APPARATUS AND SYSTEM FOR PREPARING EARS OF CORN FOR AUTOMATED HANDLING, POSITIONING AND ORIENTING

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ABSTRACT
An apparatus and system for automated handling, positioning and orienting of an ear of corn includes apparatuses and systems for altering a portion of an ear of corn. Optionally included are one or more stations for automatically processing, testing, sampling and preparing the ear of corn for processing, testing or sampling and an automated transport means automatically moving ears of corn from station to station using alterations made to the ear of corn.
APPARATUS AND SYSTEM FOR PREPARING EARS OF CORN FOR AUTOMATED HANDLING, POSITIONING AND ORIENTING

RELATED APPLICATIONS


FIELD OF THE INVENTION

[0002] The present invention relates to handling, positioning and orienting ears of corn. More particularly, the present invention relates to automated, high-throughput apparatuses and systems for altering ears of corn to provide for automated handling, positioning and orienting of the ear.

BACKGROUND

[0003] Apparatuses and systems for handling, positioning and/or orienting ears of corn for sampling purposes have been predominantly accomplished using manual techniques. Most manual techniques require unnecessary amounts of human involvement, which invariably limits the overall efficiency of the process. As companies try to conserve resources, time, money and manpower, techniques for automating processes otherwise performed manually are of increasing importance.

[0004] As more and more corn sampling methods and processes are automated, what is needed is an efficient and high-throughput handling, positioning and orienting apparatus and system for an ear of corn.

[0005] Therefore, it is a primary object, feature, or advantage of the present invention to improve over the state of the art.

[0006] It is a further object, feature, or advantage of the present invention to provide an apparatus and system for high-throughput handling, positioning and orienting of an ear of corn.

[0007] Another object, feature, or advantage of the present invention is to provide for an easy and safe apparatus and system for preparing an ear of corn for automated handling, positioning and orienting.

[0008] A still further object, feature, or advantage of the present invention is to provide apparatuses and systems for preparing an ear of corn for being handled, positioned and oriented in automated ear preparation and sampling processes.

[0009] Yet another object, feature, or advantage of the present invention is to provide an apparatus and system for preparing an ear of corn for being handled, positioned and oriented by automation.

[0010] A still further object, feature, or advantage of the present invention is to provide an apparatus and system for preparing an ear of corn for being handled, positioned and oriented by automation that automatically accounts for size and shape differences between each ear of corn.

[0011] Yet another object, feature, or advantage of the present invention is to provide an apparatus and system for preparing an ear of corn for being handled, positioned and oriented by automation which is user friendly, and safe to operate.

[0012] A still further object, feature, or advantage of the present invention is to provide an apparatus and system for preparing an ear of corn for being handled, positioned and oriented by automation which can be operated and performed by a single operator.

[0013] These and/or other objects, features, or advantages of the present invention will become apparent. No single embodiment of the present invention need achieve all or any particular number of the foregoing objects, features, or advantages.

BRIEF SUMMARY

[0014] The invention generally provides an automated apparatus and system for preparing an ear of corn for being handled, positioned and/or oriented by one or more automated processes.

[0015] According to one aspect of the present invention, a system for automated handling, positioning and/or orienting of an ear of corn is disclosed. The system includes a station for altering a portion of an ear of corn. The station includes altering means for removing tissue from or appending material to the ear of corn to provide for automated handling, positioning and/or orienting of the ear of corn. The system may also include one or more stations automatically processing, testing, sampling and/or preparing the ear of corn for processing, testing and/or sampling. The system may also include transport means for automatically moving ears of corn from station to station. The transport means uses the altered portion of the ear of corn to handle, position and orient the ear of corn at and/or between the stations.

[0016] According to another aspect of the present invention, an apparatus for preparing an ear of corn for being handled, positioned and oriented by automation is disclosed. The apparatus includes a station for altering an ear of corn, holding means adapted for keeping the ear of corn in a desired position and orientation, and altering means. The altering means includes a tissue removal device having tissue removal means or a material appendage device having material appendage means for preparing a portion of the ear of corn to provide for automated handling, positioning and/or orienting of the ear of corn.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 is a perspective view of the apparatus.

[0018] FIG. 2 is a front view of the apparatus.

[0019] FIG. 3 is a side view of the apparatus.

[0020] FIG. 4 is a cut away side view of the interior of the apparatus.

[0021] FIG. 5 is a perspective view of a system using the apparatus shown in FIG. 1 according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0022] The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses. For a better understanding of the invention, several exemplary embodiments will now be described in detail. Reference will be taken from time to time to the appended drawings. Reference numerals will be used to indicate certain parts or locations in the drawings. These same reference numerals will indicate the same parts or locations throughout the drawings, unless otherwise indicated.
Apparatus

[0023] The present invention discloses, in one aspect, an apparatus for preparing an ear of corn for being handled, positioned and oriented by automation. One embodiment of apparatus 10 is shown in FIG. 1. Apparatus 10 may be in the form of a station having at least the ability to alter an ear of corn for being handled, positioned and oriented by automation. Apparatus 10 may be partially or fully enclosed within cabinet 12; alternatively, a frame or other supporting members may be fashioned, alone or in combination with another system for holding the various components of apparatus 10. In a preferred form, apparatus 10 includes some holding means adapted for keeping the ear of corn in a desired position and orientation. The holding means may be full or semi-automated holding means. The present invention contemplates that the holding means could include any type of mechanical device that applies positive pressure to the ear of corn to keep the ear of corn in a desired position and orientation. Such mechanical devices may include grips, clamps, iris, a chuck, an expandable bladder or any other mechanical means for gripping or holding an ear of corn by the shank or some other portion of the ear. Other holding means are contemplated herein, such as pneumatic devices that generate a negative pressure (i.e., a vacuum) to keep the ear of corn in a desired position and orientation. One example of a pneumatic holding means is illustrated in FIGS. 1-3, which show a conofrustrical recess 20. Recess 20 is in operable communication with a vacuum to provide negative pressure or a vacuum force at the conofrustrical recess 20 for retaining the ear of corn 16 in a desired position and orientation. Contemplation has also been given to holding means, such as support device that includes one or more support members for resting the ear of corn thereon. For example, pins, tubing or other guide members could be used to orient and keep the ear of corn in a desired position or orientation at apparatus 10 during altering. In the preferred form, the holding means provides for automated high-throughput positioning and orienting of ears of corn at apparatus 10.

[0024] According to a preferred form of the present invention, apparatus 10 also includes altering means. Generally, the altering means provides some automated alteration of the ear of corn to allow for automated handling, positioning and orienting of the ear of corn. The altering means may be configured to alter each ear of corn by appending material to or removing material (tissue) from the ear of corn. For example, a tissue removal device having tissue removal means may be used for preparing a portion of the ear of corn to provide for automated handling, positioning and/or orienting of the ear of corn. Alternatively, a material appendage device having material appendage means may be used for preparing a portion of the ear of corn to provide for automated handling, positioning and/or orienting of the ear of corn. Depending on the desired type of alteration, apparatus 10 may include one or both types of altering means. In the case where apparatus 10 includes tissue removal means, contemplation is given in the present invention to an automated scraping tool having one or more edges for scraping material from the ear of corn, an automated erosion tool having one or more liquid jets for eroding material from the ear of corn, or an automated cutting tool having one or more blades for cutting material from the ear of corn. In the case where material, such as ear tissue, is removed from the ear of corn, any of the aforementioned concepts may be used to create a hole or void in the ear of corn or clear tissue from a portion of the ear to provide a spot for holding the ear of corn. Boring a hole in the shank of the ear of corn or removing tissue (i.e., kernels) from the ear of corn may be accomplished specifically by using a drill bit, router bit, forstner bit, hollow boring tube, liquid jet cutter, or chisel. According to one aspect of the present invention, a pneumatically actuated drill (see FIG. 4) may be used to create a hole in the shank of the ear of corn. In the case where material is being appended to an ear of corn, apparatus 10 may include an automated device adapted to append a member or material to the ear of corn to provide for automated positioning, handling and/or orienting of the ear of corn using the appended material or member. Various types of materials or members could be appended to the ear of corn whereby some automated system could use the appended materials or members to position, handle and/or orient the ear of corn. Materials such as magnetically active coatings could be applied to a portion of the ear of corn (i.e., the shank portion) whereby an automated process or system uses the coating to grip or hold onto the ear of corn. Alternatively, rigid structural members such as spindle, post, nail, or screw could be inserted into a portion of the ear of corn whereby some automated system could use the member to position, handle and/or orient the ear of corn. For example, an automated drill or impacting device could be used to append such members as a post, spindle, screw or nail to the ear of corn. In a preferred form of the present invention, the altering means is actuated into the holding means. For example, as shown in FIGS. 1-4, drill 30 is actuated by piston 32 to engage ear of corn 16. The present invention also contemplates that the holding means could be actuated into the altering means.

[0025] As shown in FIG. 5, apparatus 10 may be used in combination with an automated system or process such as the “High Throughput Automated Apparatus, Method and System for Coating Ears of Corn” as shown and described in Provisional Application Ser. No. 61/090,579, filed Aug. 22, 2008, which application is assigned to the owner of the present application and incorporated by reference herein in its entirety. Automated system 100 may be configured for processing, testing or sampling the ear of corn. System 100 may also be configured for preparing the ear of corn for processing, testing or sampling. In the preferred configuration, automated system 100 would include some type of ear moving means for moving and/or positioning corn at and between stations. Alterations made to the ear of corn are configured to work in concert with the moving means, such as for example, where the ear moving means includes one or more features adapted to make use of the cavity, added material or appended structure to handle, position and/or orient the ear of corn by automation.

[0026] FIGS. 1-5 illustrate one exemplary embodiment configured to accomplish one or more of the objects, features or advantages of the present invention. FIG. 1 is a perspective view of apparatus 10 configured to alter an ear of corn 16 by tapping a hole into a portion of the ear of corn 16. The apparatus 10 generally comprises a cabinet 12 upon which is mounted a control panel 40 and includes holding means, such as a conofrustrical recess 20 having a drill cuttings suction port 22. Within the interior of the cabinet 12, as shown in FIG. 4, is a tissue removal means, such as a drill 30 for drilling ear of corn 16 and piston 32 for advancing drill 30 and bit 36 into the shank or cob of ear of corn 16. The present invention also contemplates that the ear of corn 16 could be moved into contact with drill 30.
[0027] The conofrustical recess 20 has a cropped cone shape, as best shown in FIGS. 2 and 3, for self-centering of the ear of corn 16 relative to drill 30. The drill cuttings suction port 22, as shown in FIG. 3, is in operative communication with the conofrustical recess 20 so that suction is provided at the drill cuttings suction port 22 the pressure differential is communicated to the conofrustical recess 20, thereby holding the ear of corn 16 in place. The drill cuttings suction port 22 removes cuttings and other debris from the conofrustical recess 20 as it is removed from the ear of corn 16 during the drilling process. The present invention is not limited to vacuum assisted retention of the ear of corn 16 within the conofrustical recess 20. The present invention contemplates that other holding means could be used, such as any one of the holding means discussed previously. For example, holding means may include positive-pressure, self-adjusting grips that would secure the ear of corn 16 by gripping the shank. Other considerations include, but are not limited to, counter screws for screwing into the shank or cob of the ear of corn 16 for securing the ear or an inflatable bladder within the conofrustical recess that surrounds and captures the shank of the ear of corn 16 when set in the conofrustical recess 20.

[0028] Also on cabinet 12 is a control panel 40, as shown in FIG. 2. Most importantly, the control panel includes a main disconnect 42 and a free hand safety switch 44. Additionally, a light sensor (not shown) in operative communication with the control panel may be included in the conofrustical recess 20 at the appropriate depth to ensure that the ear of corn 16 is seated properly within the conofrustical recess 20 before engaging the drill 30 or allowing the drill 30 and bit 36 to be advanced into the shank of the ear of corn 16. The sensor and free hand safety switch 44 provide adequate redundancy in safety to prevent the operator from accidentally coming into contact with drill bit 36. The control panel 40 may also include controls for adjusting the drilling speed and depth of the tap into the ear of corn 16. The main disconnect 42 is necessarily present so that power to the system can be disengaged for safety or maintenance purposes.

[0029] As shown in FIG. 4, apparatus 10 further includes a drill 30 and piston 32. The drill 30 is attached to the arm 34 of the piston so that the drill 30 and bit 36 may be raised or lowered to tap a hole into the shank of the ear of corn 16 using bit 36. Preferably, the drill 30 and piston 32 are pneumatically powered from a central power source. The rotational speed of the drill bit 36 and depth to which the ear of corn 16 is tapped (the extension of piston 32) are monitored by an operator or electronically controlled by the control panel 40. Drill 30 is preferably pneumatic (e.g., PARAMATIC self-feed drill, model no. X255-A, Winnipeg, Manitoba, Calif.) and pneumatically actuated by piston 32. Both drill 30 and piston 32 could be operated by a local or remote pneumatic pump. In the present invention, a hole is created in the shank of the ear of corn 16. Preferably, the hole in the ear of corn 16 is used for handling, positioning and/or orienting the ear of corn 16; however, the present invention contemplates that the hole created in the shank or cob of the ear of corn 16 could be used to inductate the ear of corn 16. Apparatus 10 could also be used to drill out and collect samples (the cuttings and debris) from each ear of corn 16 for testing. The apparatus 10 of the present invention could be used in combination with any automated system, such as system 100 shown in FIG. 5, for processing, testing, sampling the ear of corn 16 and/or an automated machine for preparing the ear of corn 16 for processing, testing and/or sampling.

[0030] FIG. 5 illustrates one example of apparatus 10 functioning as a subsystem or station of an automated system 100, such as the “High Throughput Automated Apparatus, Method and System for Coating Ears of Corn” as shown and described in Provisional Application Ser. No. 61/990,979, filed Aug. 22, 2008, which application is assigned to the owner of the present application and incorporated by reference herein in its entirety. FIG. 5 illustrates but one embodiment of apparatus 10 functioning as a subsystem or station of an automated system. One purpose of apparatus 10, as can be seen from FIG. 5, is to prepare the ear of corn 16 for processing, testing and/or sampling by automation. Apparatus 10 may also be used in combination with one or more automated systems for processing, testing, sampling the ear of corn 16. By way of example, automated system 100 shown in FIG. 5 may include one or more types of automated transport means 102 for automatically moving ears of corn 16 from one processing station 104 to another processing station 106. The automated transport means 102 may also be used to provide automated positioning, handling and/or orientation of the ear of corn 16 to facilitate processing of the ear of corn 16 at each processing station 104, 106. The present invention contemplates that the automated transport means 102 could be any type of shuttle, carriage, or conveyor, such as a chain-on-edge conveyor chain or drive 110 shown in FIG. 5. The chain-on-edge conveyor chain or drive 110 may include, for example, vertically oriented posts or spindles 108 intermittently spaced and attached along a continuous chain or belt that is cycled through one or more stations, such as processing stations 104, 106. Processing stations 104, 106 could be any station or subsystem providing automated processing, testing, sampling and/or preparing the ear of corn 16 for processing, testing and/or sampling. The processing stations could include an automated ear coating station for coating each ear of corn 16 with a magnetically active coating, and an automated drying station for curing the coating. The present invention contemplates other coatings for applying to the ear of corn, such as fungicides. Processing stations 104, 106 could also include any station or subsystem providing automated positioning of the coated kernels for seed testing. The kernels of corn separated from the cob could be positioned within the station collectively or individually using magnetic attenuation from a magnetic source. Using apparatus 10, as described above, holes are drilled into the shank of each ear of corn 16. The ear of corn 16 is mounted onto the vertically oriented spindle 108 using the hole drilled in the shank. Thus, using the connection between the hole tapped in the shank of the ear of corn 16 and the vertically oriented spindle, the ear of corn 16 may be handled, oriented and positioned at and/or between stations 104, 106 by automation using transport means 102.

Method

[0031] Also disclosed by the present invention is a method for preparing an ear of corn 16 for being handled, positioned and/or orienting by automated means, including semi and fully automated processes and/or systems. Generally, the method includes providing a station for altering an ear of corn and keeping the ear of corn in a desired position and orientation at the station. In one aspect, altering the ear of corn includes one or both of the steps of removing tissue from the ear of corn to provide for automated handling, positioning and/or orienting of the ear of corn, or appending material to the ear of corn to provide for automated handling, positioning and/or orienting
of the ear of corn 16. Steps contemplated for removing tissue include, but are not limited to, scraping tissue from the ear of corn, eroding tissue from the ear of corn, or cutting tissue from the ear of corn. In the case where material, such as ear tissue, is removed from the ear of corn, any of the aforementioned concepts may be used to create a hole or void in the ear of corn or clear tissue from a portion of the ear to provide a spot for holding the ear of corn. Boring a hole in the shank of the ear of corn or removing tissue (i.e., kernels) from the ear of corn may be accomplished specifically by using a drill bit, router bit, forstner bit, hollow boring tube, liquid jet cutter, or chisel. According to one aspect of the present invention, a pneumatically actuated drill 30 (see FIG. 4) may be used to create a hole in the shank of the ear of corn 16. In the preferred method, the present invention provides for automated handling, positioning and/or orienting the ear of corn using the hole created in the ear of corn 16. Tissue extracted or removed from the ear of corn 16 may be evacuated from the station using a vacuum in operative communication with the means for holding the ear of corn or the means for removing/extracting tissue from the ear of corn. In the case where material is being appended to an ear of corn, the method may include an automated device adapted to append a member or material to the ear of corn to provide for automated positioning, handling and/or orienting of the ear of corn using the appended material or member. Various types of materials or members could be appended to the ear of corn whereby some automated system could use the appended materials or members to position, handle and/or orient the ear of corn. Materials such as magnetically active coatings could be applied to a portion of the ear of corn (i.e., the shank portion) whereby an automated process or system uses the coating to grip or hold onto the ear of corn. Alternatively, rigid members or devices such as spindle 108, post, nail, or screw could be inserted into a portion of the ear of corn whereby some automated system could use the rigid member or device to position, handle and/or orient the ear of corn. Automated means for appending, inserting, applying or connecting such materials as a magnetically active coating and/or rigid members or devices such as a screw, post, spindle or nail may be used for manipulating the ear of corn at each station. Methods contemplated for keeping the ear of corn in the desired position and orientation at the station include, but are not limited to, supporting, gripping, holding, stabilizing or retaining the ear of corn to keep the ear of corn in a desired position and orientation at the station and relative to the altering means. One method for keeping the ear of corn in the desired position and orientation at the station may include exposing a portion of the ear of corn (i.e., the shank portion) to positive or negative pressure or forces. Keeping the ear of corn in the desired position and orientation may include positive pressure mechanical devices such as grips, clamps, irises, a chuck, an expandable bladder or any other mechanical means for gripping or holding an ear of corn by the shank or some other portion of the ear. Negative pressure or vacuum pressure may also be used to keep the ear of corn in a desired position and orientation. One example of a pneumatic holding means is illustrated FIGS. 1-3, which show a conofrustral recess 20. Recess 20 is in operable communication with a vacuum to provide negative pressure or a vacuum force at the conofrustral recess 20 for retaining the ear of corn 16 in a desired position and orientation. Contemplation has also been given to holding means, such as support device that includes one or more support members for resting the ear of corn thereon. For example, rails, tubing or other guide members could be used to orient and keep the ear of corn in a desired position and orientation at apparatus 10 during altering. In the preferred form, the holding means as best illustrated in FIGS. 1-3 provides automated high-throughput positioning and orienting of ears of corn to help facilitate an alteration process whereby tissue is removed or material is appended to the ear of corn 16 to provide for automated handling, positioning and/or orienting of the ear of corn 16.

[0032] As shown in FIG. 5, methods of the present invention may be used in combination with an automated system or process. Automated system 100 may be configured for processing, testing or sampling an ear of corn 16. System 100 may also be configured for preparing the ear of corn 16 for processing, testing or sampling. In the preferred configuration, automated system 100 would include some type of ear moving means 102 for moving and positioning corn at and between one or more work or processing stations 104 and 106. Alterations made to the ear of corn 16 are configured to work in concert with the moving means 102, such as for example, where the ear moving means 102 includes one or more features adapted to make use of the cavity, added material or appended structure to handle, position and/or orient the ear of corn 16 by automation.

[0033] FIGS. 1-5 illustrate exemplary methods configured to accomplish one or more of the objects, features or advantages of the present invention. The method includes using apparatus 10 for tapping a hole into the shank or cob portion of an ear of corn 16. Apparatus 10 generally comprises a cabinet 12 upon which is mounted a control panel 40 and a conofrustral recess 20 having a drill cuttings suction port 22. Within the interior of the cabinet 12, as shown in FIG. 4, is a drill 30 for drilling ear of corn 16 and piston 32 for advancing bit 36 into the shank or cob of each of corn 16.

[0034] The conofrustral recess 20 has a cropped cone shape, as best shown in FIGS. 2 and 3, for auto-centering the ear of corn 16 relative to drill 30. The drill cuttings suction port 22, as shown in FIG. 3, is in operative communication with the conofrustral recess 20 so that as suction is provided at the drill cuttings suction port 22 the pressure differential is communicated to the conofrustral recess 20 thereby holding the ear of corn 16 in place using vacuum. The drill cuttings suction port 22 removes cuttings and other debris from the conofrustral recess 20 as it is removed from the ear of corn 16 during the drilling process.

[0035] One exemplary method of the present invention for preparing an ear of corn 16 for being handled, positioned and oriented by automation includes inserting an ear of corn 16 shank first into the conofrustral recess 20 for auto-centering the ear of corn 16 relative to the drill 30, retaining the ear of corn 16 within the conofrustral recess 20 by vacuum, and automatically advancing the drill 30 and bit 36 into the shank of the ear of corn 16 for tapping a hole in the shank of the ear of corn 16. The method also includes pneumatically actuating and advancing the drill 30 into the conofrustral recess 20 for tapping the hole in the shank or cob portion of each ear of corn 16. Pneumatic advancement of drill 30 is provided by pneumatic piston 32 that is operated by a local or remotely positioned source, such as a compressor. Pneumatic piston 32 is of the type that is commercially available. Drill 30 is preferably a pneumatic drill (e.g., PAR-A-MATIC self-feed drill, model no. 8255-A, Winnipeg, Manitoba, Calif.). Although a pneumatic drill is preferred, the present invention contemplates substitution of other boring devices, such as an electric or
hydraulic drill or impacting device, and including those previously described. Activating the free-hand safety switch 44 and tripping the sensor allows activation and advancement of the drill 30 and bit 36 into the shank of the ear of corn 16. The sensor (not shown) is tripped by inserting the ear of corn 16 into the conoformal recess 20, which in-turn activates drill cuttings suction port 22, which by vacuum pressure helps retain the ear of corn 16 within the conoformal recess 20 and evacuates cuttings from the drill 30 passing into the shank of the ear of corn 16. In one embodiment, vacuum pressure supplied to the conoformal recess 20 is continuously on, but at a pressure that allows manual or automated placement and removal of the ear of corn 16. In an alternative embodiment, drill 30 cycles and the vacuum pressure supplied to the conoformal recess 20 is turned off which allows the operator to remove the ear of corn 16 from the conoformal recess 20 without the opposing vacuum force acting on the ear of corn 16. The method of preparing an ear of corn 16 for being handled, positioned and oriented by automation could be in combination with an automated machine or system for testing, sampling and/or preparing the ear of corn 16 for testing and/or sampling. The automated machine, such as automated system 100 shown in FIG. 5, may include a chain-on-edge conveyor spindle or drive 110 wherein the ear of corn 16 is automatically handled, positioned and oriented by insertion of the spindle 108 into the hole in the shank of the ear of corn 16.

[0036] It should be appreciated that by using one method of the present invention, material removed or extracted from the ear of corn, such as for example where a hole is drilled in the shank of the ear, allows the ear of corn 16 to be handled, positioned and/or oriented in a high-throughput system, which in-turn allows for testing, sampling and/or preparing the ear of corn 16 for testing and/or sampling. In one aspect, this could include the high-throughput system having an automated transport means 102, such as for example an automated transport means 102 having a spindle 108 for handling, positioning and/or orienting the ear of corn 16 by impaling the ear of corn 16 on the spindle 108 using the hole in the shank of the ear of corn 16. In the case where material is appended to the ear of corn 16, automated transport means 102 may be configured to grip or hold the material, such as a post or spindle, attached to the ear of corn 16. The automated transport means 102 may be configured to pass the ears of corn 16 through one or more processing stations 104, 106. These stations 104, 106 could include any station or subsystem providing automated processing, testing, and sampling of the ear of corn 16, as well as any station or subsystem adapted for preparing the ear of corn 16 for processing, testing and/or sampling. As shown and described in Provisional Application Ser. No. 61/090,979, filed Aug. 22, 2008, entitled “High Throughput Automated Apparatus, Method and System for Coating Ears of Corn,” processing stations 104, 106 could include an automated ear coating station for coating each ear of corn 16 with a magnetically active coating and an automated drying station for curing the coating. Processing stations 104, 106 could also include any station or subsystem providing automated positioning of the coated kernels for seed testing. The identification of each ear of corn 16 could be tracked individually or collectively. For example, one ear of corn 16 in each batch being processed could receive an identification tag for identifying the entire batch. Alternatively, each ear of corn 16 could be individually tagged for providing identification of each ear of corn 16 during processing or preparing the ear of corn 16 for processing.

System

[0037] Also disclosed by the present invention is a system for automated handling, positioning and/or orienting of an ear of corn 16. The system for automated handling, positioning and/or orienting of an ear of corn includes a station for altering a portion of an ear of corn and altering means for removing tissue from or appending material to the ear of corn 16 to facilitate automated handling, positioning and/or orienting of the ear of corn. The system 100 may include one or more stations automatically processing, testing, sampling and/or preparing the ear of corn for automated processing, testing and/or sampling. Transport means 102 may also be provided for automatically moving ears of corn 16 from station to station (see generally 104 and 106). The transport means 102 is configured for using the altered portion of the ear of corn to handle, position and orient the ear of corn at and between stations 104 and 106. In a preferred form, the altering means of the system 100 includes, but is not limited to, material removal means operatively supported at the station, holding means for positioning and orienting the ear of corn relative to the material removal means, and actuation means for removing said holding means or material removal means for removing tissue from the portion of the ear of corn. The system contemplates altering means having material appending means operatively supported at the station, holding means for positioning and orienting the ear of corn relative to the material appending means, and actuation means for moving the holding means or material appending means for appending material to a portion of the ear of corn 16. The system may include any semi- or fully-automated station adapted for processing, testing or sampling the ear of corn and/or preparing the ear of corn for processing, testing and/or sampling. Moving ears of corn at and between stations of system 100 could be accomplished by transport means, such as a shuttle, a carriage or a conveyor. One type of conveyor is shown in FIG. 5, such as a chain-on-edge conveyor spindle or drive 102.

[0038] FIG. 5 illustrates an exemplary system of the present invention. One example of the system includes apparatus 10 for automatically tapping a hole in the shank of the ear of corn 16, one or more stations 104, 106 for automatically processing, testing, sampling and/or preparing the ear of corn 16 for processing, testing and/or sampling, and some automated transport means 102 for automatically moving ears of corn 16 from station to station 104, 106. In the preferred form, the automated transport means 102 uses alternations made to the ear of corn 16, such as a hole tapped in the shank of the ear of corn 16 to handle, position and orient the ear of corn 16 at and between stations 104, 106. The system includes apparatus 10 as described above. Apparatus 10 includes, but is not limited to, a drill 30 operatively supported within a cabinet 12, a conoformal recess 20 at the cabinet 12 and adapted for auto-centering the ear of corn 16 relative to the drill 30, a vacuum assist system in operative communication with the conoformal recess 20 for retaining the ear of corn 16 by vacuum pressure, and some actuation means for advancing the drill 30 and bit 36 into the shank of the ear of corn 16 for tapping a hole in the shank of the ear.

[0039] The present invention contemplates that the system 100 may include one or more processing stations 104, 106 through which automated transport means 102 passes. The stations 104 and 106 may include any station or subsystem
providing automated processing, testing, and sampling of the ear of corn. Stations 104 and 106 could also be configured to prepare the ear of corn for processing, testing and/or sampling. Processing stations 104, 106 could include an automated ear coating station for coating each ear of corn with a magnetically active coating and an automated drying station for curing the coating. Processing stations 104, 106 could also include any station or sub-system providing automated positioning of the coated kernels for seed testing, such as shown and illustrated in the application Ser. Nos. 12/336,084 and 11/939,402, filed Dec. 16, 2008 and Nov. 13, 2007, respectively, which applications are assigned to the owner of the present application and are incorporated by reference herein in their entirety. The automated transport means 102 could include a shuttle, a carriage or a conveyor such as a chain-on-edge conveyor spindle or drive 110. Using the hole prepared in the shank of the ear of corn 16, the automated transport means 102 handles, orients and positions the ear of corn 16 as needed for each of the processes occurring at stations 104, 106. For example, the automated transport means 102 may be a chain-on-edge conveyor spindle 110 as shown in FIG. 5. Each ear of corn 16 is impaled onto a spindle 108 by inserting the spindle 108 into the hole in the shank of the ear of corn 16. The ear of corn 16 is then shuttled through various types of processing stations 104, 106 of the system 100 for preparing or testing the ear of corn 16 and/or kernels on the ear of corn 16. These processing stations could include stations 104, 106 that prepare each ear of corn 16 for automated seed sampling processes, such as for example, where each kernel of corn is magnetically oriented by magnetic attenuation using a magnetically active coating applied to and cured on the crown of each kernel using stations 104, 106. In the case where material or some member is appended to the ear of corn 16, such as a post, nail, screw, hook, spindle or other rigid structural member, provisions may be configured into the transport means for working in cooperation with the appended material or member for providing automated handling, positioning and/or orienting the ear. For example, in the case where a post is appended to the ear of corn, the automated transport means 102 may include a socket adapted to receive the post to provide handling, positioning and orienting of the ear 16 by automation.

The embodiments of the present invention have been set forth in the drawings and specification and although specific terms are employed, these are used in a generically descriptive sense only and are not used for purposes of limitation. Changes in the formed portion of parts, as well as any substitutions of equivalences are contemplated as circumstances may suggest or are rendered expedient without departing from the spirit and scope of the invention as further defined in the following claims.

What is claimed is:

1. A system for automated handling, positioning and orienting an ear of corn comprising:
   a station for altering a portion of an ear of corn;
   altering means for removing tissue from or appending material to the ear of corn to provide for automated handling, positioning and orienting of the ear of corn;
   one or more stations automatically processing, testing, sampling or preparing the ear of corn for processing, testing or sampling;
   transport means automatically moving ears of corn from station to station; and
   said transport means using said altered portion of the ear of corn to handle, position and orient the ear of corn.

2. The system of claim 1 wherein the altering means comprises:
   a material removal means operatively supported at the station;
   b. holding means for positioning and orienting the ear of corn relative to the material removal means; and
   c. actuation means for moving said holding means or material removal means for removing tissue from a portion of the ear of corn.

3. The system of claim 1 wherein the altering means comprises:
   a. material appending means operatively supported at the station;
   b. holding means for positioning and orienting the ear of corn relative to the material appending means; and
   c. actuation means for moving said holding means or material appending means for appending material to a portion of the ear of corn.

4. The system of claim 1 wherein the one or more stations comprise:
   a. stations adapted for processing, testing or sampling the ear of corn;
   or
   b. stations adapted for preparing the ear of corn for processing, testing or sampling.

5. The system of claim 1 wherein the transport means comprises:
   a. a shuttle;
   b. a carriage; or
   c. a conveyor;

6. The system of claim 1 wherein the transport means comprises a chain-on-edge conveyor spindle.

7. An apparatus for preparing an ear of corn for being handled, positioned and orienting by automation, the apparatus comprising:
   a. a station for altering an ear of corn;
   b. holding means adapted for keeping the ear of corn in a desired position and orientation at the station;
   c. altering means comprising:
      a. a tissue removal device comprising tissue removal means for preparing a portion of the ear of corn to provide for automated handling, positioning and orienting of the ear of corn;
      b. a material appending device comprising material appending means for preparing a portion of the ear of corn to provide for automated handling, positioning and orienting of the ear of corn.

8. The apparatus of claim 7 wherein the holding means comprises:
   a. a mechanical device comprising a positive pressure applicator applied to the ear of corn;
   b. a pneumatic device comprising a negative pressure applicator applied to the ear of corn; or
   c. a support device comprising one or more support members for resting the ear of corn thereon.

9. The apparatus of claim 7 wherein:
   a. the holding means is actuated to bring the ear of corn into engagement with said altering means; or
   b. the altering means is actuated to engage the ear of corn held by said holding means.

10. The apparatus of claim 7 wherein said tissue removal means comprises:
a. an automated scraping tool having one or more edges for scraping tissue from the ear of corn;
b. an automated erosion tool comprising one or more liquid jets for eroding tissue from the ear of corn; or
c. an automated cutting tool comprising one or more blades for cutting tissue from the ear of corn.

11. The apparatus of claim 7 wherein said material appendage means comprises an automated device adapted to append a member or material to the ear of corn, the ear of corn positioned, handled and oriented using the appended material.

12. The apparatus of claim 7 in combination with an automated system for processing, testing or sampling the ear of corn.

13. The apparatus of claim 7 in combination with an automated system for preparing the ear of corn for processing, testing or sampling.

14. The apparatus of claim 12 wherein the automated system comprises ear moving means for moving and positioning the ear of corn at and between one or more stations of the automated system.

15. The apparatus of claim 14 wherein said ear moving means comprises one or more features adapted to make use of the cavity, added material or appended structure to handle, position and orient the ear of corn.

16. An apparatus for altering an ear of corn for being handled, positioned and oriented by conveyance means configured to use the alteration made to the ear of corn, the apparatus comprising:

a. a station for altering an ear of corn;
b. holding means adapted for keeping the ear of corn in a desired position and orientation at the station; and
c. automated altering means at the station adapted to perform an alteration on a portion of the ear of corn.

17. The apparatus of claim 16 wherein the automated altering means comprises:
a. a material extraction tool comprising material extraction means for creating a hole in a portion of the ear of corn; or
b. a material appendage tool comprising material appendage means for appending a feature to the ear of corn to provide for automated handling, positioning and orienting of the ear of corn.

18. The apparatus of claim 17 in combination with an automated system comprising conveyance means, said conveyance means comprising a post whereby an ear of corn is handled, positioned and oriented by the conveyance means by impaling the ear of corn on the post.

19. The apparatus of claim 17 in combination with a automated system comprising conveyance means, said conveyance means comprises ear securing means whereby an ear of corn is handled, positioned and oriented by the conveyance means by gripping said feature appended to the ear of corn using said ear securing means.

20. The apparatus of claim 19 wherein said feature appended to the ear of corn comprises:
a. a rigid post;
b. a hook; or
c. a magnetically active coating.