms, or any other element capable of selectively routing the packages.

[0099] The downstream package handling system **300** also includes package destinations **306**$_1$, **306**$_2$, and **306**$_N$ (collectively package destinations **306**). The package destinations **306** are destinations for the packages that have been routed through the downstream package handling system **300** by the routing system **304**. In some embodiments, the package destinations **306** are bins configured to hold a number of packages that are intended for different handling. For example, the package destination **306**$_1$ may be a bin designated to hold packages that are deemed to be flawed, the package destination **306**$_2$ may be a bin designated to hold packages that will be shipped by a first shipping company, and the package destination **306**$_N$ may be a bin designated to hold packages that will be shipped by a second shipping company. In this way, the different types of packages are separated and collected in an appropriate holding bin at the package destinations **306**. In other embodiments, the package destinations **306** are outfeed conveyors configured to route the packages for further handling. For example, the package destination **306**$_2$ may be an outfeed conveyor that routes packages to a transportation vehicle of a first shipping company, and the package destination **306**$_N$ may be an outfeed conveyor that routes packages to a transportation vehicle of a second shipping company. It will be understood that the downstream package handling system **300** can include any number of conveyors in the conveyance system **302**, any number of routing elements in the routing system **304**, and any number of the packaging destinations **306**.

[0100] The downstream package handling system **300** also includes a controller **308**. The controller **308** is communicatively coupled to each of the routing elements **304**$_1$ and **304**$_M$ in the routing system **304**. The controller **308** is configured to send control signals to the routing system **304** to control operation of each of the routing elements **304**$_1$ and **304**$_M$ in the routing system **304**. In this way, the controller **308** is able to control which packages arrive at particular package destinations **306**. In some embodiments, the controller **308** is configured to send control signals based on user inputs. In other examples, as will be discussed in greater detail below, the controller **308** is configured to send control signals based on information received from a packaging system.

[0101] In FIG. **7**A, the system **310** includes the packaging system **10** and the downstream package handling system **300**. The system **310** is configured to convey objects and packages in a direction **312**. More specifically, the packaging system **10** is configured to receive objects and to form packages around the objects, and the downstream package handling system **300** is configured to receive the packages and to sort the packages to the different package destinations **306**. The system optionally includes an intermediate conveyor **314** between the conveyance system **24** of the packaging system **10** and the conveyance system **302** of the downstream package handling system **300**. The intermediate conveyor **314** may be configured to convey packages exiting the packaging system **10** and convey the packages to an infeed location of the downstream package handling system **300**. In other embodiments, the system **310** does not include the intermediate conveyor **314** and the conveyor **244** is configured to pass the packages directly to the conveyor **302_1**.

[0102] In the despite embodiment, the system **310** also includes a network **316**. The network **316** may be a wired network, a wireless network, or any combination of wired and wireless networks. In other embodiments, the network **316** may be replaced by a direct communication link, such as a wired serial communication line, a wireless Bluetooth connection, a communication bus, or any other direct communication link. The controller **70** of the packaging system **10** is communicatively coupled to the network **316**. The controller **308** of the downstream package handling system **300** is also communicatively coupled to the network **316**. The controller **70** and the controller **308** are capable of communicating information to each other via the network **316**.

[0103] In some embodiments, the controller **70** is configured to determine whether any of the packages formed by the packaging system is flawed. As noted above, a package can be deemed to be flawed if the package lacks one of the objects that should be in the package, the package includes an extra object that should not be in the package, a label on the package cannot be read, the package lacks a label, the package has an improper dimension, a transverse seal on the package intersects a graphic region, a user input indicates that the package is flawed, any other flaw, or any combination thereof. If the controller **70** determines that one of the packages is flawed, the controller **70** can communicate to the controller **308**, via the network **316**, an indication that the package is flawed. The controller **308** is configured to sort flawed packages from other packages that are not flawed based at least on the location of the package and the indication that the package is flawed received from the controller **70**.

[0104] In FIG. **7**B, the system **320** includes the packaging system **100** and the downstream package handling system **300**. The system **320** is configured to convey objects and packages in a direction **322**. More specifically, the packaging system **100** is configured to receive objects and to form packages around the objects, and the downstream package handling system **300** is configured to receive the packages and to sort the packages to the different package destinations **306**. The system optionally includes an intermediate conveyor **324** between the conveyance system **124** of the packaging system **100** and the conveyance system **302** of the downstream package handling system **300**. The intermediate conveyor **314** may be configured to convey packages exiting the packaging system **100** and convey the packages to an infeed location of the downstream package handling system **300**. In other embodiments, the system **320** does not include the intermediate conveyor **324** and the conveyor **124_4** is configured to pass the packages directly to the conveyor **302_1**.

[0105] In the depicted embodiment, the system **320** also includes a network **326**. The network **326** may be a wired network, a wireless network, or any combination of wired and wireless networks. In other embodiments, the network **326** may be replaced by a direct communication link, such as a wired serial communication line, a wireless Bluetooth connection, a communication bus, or any other direct communication link. The controller **160** of the packaging system **10** is communicatively coupled to the network **326**. The controller **308** of the downstream package handling system **300** is also communicatively coupled to the network **326**. The controller **160** and the controller **308** are capable of communicating information to each other via the network **326**.

[0106] In some embodiments, the controller **160** is configured to determine whether any of the packages formed by the packaging system is flawed. As noted above, a package can be deemed to be flawed if the package lacks one of the objects that should be in the package, the package includes an extra object that should not be in the package, a label on the package cannot be read, the package lacks a label, the package has an improper dimension, a transverse seal on the package intersects a graphic region, a user input indicates that the package is flawed, any other flaw, or any combination thereof. If the controller **160** determines that one of the packages is flawed, the controller **160** can communicate to the controller **308**, via the network **326**, an indication that the package is flawed. The controller **308** is configured to sort flawed packages from other packages that are not flawed based at least on the location of the package and the indication that the package is flawed received from the controller **160**.

[0107] The embodiments of the systems **310** and **320** shown in FIGS. **7**A and **7**B include one packaging system—either packaging system **10** or packaging system **100**—upstream from the downstream package handling system **300**. In other embodiments, multiple packaging systems may be located upstream of the downstream package handling system **300**. In one embodiment, a system can include the packaging system **100**, the packaging system **10**, and the downstream package handling system **300**, all of which are communicatively coupled to each other via one or more networks. The packaging system **100** is capable of receiving objects that are non-uniformly spaced, forming cushion packages around the objects, and passing the cushion packages to the packaging system **10**. The controller **160** is capable of communicating information about the cushion packages (e.g., locations of the cushion packages) to the controller **70** of the packaging system **10**. The packaging system **10** is capable of receiving the cushion packages, forming packages around the cushion packages, and passing the packages to the downstream package handling system **300**. The controller **70** is capable of communicating information about the packages (e.g., locations of the packages) to the controller **308** of the downstream package handling system **300**. The downstream package handling system **300** is capable of packages based at least on the information received from one or both of the controllers **70** and **160**. In some embodiments, one or both of the controllers **70** and **160** can determine that one of the packages is flawed and communicate that to the controller **308** so that the controller **308** can cause the flawed package to be sorted from the packages that are not flawed.

[0108] As described above, embodiments of packaging systems described herein are capable of tracking locations of objects as the objects are conveyed through the packaging systems. The ability to track the locations of objects can aid in placement of labels on packages after the packages are formed around the objects. Existing systems rely on the proper placement of inducting documents on objects for the packaging system to properly locate a label on packages. An example of this type of system and some of the drawbacks associated therewith are depicted in FIGS. **8**A to **8**C. In the systems described herein, the ability of the packaging system to track locations of the objects may eliminate the need to rely on the proper placement of inducting documents. An example of this type of system and some of the benefits associated therewith are depicted in FIGS. **9**A to **9**C.

[0109] FIGS. **8**A and **8**B depict two instances of an infeed portion of a packaging system **400**. The packaging system **400** includes a conveyance system **424** that conveys objects $\mathbf{436}_1$, $\mathbf{436}_2$, $\mathbf{436}_3$, $\mathbf{436}_4$, and $\mathbf{436}_5$ (collectively, objects **436**). Each of the objects **436** includes, respectively, a leading edge $\mathbf{452}_1$, $\mathbf{452}_2$, $\mathbf{452}_3$, $\mathbf{452}_4$, and $\mathbf{452}_5$ (collectively, leading edges **452**) and a trailing edge $\mathbf{454}_1$, $\mathbf{454}_2$, $\mathbf{454}_3$, $\mathbf{454}_4$, and $\mathbf{454}_5$ (collectively, trailing edges **454**). The conveyance system **424** is configured convey the objects **436** in a conveyance direction **438**. As the objects **436** are conveyed by the conveyance system **424**, the objects **436** pass by an infeed scanner **472**. The infeed scanner **472** is arranged to scan for identifiers at a particular transverse location on the conveyance system **424**.

[0110] Each of the objects $\mathbf{436}_1$, $\mathbf{436}_2$, $\mathbf{436}_3$, $\mathbf{436}_4$, and $\mathbf{436}_5$ has an associated inducting document objects $\mathbf{482}_1$, $\mathbf{482}_2$, $\mathbf{482}_3$, $\mathbf{482}_4$, and $\mathbf{482}_5$ (collectively, inducting documents **482**). The inducting documents **482** include information identifying one or more of the objects **436** and/or one or more orders associated with the objects **436**. In some embodiments, the inducting documents **482** include machine-readable information and/or human-readable information. In some examples, each of the inducting documents **482** includes a barcode, a QR code, a RFID tag, any other form a machine-readable information, or any combination thereof. In the depicted embodiment, each of the inducting documents **482** includes a QR code. The infeed scanner **472** is configured to read the QR codes on the inducting documents **482** if the QR codes are arranged appropriately with respect to the infeed scanner **472**. The infeed scanner **472** is configured to send information to other components in the packaging system **400**, such as a labeling mechanism or a discharge scanner.

[0111] FIG. **8**C depicts an outfeed portion of the packaging system **400**. At this point, packages $\mathbf{434}_1$, $\mathbf{434}_2$, $\mathbf{434}_3$, and $\mathbf{434}_4$ (collectively, packages **434**) have been formed around the respective objects **436**. In the depicted embodiment, the packaging system **400** includes a labeling mechanism **476** configured to print or place labels $\mathbf{478}_1$ and $\mathbf{478}_3$ (collectively, labels **478**) on the packages **434**. The labels **478** on the packages **434** may contain any type of human-readable and/or machine-readable information. The packaging system **400** also includes a discharge scanner **474** configured to scan the packages **434** as they leave the packaging system **400**. In some embodiments, the discharge scanner **474** may be configured to scan any aspect of the packages, such as an optical scan of the labels on the packages **434**, an optical scan of the location of one or more sides of the packages **434**, a radio frequency scan of RFID tags on the inducting documents **482** inside of the packages **434**, or any other type of scan. The data obtained from the discharge scanner **474** may be used for verification that the objects **436** have been properly packaged in the packages **434**, for creation of a record of the objects **436** that are being shipped, for passing information about the packages **434** to downstream systems, or for any other reason.

[0112] In the embodiment shown in FIGS. **8**A to **8**C, the inducting documents **482** are intended to be placed on their associated objects **436** aligned with the leading edge **452** and the left transverse edge (i.e., the left and top sides as seen in FIGS. **8**A to **8**C). For example, the inducting document $\mathbf{482}_1$ is placed on the object $\mathbf{436}_1$ and arranged at the leading edge $\mathbf{452}_1$ and the left transverse edge of the object $\mathbf{436}_1$. As can be seen in FIG. **8**A, when the inducting document $\mathbf{482}_1$ is properly placed on the object $\mathbf{436}_1$, the location of the QR code in the transverse direction allows the infeed scanner **472** to read the QR code as the object $\mathbf{436}_1$ passes the infeed scanner **472**. The information gathered by the infeed scanner **472** can be used by the packaging system **400** to process the object $\mathbf{436}_1$ and/or the package $\mathbf{434}_1$. As can be seen in FIG. **8**C, the labeling mechanism **476** can print and/or apply the label $\mathbf{478}_1$ on the package based on the information obtained from the infeed scanner **472**. For example, shipping information for the package $\mathbf{434}_1$ can be printed on the label $\mathbf{478}_1$ based on the scan of the inducting document $\mathbf{482}_1$ by the infeed scanner **472**.

[0113] One drawback to the use of inducting documents **482** is the effect of improper placement of the inducting documents **482** on the objects **436**. For example, the inducting document $\mathbf{482}_2$ is not properly placed on the object $\mathbf{436}_2$ at the leading edge $\mathbf{452}_2$ and the left transverse edge of the object $\mathbf{436}_2$. As can be seen in FIG. **8**B, the infeed scanner **472** cannot scan the QR code on the inducting document $\mathbf{482}_2$ because the inducting document $\mathbf{482}_2$ is not properly placed. In this case, the infeed scanner **472** does not "read" the inducting document $\mathbf{482}_2$ and does not signal the appropriate information to other components of the packaging system **400**. For example, the labeling mechanism **476** does not receive the information needed to print a label for the package $\mathbf{434}_2$. As can be seen in FIG. **8**C, there is no label on the exterior of the package $\mathbf{434}_2$ even though the package $\mathbf{434}_2$ has already been conveyed beyond the labeling mechanism **476**.

[0114] Another example of improper placement of an inducting document is shown with respect to the inducting document $\mathbf{482}_3$ and the object $\mathbf{436}_3$. As shown in FIGS. **8**A and **8**B, the inducting document $\mathbf{482}_3$ is placed on the object $\mathbf{436}_3$ where it is aligned with the left transverse edge, but the inducting document $\mathbf{482}_3$ is not aligned with the leading edge $\mathbf{452}_3$. An operator may have placed the inducting document $\mathbf{482}_3$ on the object toward the trailing edge $\mathbf{454}_3$ because of the narrow width of the object $\mathbf{436}_3$ at the leading edge $\mathbf{452}_3$. However, the packaging system **400** is configured to place the labels **478** on the packages **434** based on the location of the inducting document $\mathbf{482}_3$. In the depicted example, the packaging system **400** is configured to place the label $\mathbf{478}_3$ on the package $\mathbf{434}_1$ so that the center of the label $\mathbf{478}_1$ is a particular distance (e.g., 2 inches) away from the QR code on the inducting document $\mathbf{482}_1$ toward the trailing edge of the package $\mathbf{434}_1$. When the inducting documents **482** are properly placed with respect to the objects **436** (e.g., aligned at the leading edges **452** of the objects **436**), the labels **478** are properly placed on the exterior of the packages **434**. When the labels **478** are not properly placed with respect to the objects **436**, the labels **478** may not be placed properly. For example, the label $\mathbf{478}_3$ is placed on the package $\mathbf{434}_3$ so that the center of the label $\mathbf{478}_3$ is same particular distance (e.g., 2 inches) away from the QR code on the inducting document $\mathbf{482}_3$ toward the trailing edge of the package $\mathbf{434}_3$. Because the inducting document **482**$_3$ is not aligned with the leading edge **452**$_3$, the label **478**$_3$ is located on the package **434**$_3$ much closer to the trailing edge of the package **434**$_3$ than the label **478**$_1$ is located on the package **434**$_1$.

[0115] Another example of improper placement of an inducting document is shown with respect to the inducting document **482**$_4$ and the object **436**$_4$. As shown in FIG. **8**A, the corner of the object **436**$_4$ at the leading edge **452**$_4$ and the left transverse edge is rounded. An operator may have a difficult time placing the inducting document **482**$_4$ properly on such an object. As shown in FIG. **8**B, the operator may place the corner of the inducting document **482**$_4$ at the rounded corner of the object **436**$_4$ at the leading edge **452**$_4$ and the left transverse edge. While the depiction shown in FIG. **8**C shows the package **434**$_4$ without a label because the package **434**$_4$ is upstream of the labeling mechanism **476**, the labeling mechanism **476** may not properly place a label on the package **434**$_4$ because of the improper placement of the inducting document **482**$_4$ on the object **436**$_4$.

[0116] The drawbacks of the packaging system **400** depicted in FIGS. **8**A to **8**C are due to the use of the locations of the inducting documents **482** as a basis for the location of the labels **478** applied by the labeling mechanism **476**. The locations of the inducting documents **482** with respect to the objects **436** are subject to errors, such as human error when pacing the inducting documents **482** on the objects **436**, errors from the inducting documents **482** moving to an improper location after proper placement on the objects **436** (e.g., a gust of air from an HVAC vent), errors from the inducting documents **482** falling off of the objects **436** (e.g., due to vibration during conveyance of the objects **436** from the conveyance system **424**), or any other type of error. These errors can be overcome by the use of a packaging system that places and/or prints labels on packages independently of the locations of inducting documents on objects.

[0117] Depicted in FIGS. **9**A to **9**C is an embodiment of a packaging system **500** that prints and/or places labels on packages independently of the locations of inducting documents on objects. In particular, the packaging system **500** tracks the locations of the objects independently of the locations of inducting documents on the objects and prints and/or places the labels on the packages based on the locations of the objects. FIGS. **9**A and **9**B depict two instances of an infeed portion of a packaging system **500**. The packaging system **500** includes a conveyance system **524** that conveys objects **536**$_1$, **536**$_2$, **536**$_3$, **536**$_4$, and **536**$_5$ (collectively, objects **536**). Each of the objects **536** includes, respectively, a leading edge **552**$_1$, **552**$_2$, **552**$_3$, **552**$_4$, and **552**$_5$ (collectively, leading edges **552**) and a trailing edge **554**$_1$, **554**$_2$, **554**$_3$, **554**$_4$, and **554**$_5$ (collectively, trailing edges **554**). The conveyance system **524** is configured convey the objects **536** in a conveyance direction **538**. As the objects **536** are conveyed by the conveyance system **524**, the objects **536** pass by an infeed scanner **572**. The infeed scanner **572** is arranged to scan for identifiers on the objects **536** on the conveyance system **524**.

[0118] Each of the objects **536**$_1$, **536**$_2$, **536**$_3$, **536**$_4$, and **536**$_5$ has an associated inducting document objects **582**$_1$, **582**$_2$, **582**$_3$, **582**$_4$, and **582**$_5$ (collectively, inducting documents **582**). The inducting documents **582** include information identifying one or more of the objects **536** and/or one or more orders associated with the objects **536**. In some embodiments, the inducting documents **582** include machine-readable information and/or human-readable information. In some examples, each of the inducting documents **582** includes a barcode, a QR code, a RFID tag, any other form a machine-readable information, or any combination thereof. In the depicted embodiment, each of the inducting documents **582** includes a QR code. The infeed scanner **572** is configured to read the QR codes on the inducting documents **582**. The infeed scanner **572** is configured to send information to other components in the packaging system **500**, such as a labeling mechanism or a discharge scanner.

[0119] FIG. **8**C depicts an outfeed portion of the packaging system **500**. At this point, packages **534**$_1$, **534**$_2$, **534**$_3$, and **534**$_4$ (collectively, packages **534**) have been formed around the respective objects **536**. In the depicted embodiment, the packaging system **500** includes a labeling mechanism **576** configured to print or place labels **578**$_1$, **578**$_2$, and **578**$_3$ (collectively, labels **578**) on the packages **534**. The labels **578** on the packages **534** may contain any type of human-readable and/or machine-readable information. The packaging system **500** also includes a discharge scanner **574** configured to scan the packages **534** as they leave the packaging system **500**. In some embodiments, the discharge scanner **574** may be configured to scan any aspect of the packages, such as an optical scan of the labels on the packages **534**, an optical scan of the location of one or more sides of the packages **534**, a radio frequency scan of RFID tags on the inducting documents **582** inside of the packages **534**, or any other type of scan. The data obtained from the discharge scanner **574** may be used for verification that the objects **536** have been properly packaged in the packages **534**, for creation of a record of the objects **536** that are being shipped, for passing information about the packages **534** to downstream systems, or for any other reason.

[0120] The packaging system **500** is also configured to track locations of the objects **536** as they are conveyed by the conveyance system. The packaging system **500** may include any of the tracking systems disclosed here, such as a position detector in the infeed portion of the conveyance system **524** configured to detect an initial position of the objects **536** and an encoder in every conveyor of the conveyance system **524** to detect movements of the objects **536** after the initial position by the conveyance system **524**. In some embodiments, the packaging system **500** detects the leading edges **552** and the trailing edges **554** of the objects **536** at an infeed portion of the conveyance system **524**. The packaging system **500** controls the infeed scanner **572** to detect the QR codes on the inducting documents **582** at any point between the leading edges **552** and the trailing edges **554** of the objects **536**. For example, the packaging system (e.g., a controller in the packaging system **500**) controls the infeed scanner to detect a QR code on the inducting document **582**$_1$ between the leading edge **552**$_1$ and the trailing edges **554**$_1$ of the object **536**$_1$, to detect a QR code on the inducting document **582**$_2$ between the leading edge **552**$_2$ and the trailing edges **554**$_2$ of the object **536**$_2$, and so forth. Significantly, the QR codes can be located at any longitudinal position and transverse position on the objects **536**. Thus, the inducting documents **582** do not need to be as specifically positioned on the objects **536** as the inducting documents **482** need to be positioned on the objects **436**. As long as the QR codes are located on the objects **536**, the infeed scanner **572** can scan the QR code and associate it with the object that is beneath the QR code. Thus, the infeed scanner **572** is able to scan both the QR code on the inducting document 482_1 and the inducting document 482_2 even though the inducting document 482_1 and 482_2 are not in the same position on their respective objects 536_1 and 536_2.

[0121] On the outfeed portion of the packaging system **500** shown in FIG. 9C, the labeling mechanism **576** has placed labels 578_1, 578_2, and 578_3, (collectively, labels **578**) on the respective packages 534_1, 534_2, and 534_3. The packaging system **500** caused the labeling mechanism **576** to place the labels **578** on the packages **534** at longitudinal locations that are approximately centered between the leading edges **552** and the trailing edges **554** of the object **536**. The packaging system **500** also caused the labeling mechanism **576** to place the labels **578** irrespective of the locations of the inducting documents **582**. The packaging system **500** is able to do this because the packaging system **500** tracks the locations of the objects **536** on the conveyance system **524** independently of the locations of the inducting documents **582**. While the embodiment depicted in FIG. 9C shows the labels **578** on the packages **534** at longitudinal locations that are approximately centered between the leading edges **552** and the trailing edges **554** of the object **536**, it will be understood that the packaging system **500** could cause the labeling mechanism **576** to place and/or print a label at any location with respect to the objects **536** on the packages **534**.

[0122] FIG. **10** depicts an example embodiment of a system **610** that may be used to implement some or all of the embodiments described herein. In the depicted embodiment, the system **610** includes computing devices 620_1, 620_2, 620_3, and 620_4 (collectively computing devices **620**). In the depicted embodiment, the computing device 620_1 is a tablet, the computing device 620_2 is a mobile phone, the computing device 620_3 is a desktop computer, and the computing device 620_4 is a laptop computer. In other embodiments, the computing devices **620** include one or more of a desktop computer, a mobile phone, a tablet, a phablet, a notebook computer, a laptop computer, a distributed system, a gaming console (e.g., Xbox, Play Station, Wii), a watch, a pair of glasses, a key fob, a radio frequency identification (RFID) tag, an ear piece, a scanner, a television, a dongle, a camera, a wristband, a wearable item, a kiosk, an input terminal, a server, a server network, a blade, a gateway, a switch, a processing device, a processing entity, a set-top box, a relay, a router, a network access point, a base station, any other device configured to perform the functions, operations, and/or processes described herein, or any combination thereof.

[0123] The computing devices **620** are communicatively coupled to each other via one or more networks **630** and **632**. Each of the networks **630** and **632** may include one or more wired or wireless networks (e.g., a 3G network, the Internet, an internal network, a proprietary network, a secured network). The computing devices **620** are capable of communicating with each other and/or any other computing devices via one or more wired or wireless networks. While the particular system **610** in FIG. **10** depicts that the computing devices **620** communicatively coupled via the network **630** include four computing devices, any number of computing devices may be communicatively coupled via the network **630**.

[0124] In the depicted embodiment, the computing device 620_3 is communicatively coupled with a peripheral device **640** via the network **632**. In the depicted embodiment, the peripheral device **640** is a scanner, such as a barcode scanner, an optical scanner, a computer vision device, and the like. In some embodiments, the network **632** is a wired network (e.g., a direct wired connection between the peripheral device **640** and the computing device 620_3), a wireless network (e.g., a Bluetooth connection or a WiFi connection), or a combination of wired and wireless networks (e.g., a Bluetooth connection between the peripheral device **640** and a cradle of the peripheral device **640** and a wired connection between the peripheral device **640** and the computing device 620_3). In some embodiments, the peripheral device **640** is itself a computing device (sometimes called a "smart" device). In other embodiments, the peripheral device **640** is not a computing device (sometimes called a "dumb" device).

[0125] Depicted in FIG. **11** is a block diagram of an embodiment of a computing device **700**. Any of the computing devices **620** and/or any other computing device described herein may include some or all of the components and features of the computing device **700**. In some embodiments, the computing device **700** is one or more of a desktop computer, a mobile phone, a tablet, a phablet, a notebook computer, a laptop computer, a distributed system, a gaming console (e.g., an Xbox, a Play Station, a Wii), a watch, a pair of glasses, a key fob, a radio frequency identification (RFID) tag, an ear piece, a scanner, a television, a dongle, a camera, a wristband, a wearable item, a kiosk, an input terminal, a server, a server network, a blade, a gateway, a switch, a processing device, a processing entity, a set-top box, a relay, a router, a network access point, a base station, any other device configured to perform the functions, operations, and/or processes described herein, or any combination thereof. Such functions, operations, and/or processes may include, for example, transmitting, receiving, operating on, processing, displaying, storing, determining, creating/generating, monitoring, evaluating, comparing, and/or similar terms used herein. In one embodiment, these functions, operations, and/or processes can be performed on data, content, information, and/or similar terms used herein.

[0126] In the depicted embodiment, the computing device **700** includes a processing element **705**, memory **710**, a user interface **715**, and a communications interface **720**. The processing element **705**, memory **710**, a user interface **715**, and a communications interface **720** are capable of communicating via a communication bus **725** by reading data from and/or writing data to the communication bus **725**. The computing device **700** may include other components that are capable of communicating via the communication bus **725**. In other embodiments, the computing device does not include the communication bus **725** and the components of the computing device **700** are capable of communicating with each other in some other way.

[0127] The processing element **705** (also referred to as one or more processors, processing circuitry, and/or similar terms used herein) is capable of performing operations on some external data source. For example, the processing element may perform operations on data in the memory **710**, data receives via the user interface **715**, and/or data received via the communications interface **720**. As will be understood, the processing element **705** may be embodied in a number of different ways. In some embodiments, the processing element **705** includes one or more complex programmable logic devices (CPLDs), microprocessors, multi-core processors, co processing entities, application-specific instruction-set processors (ASIPs), microcontrollers, controllers, integrated circuits, application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), programmable logic arrays (PLAs), hardware accelerators, any other circuitry, or any combination thereof. The term circuitry may refer to an entirely hardware embodiment or a combination of hardware and computer program products. In some embodiments, the processing element **705** is configured for a particular use or configured to execute instructions stored in volatile or nonvolatile media or otherwise accessible to the processing element **705**. As such, whether configured by hardware or computer program products, or by a combination thereof, the processing element **705** may be capable of performing steps or operations when configured accordingly.

[0128] The memory **710** in the computing device **700** is configured to store data, computer-executable instructions, and/or any other information. In some embodiments, the memory **710** includes volatile memory (also referred to as volatile storage, volatile media, volatile memory circuitry, and the like), non-volatile memory (also referred to as non-volatile storage, non-volatile media, non-volatile memory circuitry, and the like), or some combination thereof.

[0129] In some embodiments, volatile memory includes one or more of random access memory (RAM), dynamic random access memory (DRAM), static random access memory (SRAM), fast page mode dynamic random access memory (FPM DRAM), extended data-out dynamic random access memory (EDO DRAM), synchronous dynamic random access memory (SDRAM), double data rate synchronous dynamic random access memory (DDR SDRAM), double data rate type two synchronous dynamic random access memory (DDR2 SDRAM), double data rate type three synchronous dynamic random access memory (DDR3 SDRAM), Rambus dynamic random access memory (RDRAM), Twin Transistor RAM (TTRAM), Thyristor RAM (T-RAM), Zero-capacitor (Z-RAM), Rambus in-line memory module (RIMM), dual in-line memory module (DIMM), single in-line memory module (SIMM), video random access memory (VRAM), cache memory (including various levels), flash memory, any other memory that requires power to store information, or any combination thereof.

[0130] In some embodiments, non-volatile memory includes one or more of hard disks, floppy disks, flexible disks, solid-state storage (SSS) (e.g., a solid state drive (SSD)), solid state cards (SSC), solid state modules (SSM), enterprise flash drives, magnetic tapes, any other non-transitory magnetic media, compact disc read only memory (CD ROM), compact disc-rewritable (CD-RW), digital versatile disc (DVD), Blu-ray disc (BD), any other non-transitory optical media, read-only memory (ROM), programmable read-only memory (PROM), erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), flash memory (e.g., Serial, NAND, NOR, and/or the like), multimedia memory cards (MMC), secure digital (SD) memory cards, Memory Sticks, conductive-bridging random access memory (CBRAM), phase-change random access memory (PRAM), ferroelectric random-access memory (FeRAM), non-volatile random access memory (NVRAM), magneto-resistive random access memory (MRAM), resistive random-access memory (RRAM), Silicon Oxide-Nitride-Oxide-Silicon memory (SONOS), floating junction gate random access memory (FJG RAM), Millipede memory, racetrack memory, any other memory that does not require power to store information, or any combination thereof.

[0131] In some embodiments, memory **710** is capable of storing one or more of databases, database instances, database management systems, data, applications, programs, program modules, scripts, source code, object code, byte code, compiled code, interpreted code, machine code, executable instructions, or any other information. The term database, database instance, database management system, and/or similar terms used herein may refer to a collection of records or data that is stored in a computer-readable storage medium using one or more database models, such as a hierarchical database model, network model, relational model, entity relationship model, object model, document model, semantic model, graph model, or any other model.

[0132] The user interface **715** of the computing device **700** is in communication with one or more input or output devices that are capable of receiving inputs into and/or outputting any outputs from the computing device **700**. Embodiments of input devices include a keyboard, a mouse, a touchscreen display, a touch sensitive pad, a motion input device, movement input device, an audio input, a pointing device input, a joystick input, a keypad input, peripheral device **640**, foot switch, and the like. Embodiments of output devices include an audio output device, a video output, a display device, a motion output device, a movement output device, a printing device, and the like. In some embodiments, the user interface **715** includes hardware that is configured to communicate with one or more input devices and/or output devices via wired and/or wireless connections.

[0133] The communications interface **720** is capable of communicating with various computing devices and/or networks. In some embodiments, the communications interface **720** is capable of communicating data, content, and/or any other information, that can be transmitted, received, operated on, processed, displayed, stored, and the like. Communication via the communications interface **720** may be executed using a wired data transmission protocol, such as fiber distributed data interface (FDDI), digital subscriber line (DSL), Ethernet, asynchronous transfer mode (ATM), frame relay, data over cable service interface specification (DOCSIS), or any other wired transmission protocol. Similarly, communication via the communications interface **720** may be executed using a wireless data transmission protocol, such as general packet radio service (GPRS), Universal Mobile Telecommunications System (UMTS), Code Division Multiple Access 2000 (CDMA2000), CDMA2000 1X (1xRTT), Wideband Code Division Multiple Access (WCDMA), Global System for Mobile Communications (GSM), Enhanced Data rates for GSM Evolution (EDGE), Time Division-Synchronous Code Division Multiple Access (TD-SCDMA), Long Term Evolution (LTE), Evolved Universal Terrestrial Radio Access Network (E-UTRAN), Evolution-Data Optimized (EVDO), High Speed Packet Access (HSPA), High-Speed Downlink Packet Access (HSDPA), IEEE 802.11 (WiFi), WiFi Direct, 802.16 (WiMAX), ultra wideband (UWB), infrared (IR) protocols, near field communication (NFC) protocols, Wibree, Bluetooth protocols, wireless universal serial bus (USB) protocols, or any other wireless protocol.

[0134] As will be appreciated by those skilled in the art, one or more components of the computing device **700** may be located remotely from other components of the computing device **700** components, such as in a distributed system. Furthermore, one or more of the components may be combined and additional components performing functions described herein may be included in the computing device **700**. Thus, the computing device **700** can be adapted to accommodate a variety of needs and circumstances. The depicted and described architectures and descriptions are provided for exemplary purposes only and are not limiting to the various embodiments described herein.

[0135] Embodiments described herein may be implemented in various ways, including as computer program products that comprise articles of manufacture. A computer program product may include a non-transitory computer-readable storage medium storing applications, programs, program modules, scripts, source code, program code, object code, byte code, compiled code, interpreted code, machine code, executable instructions, and/or the like (also referred to herein as executable instructions, instructions for execution, computer program products, program code, and/or similar terms used herein interchangeably). Such non-transitory computer-readable storage media include all computer-readable media (including volatile and non-volatile media).

[0136] As should be appreciated, various embodiments of the embodiments described herein may also be implemented as methods, apparatus, systems, computing devices, and the like. As such, embodiments described herein may take the form of an apparatus, system, computing device, and the like executing instructions stored on a computer readable storage medium to perform certain steps or operations. Thus, embodiments described herein may be implemented entirely in hardware, entirely in a computer program product, or in an embodiment that comprises combination of computer program products and hardware performing certain steps or operations.

[0137] Embodiments described herein may be made with reference to block diagrams and flowchart illustrations. Thus, it should be understood that blocks of a block diagram and flowchart illustrations may be implemented in the form of a computer program product, in an entirely hardware embodiment, in a combination of hardware and computer program products, or in apparatus, systems, computing devices, and the like carrying out instructions, operations, or steps. Such instructions, operations, or steps may be stored on a computer readable storage medium for execution buy a processing element in a computing device. For example, retrieval, loading, and execution of code may be performed sequentially such that one instruction is retrieved, loaded, and executed at a time. In some exemplary embodiments, retrieval, loading, and/or execution may be performed in parallel such that multiple instructions are retrieved, loaded, and/or executed together. Thus, such embodiments can produce specifically configured machines performing the steps or operations specified in the block diagrams and flowchart illustrations. Accordingly, the block diagrams and flowchart illustrations support various combinations of embodiments for performing the specified instructions, operations, or steps.

[0138] For purposes of this disclosure, terminology such as "upper," "lower," "vertical," "horizontal," "inwardly," "outwardly," "inner," "outer," "front," "rear," and the like, should be construed as descriptive and not limiting the scope of the claimed subject matter. Further, the use of "including," "comprising," or "having" and variations thereof herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Unless limited otherwise, the terms "connected," "coupled," and "mounted" and variations thereof herein are used broadly and encompass direct and indirect connections, couplings, and mountings. Unless stated otherwise, the terms "substantially," "approximately," and the like are used to mean within 5% of a target value.

[0139] The principles, representative embodiments, and modes of operation of the present disclosure have been described in the foregoing description. However, aspects of the present disclosure which are intended to be protected are not to be construed as limited to the particular embodiments disclosed. Further, the embodiments described herein are to be regarded as illustrative rather than restrictive. It will be appreciated that variations and changes may be made by others, and equivalents employed, without departing from the spirit of the present disclosure. Accordingly, it is expressly intended that all such variations, changes, and equivalents fall within the spirit and scope of the present disclosure, as claimed.

What is claimed is:

1. A packaging system comprising:

a conveyance system configured to convey objects through the packaging system, wherein the objects include a preceding object and a following object;

a package forming system configured to feed a packaging material to form an interior space bounded by the packaging material, wherein the conveyance system configured to convey the objects into the interior space bounded by the packaging material;

one or more infeed sensors configured to detect heights and longitudinal lengths of the objects as the objects are conveyed by the conveyance system;

a computing device configured to:

receive signals from the one or more infeed sensors indicative of the height and the longitudinal length of each of the preceding object and the following object,

determine a spacing between the preceding object and the following object based at least in part on the height and the longitudinal length of each of the preceding object and the following object, and

cause the conveyance system to insert the preceding object and the following object into the interior space bounded by the packaging material such that the preceding object and the following object are spaced apart based on the determined spacing; and

a sealing mechanism configured to seal the packaging material around each of the preceding object and the following object, including being configured to form a transverse seal in the packaging material between the preceding object and the following object.

2. The packaging system of claim **1**, wherein the transverse seal in the packaging material includes a trailing edge seal and a leading edge seal.

3. The packaging system of claim **2**, wherein the sealing mechanism is configured to cut the packaging material between the trailing edge seal and the leading edge seal.

4. The packaging system of claim **3**, wherein the cut of the packaging material between the trailing edge seal and the leading edge seal severs a package around the preceding object from the packaging material in which the following object is located.

5. The packaging system of claim **1**, wherein the conveyance system comprises:

an infeed conveyor configured to receive the objects, wherein the objects are non-uniformly spaced when they are received by the infeed conveyor.

6. The packaging system of claim **5**, wherein the conveyance system further comprises:

an infeed spacing conveyor configured to receive the objects from the infeed conveyor and to convey the objects by the one or more infeed sensors.

7. The packaging system of claim **1**, wherein the conveyance system comprises:

an object conveyor configured to support the packaging material and the objects located in the interior space bounded by the packaging material.

8. The packaging system of claim **1**, wherein the conveyance system comprises:

a discharge conveyor configured to convey the package around the preceding object after the package has been severed from the packaging material.

9. The packaging system of claim **1**, wherein the one or more infeed sensors are configured to generate signals indicative of the detected heights of the objects as the objects, wherein the signals indicative of the detected heights include at least one of:

an indication whether any portion of one of the objects exceeds a predetermined height,

an indication of a height of a leading edge of one of the objects,

an indication of a height of a trailing edge of one of the objects,

an indication of a height profile of one of the objects.

10. The packaging system of claim **1**, further comprising:

a longitudinal sealer configured to form a longitudinal seal in the packaging material, wherein the longitudinal seal closes a longitudinal edge of the package around the preceding object.

11. The packaging system of claim **1**, wherein the packaging material is multilayered and include an outer layer adapted to be heat sealed to seal the packaging material to itself.

12. The packaging system of claim **1**, further comprising:

a downstream package handling system configured to receive packages severed from the packaging material and to selectively route each of the packages to one of a plurality of package destinations.

13. The packaging system of claim **12**, wherein the plurality of package destinations comprises:

a first bin designated to hold packages to be shipped by a first shipping company; and

a second bin designated to hold packages to be shipped by a second shipping company.

14. The packaging system of claim **13**, wherein the plurality of package destinations further comprises:

a third bin designated to hold packages that are deemed to be flawed.

15. The packaging system of claim **12**, wherein the downstream package handling system includes one or more routing elements configured to selectively route the each of the packages to one of the plurality of package destinations.

16. The packaging system of claim **15**, wherein the one or more routing elements includes at least one of: a set of directional rollers, a conveyor belt, a door, or a robotic arm.

17. The packaging system of claim **12**, wherein the downstream package handling system is configured to receive signals from the computing device indicative of the one of the plurality of package destinations to which each of the packages is to be routed.

18. The packaging system of claim **1**, further comprising:

a labeling mechanism configured to print or place labels on the packages.

19. The packaging system of claim **18**, wherein the labels include at least one of human-readable information or machine-readable information.

20. The packaging system of claim **18**, wherein the labels include shipping information for the packages.

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