GYPSUM BOARD EXTRUSION APPARATUS AND METHOD

FIELD OF INVENTION

[0001] The present disclosure relates to gypsum board manufacturing, and more particularly to an extruder plate design and creaser wheel mechanism for controlling board surface profile and tapered edge formation during extrusion.

BACKGROUND

[0002] Gypsum board is widely used in construction for interior walls and ceilings. During manufacturing, wet gypsum slurry is extruded between a pair of forming plates—a bottom plate on the face (finished) side and a top plate on the back side—to produce boards of controlled thickness and surface profile. The boards are typically manufactured with tapered edges to facilitate joint finishing at installation sites.

[0003] In conventional gypsum board manufacturing, the bottom extruder plate is flat, while the top plate provides some adjustability to control board thickness and flatness. Taper bands, also known as moulding belts, are used to create the tapered edges on the board. These taper bands are placed on the production line and shape the board edges during the extrusion process.

[0004] One challenge in gypsum board manufacturing relates to surface defects that can occur during formation and extrusion. Such defects may manifest as slight deformations or bumps in the shoulder region of the board, which is the area located several inches inward from the paperbound edges. These surface irregularities can appear on one or both edges of the board, and their magnitude can vary along the length of the board. When boards with such surface irregularities are finished at a job site, the irregularities can cause joint compound to scrape off at the affected locations, exposing visible lines that can be difficult to conceal. Finishing over such irregularities may involve wider joint treatment and additional skimming, which can increase labor time and cost.

[0005] Conventional approaches to addressing surface irregularities in the shoulder region involve making adjustments to the top forming plate. Because these adjustments affect the back of the board rather than the face, they do not provide direct control over the finished surface profile. Such adjustments can be time-consuming and may not consistently achieve the desired results.

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[0006] Another challenge in gypsum board manufacturing relates to controlling the width of tapered edges. Conventionally, tapered edges are formed using taper bands that are placed with precise alignment on the production line. If the taper bands are misaligned, the resulting tapered edge width on the finished product may be incorrect, leading to inconsistent products across plants and production runs. Achieving and maintaining precise taper band alignment can be demanding in terms of setup time and operator skill.

[0007] Accordingly, there is a general desire for improved systems and methods for gypsum board manufacturing that address one or more of these challenges.

SUMMARY

[0008] 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 or essential 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.

[0009] According to an aspect of the present disclosure, a gypsum board extrusion apparatus is provided. The apparatus includes a bottom extruder plate configured to form a face side of a gypsum board during extrusion. The bottom extruder plate has a profiled surface with a thickness variation in a shoulder region. The profiled surface includes a ramped profile extending inward from edges of the bottom extruder plate. The ramped profile is configured to form the gypsum board with a controlled thickness variation that reduces surface irregularities in the shoulder region.

[0010] According to other aspects of the present disclosure, the apparatus may include one or more of the following features. The ramped profile may extend from approximately 2 inches to approximately 12 inches inward from each edge of the bottom extruder plate. The shoulder region may be located approximately 2 inches to approximately 8 inches inward from paperbound edges of the gypsum board. The bottom extruder plate may be dimensioned to accommodate multiple board widths. The bottom extruder plate may be constructed from stainless steel. The profiled surface may include a chrome-plated coating. The thickness at an edge region of the bottom extruder plate may differ from a thickness at a center region by approximately 0.005 inches to approximately 0.010 inches. The apparatus may further include a top extruder plate configured to form a back side of the gypsum board, wherein the top extruder plate is adjustable to complement the profiled surface of the bottom extruder plate.

[0011] According to another aspect of the present disclosure, a gypsum board manufacturing system is provided. The system includes a creaser mechanism configured to create crease lines in face paper of a gypsum board during manufacturing. The creaser mechanism includes a primary creaser configured to create an inner crease line for folding and forming an edge of the gypsum board. The creaser mechanism further includes a secondary creaser wheel positioned at a fixed distance from the inner crease line. The secondary creaser wheel is configured to create a secondary crease line in the face paper at a predetermined distance from the inner crease line to control a tapered edge width of the gypsum board.

[0012] According to other aspects of the present disclosure, the system may include one or more of the following features. The fixed distance may correspond to a desired tapered edge width. The secondary creaser wheel may be positioned approximately 2.0 inches from the inner crease line toward a field of the gypsum board. The system may further include taper bands configured to physically form tapered edges of the gypsum board, wherein the secondary crease line controls a fold location of the face paper independent of exact placement of the taper bands. The secondary creaser wheel position may be adjustable to accommodate different tapered edge widths. The system may include multiple secondary creaser wheels to provide options for different tapered edge widths. A crease depth or pressure of the secondary creaser wheel may be variable to control a degree of paper weakening. The secondary creaser wheel may be applied to one or both edges of the gypsum board.

[0013] According to another aspect of the present disclosure, a method of manufacturing gypsum board is provided. The method includes extruding gypsum slurry between a bottom extruder plate and a top extruder plate. The bottom extruder plate has a profiled surface with a ramped profile in a shoulder region. The method further includes forming a gypsum board with a controlled thickness variation in the shoulder region using the profiled surface of the bottom extruder plate.

[0014] According to other aspects of the present disclosure, the method may include one or more of the following features. The method may further include adjusting the top extruder plate to complement the profiled surface of the bottom extruder plate. The ramped profile may extend from approximately 2 inches to approximately 12 inches inward from edges of the bottom extruder plate. The method may include forming gypsum boards of multiple widths using the same bottom extruder plate.

[0015] According to another aspect of the present disclosure, a method of controlling tapered edge width in gypsum board manufacturing is provided. The method includes creating an inner crease line in face paper of a gypsum board for folding and forming an edge of the gypsum board. The method further includes creating a secondary crease line in the face paper at a fixed distance from the inner crease line using a secondary creaser wheel. The secondary crease line is positioned to control a tapered edge width of the gypsum board. The method further includes forming a tapered edge using taper bands, wherein the tapered edge width is dictated by a position of the secondary crease line.

[0016] According to other aspects of the present disclosure, the method may include one or more of the following features. The fixed distance may correspond to a desired tapered edge width. The method may include positioning the secondary creaser wheel at an adjustable distance from the inner crease line to accommodate different tapered edge widths. The method may include varying a crease depth or pressure of the secondary creaser wheel to control a degree of paper weakening.

[0017] The foregoing general description of the illustrative embodiments and the following detailed description thereof are merely exemplary aspects of the teachings of this disclosure and are not restrictive.

DETAILED DESCRIPTION

[0018] The following description sets forth exemplary aspects of the present disclosure. It should be recognized, however, that such description is not intended as a limitation on the scope of the present disclosure. Rather, the description also encompasses combinations and modifications to those exemplary aspects described herein.

[0019] The present disclosure relates to improvements in gypsum board manufacturing processes and equipment. In particular, the disclosure addresses two distinct technical challenges that arise during gypsum board extrusion and formation.

[0020] A first aspect of the disclosure relates to a profiled bottom extruder plate configured to control surface profile characteristics in a shoulder region of a gypsum board. In gypsum board manufacturing, wet gypsum slurry may be extruded between a bottom extruder plate and a top extruder plate to form boards of controlled thickness. The bottom extruder plate disclosed herein may include a profiled surface with a thickness variation designed to form the face side of the board with controlled geometry in the shoulder region. The profiled surface may include a ramped profile that extends inward from edges of the bottom extruder plate. This profiled configuration may provide direct control over the face surface of the board during extrusion, rather than relying solely on adjustments to the top extruder plate that affect the back side of the board.

[0021] A second aspect of the disclosure relates to a creaser mechanism for controlling tapered edge width in gypsum board manufacturing. Gypsum boards may be manufactured with tapered edges to facilitate joint finishing during installation. The creaser mechanism disclosed herein may include a secondary creaser wheel positioned at a fixed distance from an inner crease line used for edge formation. The secondary creaser wheel may create a secondary crease line in face paper of the gypsum board at a predetermined location. The secondary crease line may weaken the face paper at a controlled position, thereby influencing where the paper folds during tapered edge formation. This approach may provide control over tapered edge width through a mechanically fixed creaser position, rather than relying solely on precise alignment of taper bands used to physically form the tapered edges.

[0022] The two aspects disclosed herein may be implemented independently or in combination in a gypsum board manufacturing system. When used together, the profiled bottom extruder plate and the secondary creaser wheel mechanism may provide complementary control over board surface profile and tapered edge geometry.

[0023] A high shoulder defect may occur during gypsum board formation and extrusion. A high shoulder may be characterized as a slight deformation or bump on a face surface of a gypsum board. The high shoulder defect may typically occur in a shoulder region of the board, which may be located approximately 2 inches to approximately 6 inches inward from paperbound edges of the gypsum board. In some cases, the high shoulder defect may appear on one edge of the board. In other cases, the high shoulder defect may appear on both edges of the board. The magnitude of the high shoulder defect may vary along a length of the board.

[0024] The high shoulder defect may create challenges during joint finishing at installation sites. When a gypsum board having a high shoulder defect is finished at a job site, the high shoulder may cause joint compound to scrape off at a location of the bump. This scraping may expose a visible line that may be difficult to conceal. The mechanism by which the high shoulder creates the visible line may involve the finishing tool contacting the raised bump and removing joint compound at that location, leaving an exposed area that contrasts with surrounding finished surfaces.

[0025] Finishing over a high shoulder defect may require wider joint treatment compared to finishing boards without such defects. In some cases, additional skimming of a larger area may be performed to hide the visible line created by the high shoulder. These additional finishing steps may increase labor time and cost at the job site.

[0026] In conventional gypsum board manufacturing, a bottom extruder plate may be configured as a flat surface, with thickness adjustments made using a top extruder plate. Such adjustments affect the back side of the board rather than the face side. The profiled bottom extruder plate disclosed herein incorporates a machined profile into the bottom plate surface rather than using a flat configuration. The machined profile may form the face side of the gypsum board with a controlled thickness variation in a shoulder region during extrusion.

[0027] The profiled bottom extruder plate may include a profiled region extending approximately 12 inches inward from each side of the plate. The 12-inch profiled region may accommodate multiple board widths using a single plate. In some cases, the profiled region may extend from approximately 2 inches to approximately 12 inches inward from each edge of the bottom extruder plate. The extent of the profiled region may be varied based on the board widths to be manufactured. The profiled region may include a variable taper height and gradient that may be selected based on characteristics observed at a given manufacturing plant.

[0028] The profiled surface may be configured to form the gypsum board slightly thinner in a thinning zone located approximately 2 inches to approximately 8 inches inward from each paperbound edge of the gypsum board. The thickness of the board may gradually increase from the thinning zone toward a field region at the center of the board. The thinning zone may correspond to a shoulder region where surface irregularities may otherwise develop during extrusion.

[0029] The ramp profile incorporated into the bottom extruder plate may be customizable for different configurations. The ramp profile height may be varied for different board widths. The ramp profile length may be varied for different plant configurations. The ramp profile may also be varied for different slurry formulations. In some cases, the ramp profile may be machined, ground, or otherwise formed into the plate surface. The customizable ramp profile may allow the bottom extruder plate to be tailored to address specific surface profile characteristics at different manufacturing facilities.

[0030] A profiled bottom extruder plate may be constructed from 304 stainless steel material. The 304 stainless steel material may provide structural strength and corrosion resistance suitable for gypsum board manufacturing environments. In some cases, the profiled bottom extruder plate may be constructed from other stainless steel grades or metal alloys depending on manufacturing requirements and operating conditions.

[0031] The face of the profiled bottom extruder plate may be chrome-plated with a chrome coating having a thickness of approximately 0.020 inches. The chrome plating may provide wear resistance during repeated extrusion cycles. The chrome plating may also provide release properties that facilitate separation of the gypsum board from the plate surface during manufacturing. In some cases, chrome plating may be applied to extend the operational life of the profiled bottom extruder plate. In other cases, chrome plating may be omitted depending on wear requirements and release characteristics of the manufacturing process.

[0032] Surface treatments other than chrome plating may be applied to the profiled bottom extruder plate. The selection of surface treatments may depend on wear requirements at a particular manufacturing facility. The selection of surface treatments may also depend on release requirements for different slurry formulations. In some cases, surface treatments may be omitted entirely, and the profiled bottom extruder plate may be used with an untreated stainless steel surface.

[0033] The profiled surface of the bottom extruder plate may be formed using various manufacturing methods. In some cases, the profiled surface may be machined into the plate. Machining may involve removing material from the plate surface to create the ramped profile in the shoulder regions. In other cases, the profiled surface may be ground into the plate. Grinding may provide precise control over the profile dimensions and surface finish. In further cases, the profiled surface may be formed using other forming techniques such as casting, forging, or additive manufacturing methods. The selection of the manufacturing method may depend on the desired profile specifications, production volume, and available manufacturing capabilities.

[0034] The profiled bottom extruder plate may include specific dimensional characteristics that define the ramped profile in the shoulder regions. In some cases, a thickness at a location approximately 1 inch inward from an edge of the bottom extruder plate may be approximately 0.819 inches. A middle field thickness of the bottom extruder plate may be approximately 0.812 inches. The difference between the thickness at the 1-inch mark from the edge and the middle field thickness may be approximately 0.007 inches.

[0035] The approximately 0.007 inches thickness difference between the edge region and the center region may create the controlled profile that forms the gypsum board with reduced surface irregularities in the shoulder region. The ramped profile may transition gradually from the thicker edge region to the thinner middle field region. In some cases, the transition may occur over a distance of several inches inward from the edge of the bottom extruder plate.

[0036] The specific thickness dimensions may be selected based on characteristics observed at a particular manufacturing plant. In some cases, the thickness at the 1-inch mark and the middle field thickness may be varied to accommodate different slurry formulations. The thickness dimensions may also be varied to accommodate different board weights. For lighter-weight board products, the thickness dimensions may be adjusted to account for spring-back effects as gypsum foam is compressed at the extruder plate.

[0037] The profiled region may extend a distance inward from each side of the bottom extruder plate. Such distance may vary or be proportional to the actual width of the plate. For example, for a 48-inch-wide board centered on the plate, the profiled region may run approximately 6 inches from each edge of the plate. For a plant capable of manufacturing both 48 and 54” board using the same extruder plate, the profiled section should run 9” inward from each edge of the plate.

[0038] The thickness variation across the profiled surface may be formed using machining, grinding, or other forming techniques. The dimensional tolerances for the thickness measurements may be controlled during manufacturing to achieve the desired profile characteristics. In some cases, the profiled surface may be measured and verified after forming to confirm that the thickness dimensions meet specifications.

[0039] The profiled bottom extruder plate may be configured to accommodate multiple board widths using a single plate design. The profiled region may extend approximately 12 inches inward from each side of the bottom extruder plate. This 12-inch profiled zone may allow the same plate to be used for manufacturing gypsum boards of different widths.

[0040] For a 48-inch wide board centered on the profiled bottom extruder plate, the profiled region may run approximately 6 inches from each edge of the plate. When the 48-inch wide board is positioned centrally on the plate, the profiled regions on both sides of the plate may extend from the plate edges to locations approximately 6 inches inward, thereby providing the ramped profile in the shoulder regions of the board.

[0041] For a 54-inch wide board centered on the profiled bottom extruder plate, the profiled region may run approximately 9 inches from each edge of the plate. When the 54-inch wide board is positioned centrally on the plate, the profiled regions on both sides of the plate may extend from the plate edges to locations approximately 9 inches inward, thereby providing the ramped profile in the shoulder regions of the board.

[0042] The multi-width configuration may allow a single profiled bottom extruder plate to be used at manufacturing facilities that produce boards of different widths. In some cases, the profiled bottom extruder plate may be designed for a single board width. In other cases, the profiled bottom extruder plate may be designed to accommodate multiple board widths on the same plate. The selection between single-width and multi-width configurations may depend on the range of board products manufactured at a particular facility.

[0043] The 12-inch profiled zone dimension may be selected to provide sufficient coverage for common board widths while maintaining the controlled thickness variation in the shoulder regions. In some cases, the extent of the profiled region may be varied based on the specific board widths to be manufactured. The profiled region dimensions may be customized during plate design to match the production requirements at a given manufacturing plant.

[0044] The profiled bottom extruder plate may be configured to work in conjunction with a top extruder plate. The top extruder plate may be configured to form a back side of the gypsum board during extrusion. In gypsum board manufacturing systems, the top extruder plate may provide adjustability to control board thickness and flatness characteristics.

[0045] When a profiled bottom extruder plate is installed in a gypsum board manufacturing system, the top extruder plate may be adjusted to complement the profiled surface of the bottom extruder plate. In some cases, the top extruder plate may be flattened to work with the profiled bottom extruder plate. The flattening of the top extruder plate may accommodate the thickness variation introduced by the ramped profile of the bottom extruder plate.

[0046] The top extruder plate may provide a degree of tunability for the gypsum board manufacturing system. In cases where the profiled surface dimensions of the bottom extruder plate are not ideal, the top extruder plate may be adjusted to offset the bottom plate profile. The adjustability of the top extruder plate may allow for fine-tuning of the board thickness profile even when the bottom extruder plate has a fixed profiled geometry.

[0047] The top extruder plate adjustments may be used to offset variations in the height of the ramped sections of the bottom extruder plate. The top extruder plate adjustments may also be used to offset variations in the length of the ramped sections of the bottom extruder plate. In some cases, the top extruder plate may be adjusted to compensate for differences in slurry formulations or board weights that affect how the gypsum board forms at the extruder plates.

[0048] The combination of the profiled bottom extruder plate and the adjustable top extruder plate may provide control over the face surface profile and the back surface profile of the gypsum board. The profiled bottom extruder plate may provide direct control over the face side thickness variation in the shoulder region, while the top extruder plate may provide complementary adjustments to achieve the desired overall board thickness and flatness characteristics.

[0049] In gypsum board manufacturing, tapered edges may be formed on boards to facilitate joint finishing during installation. Tapered edges may allow joint compound to be applied smoothly across board seams, creating a flush surface when boards are installed adjacent to one another. The formation of tapered edges may occur during the manufacturing process as the gypsum board travels along a production line.

[0050] Conventionally, tapered edges may be formed using taper bands, also known as moulding belts. Taper bands may be positioned on the production line to physically shape the edges of the gypsum board during extrusion. The taper bands may contact the board edges and form the tapered profile as the board passes through the manufacturing line. The width of the tapered edge on the finished product may depend on the positioning of the taper bands relative to the board edges.

[0051] In conventional manufacturing processes, taper bands may be placed with precise alignment on the production line to achieve a desired tapered edge width. The placement of the taper bands may determine where the face paper folds and where the tapered profile begins on the finished board. If the taper bands are positioned at the correct location relative to the board edges, the resulting tapered edge width may match the desired specification. If the taper bands are misaligned, the resulting tapered edge width on the finished product may be incorrect.

[0052] Misalignment of taper bands may lead to inconsistent tapered edge widths across different boards produced in the same production run. Misalignment may also lead to inconsistent tapered edge widths across different production runs at the same manufacturing plant. In some cases, misalignment may lead to inconsistent tapered edge widths across different manufacturing plants. Such inconsistencies may create challenges when boards from different plants or production runs are used together at installation sites.

[0053] Achieving precise taper band alignment may be demanding in terms of setup time. Operators may spend time adjusting taper band positions to achieve the desired alignment. Maintaining precise taper band alignment may also be demanding in terms of operator skill. Operators may require training and experience to consistently position taper bands at the correct locations on the production line. Variations in operator skill or attention may contribute to variations in taper band alignment and resulting tapered edge widths.

[0054] A secondary creaser wheel mechanism may be used to control tapered edge width in gypsum board manufacturing. In conventional gypsum board manufacturing, face paper may be creased at specific locations to allow the face paper to fold and form board edges. A primary creaser may create an inner crease line that facilitates folding and forming of the board edge. The secondary creaser wheel mechanism may create an additional crease line in the face paper at a controlled distance from the inner crease line.

[0055] The secondary creaser wheel may be positioned at a fixed distance from the inner crease line. The fixed distance may correspond to a desired tapered edge width. When the secondary creaser wheel creates a secondary crease line in the face paper, the secondary crease line may weaken the face paper at a precise location. The weakened face paper may fold preferentially at the location of the secondary crease line during tapered edge formation. The tapered edge width may be dictated by the position of the secondary crease line rather than by exact placement of taper bands used to physically form the tapered edges.

[0056] In some cases, the secondary creaser wheel may be positioned approximately 2.0 inches from the inner crease line toward a field of the gypsum board. The 2.0 inch positioning may correspond to a desired tapered edge width of approximately 2.0 inches. The secondary creaser wheel may create the secondary crease line at the 2.0 inch location, thereby controlling where the face paper folds during tapered edge formation.

[0057] The secondary creaser wheel position may be adjustable to accommodate different desired taper widths. In some cases, the secondary creaser wheel may be repositioned to different distances from the inner crease line to produce gypsum boards with different tapered edge widths. The adjustability of the secondary creaser wheel position may allow a single manufacturing line to produce boards with different tapered edge width specifications by adjusting the creaser wheel position between production runs.

[0058] In some cases, multiple secondary creaser wheels may be used to provide options for different taper widths without mechanical changeover. A first secondary creaser wheel may be positioned at a first distance from the inner crease line corresponding to a first tapered edge width. A second secondary creaser wheel may be positioned at a second distance from the inner crease line corresponding to a second tapered edge width. The multiple secondary creaser wheels may be selectively engaged or disengaged to produce boards with different tapered edge widths without requiring repositioning of creaser wheel hardware between production runs.

[0059] The crease depth or pressure of the secondary creaser wheel may be varied to control a degree of paper weakening. In some cases, a deeper crease or higher pressure may create a more pronounced weakening of the face paper, which may result in a sharper fold at the secondary crease line location. In other cases, a shallower crease or lower pressure may create a less pronounced weakening of the face paper, which may result in a less sharp fold at the secondary crease line location. The crease depth or pressure may be adjusted based on face paper characteristics, slurry formulation, or desired tapered edge profile characteristics.

[0060] The secondary creaser wheel may be applied to one or both edges of the gypsum board. In some cases, a secondary creaser wheel may be positioned on one side of the manufacturing line to create a secondary crease line on one edge of the gypsum board. In other cases, secondary creaser wheels may be positioned on both sides of the manufacturing line to create secondary crease lines on both edges of the gypsum board. The selection between single-edge and dual-edge application may depend on whether tapered edges are formed on one or both edges of the board product.

[0061] The taper bands may still be used to physically form the tapered edges of the gypsum board. The taper bands may contact the board edges and shape the tapered profile as the board passes through the manufacturing line. The placement of the taper bands may no longer need to be exact because the secondary crease line controls where the face paper folds. The secondary crease line may ensure a consistent tapered edge width regardless of minor variations in taper band alignment. The secondary creaser wheel mechanism may thereby reduce setup time and operator skill requirements associated with precise taper band alignment while producing uniform tapered edge widths across boards.

[0062] In a gypsum board manufacturing system incorporating both a profiled bottom extruder plate and a secondary creaser wheel mechanism, the two components may operate in sequence to control board surface profile and tapered edge width during the manufacturing process.

[0063] During operation, wet gypsum slurry may be extruded between a bottom extruder plate and a top extruder plate. The bottom extruder plate may include a profiled surface with a ramped profile extending inward from edges of the bottom extruder plate. As the gypsum slurry passes between the bottom extruder plate and the top extruder plate, the profiled surface of the bottom extruder plate may form a face side of the gypsum board with a controlled thickness variation in a shoulder region. The ramped profile may create a thickness variation such that the gypsum board is formed slightly thinner in a zone located approximately 2 inches to approximately 8 inches inward from paperbound edges of the gypsum board, with the thickness gradually increasing from that zone toward a field region at a center of the board.

[0064] The profiled surface of the bottom extruder plate may directly control the face surface geometry during extrusion. The controlled thickness variation introduced by the ramped profile may prevent surface irregularities from developing in the shoulder region as the gypsum slurry is compressed and formed between the extruder plates. The top extruder plate may be adjusted to complement the profiled surface of the bottom extruder plate. In some cases, the top extruder plate may be flattened to accommodate the thickness variation introduced by the ramped profile of the bottom extruder plate. In other cases, the top extruder plate may be adjusted to offset variations in the height or length of the ramped sections of the bottom extruder plate.

[0065] As the gypsum board travels along a production line, face paper may be applied to the face side of the gypsum board. A primary creaser may create an inner crease line in the face paper. The inner crease line may facilitate folding and forming of board edges during subsequent processing steps.

[0066] A secondary creaser wheel may be positioned at a fixed distance from the inner crease line. The secondary creaser wheel may create a secondary crease line in the face paper at a predetermined distance from the inner crease line. The secondary crease line may weaken the face paper at a controlled location. In some cases, the secondary creaser wheel may be positioned approximately 2.0 inches from the inner crease line toward the field of the gypsum board, corresponding to a desired tapered edge width of approximately 2.0 inches.

[0067] Following the creation of the secondary crease line, taper bands may contact the board edges to physically form tapered edges of the gypsum board. The taper bands may shape the tapered profile as the board passes through the manufacturing line. The weakened face paper at the location of the secondary crease line may fold preferentially at that location during tapered edge formation. The tapered edge width may be dictated by the position of the secondary crease line rather than by exact placement of the taper bands. Minor variations in taper band alignment may not affect the resulting tapered edge width because the secondary crease line controls where the face paper folds.

[0068] The combination of the profiled bottom extruder plate and the secondary creaser wheel mechanism may provide complementary control over board characteristics. The profiled bottom extruder plate may control face surface profile characteristics in the shoulder region, reducing or eliminating surface irregularities that would otherwise develop during extrusion. The secondary creaser wheel mechanism may control tapered edge width through a mechanically fixed creaser position, producing consistent tapered edge widths across boards regardless of minor variations in taper band placement.

[0069] In some cases, the profiled bottom extruder plate may be used independently without the secondary creaser wheel mechanism. In such cases, the profiled bottom extruder plate may provide control over face surface profile while tapered edges are formed using conventional taper band alignment methods. In other cases, the secondary creaser wheel mechanism may be used independently without the profiled bottom extruder plate. In such cases, the secondary creaser wheel mechanism may provide control over tapered edge width while board thickness profile is controlled using conventional extruder plate adjustment methods.

[0070] When both components are used together in a gypsum board manufacturing system, the profiled bottom extruder plate may form the gypsum board with reduced surface irregularities in the shoulder region, while the secondary creaser wheel mechanism may ensure consistent tapered edge widths. The resulting gypsum board may exhibit improved surface flatness characteristics in the shoulder region and uniform tapered edge widths suitable for joint finishing during installation.

FIG. 1 – Gypsum Board Cross Sectional View

[0071] FIG. 1 illustrates a cross-sectional view of a gypsum board showing a high shoulder defect and a properly formed edge profile. A high shoulder defect may appear as a slight deformation or bump on a face surface of the gypsum board. The high shoulder defect may be located in a shoulder region approximately 2 inches to approximately 3 inches inward from a paperbound edge of the gypsum board. FIG. 1 may show the high shoulder defect on one edge of the board, while the opposite edge may exhibit a properly formed edge profile without surface irregularities. The high shoulder defect may manifest as a raised area that extends above a nominal face surface plane of the gypsum board.

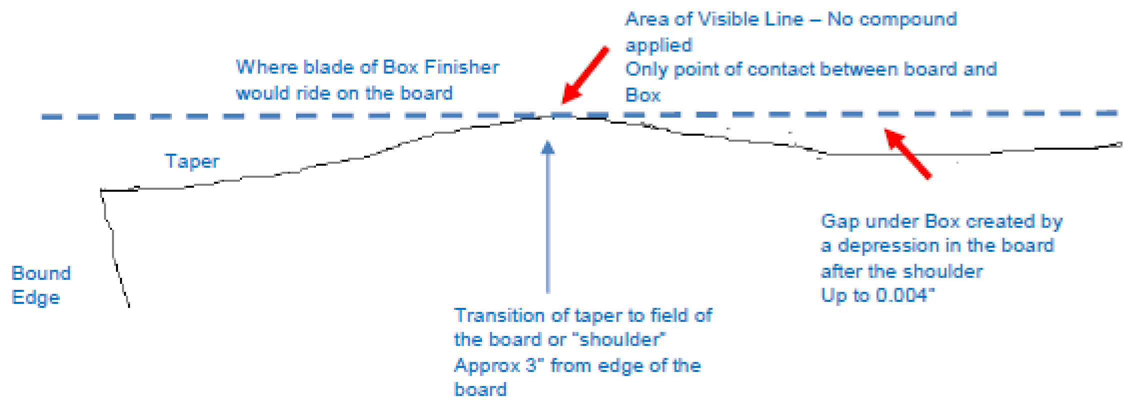

FIG. 2 – Mechanism the Creates Visible Line

[0072] FIG. 2 depicts a diagram illustrating a mechanism by which a high shoulder defect creates a visible line during joint finishing. FIG. 2 may show a tapered edge region of a gypsum board with a bound edge on the left side. The taper may transition from the bound edge downward and inward toward a field of the board. A transition from the taper to the field of the board may occur approximately 3 inches from the edge of the board. FIG. 2 may show a raised area or bump located in the shoulder region, which may represent the high shoulder defect. The raised area may have a height of up to approximately 0.004 inches. FIG. 2 may illustrate where a blade of a box finisher would ride on the board surface. The blade may contact the board at the peak of the high shoulder bump, creating a gap under the box finisher in regions before and after the high shoulder. The gap may be up to approximately 0.004 inches deep. FIG. 2 may show an area of visible line where no compound is applied, corresponding to the location where the finishing tool rides over the high shoulder and scrapes off joint compound.

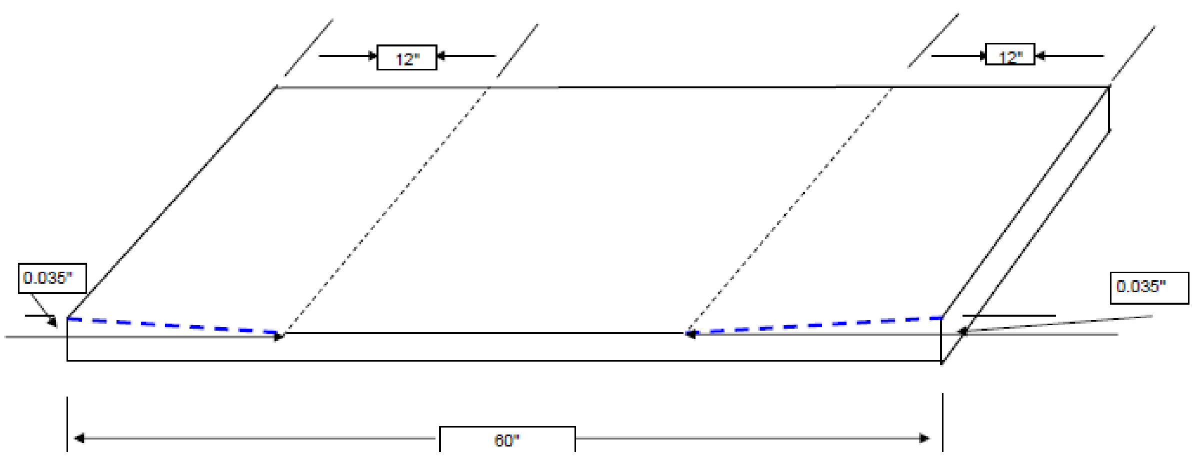

FIG. 3 – Profiled Bottom Extruder Plate

[0073] FIG. 3 illustrates a cross-sectional view of a profiled bottom extruder plate with ramped edge regions. FIG. 3 shows the bottom extruder plate from an end view perspective. The profiled bottom extruder plate may include ramped or tapered profile sections at each lateral edge. The ramped profile sections may extend approximately 12 inches inward from each side edge of the bottom extruder plate. A central portion of the bottom extruder plate between the profiled edge regions may be relatively flat. FIG. 3 may show dimensional annotations of approximately 0.035 inches at both lateral edges, indicating a height differential or taper depth of the profiled edge regions relative to the central flat portion. The ramped profile sections may be configured to form the gypsum board slightly thinner in a shoulder region during extrusion. Dashed lines at the top of FIG. 3 may indicate a position of a top extruder plate or a back surface of the board being formed.

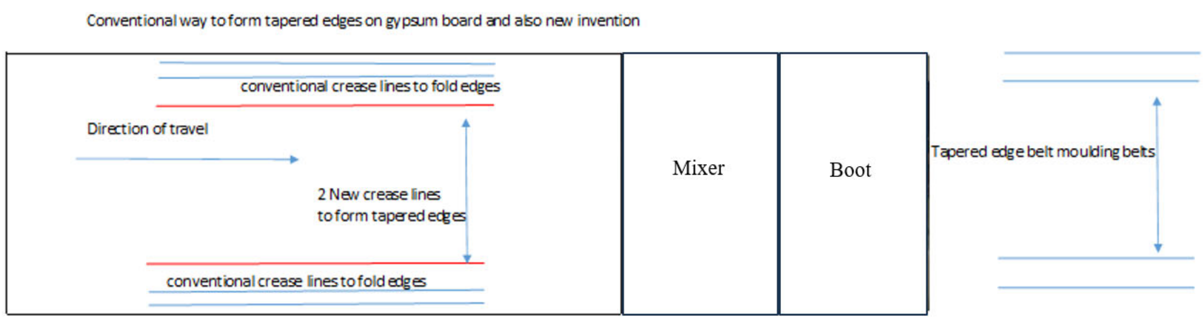

FIG. 4 – Schematic Plan View Showing Conventional and Added Crease Lines

[0074] FIG. 4 may depict a schematic plan view showing conventional crease lines and secondary crease lines for controlling tapered edge width. FIG. 4 may show a horizontal arrow labeled "Direction of travel" pointing to the right, indicating movement of a board through a production line. Two horizontal lines labeled "conventional crease lines to fold edges" may be shown at a top and a bottom of FIG. 4, representing standard crease locations used in gypsum board manufacturing. Between the conventional crease lines, two additional lines may be marked as "2 New crease lines to form tapered edges," positioned at a fixed distance inward from the conventional crease lines. The new crease lines may be configured to control a width of tapered edges by creating predetermined fold points in face paper. FIG. 4 may demonstrate that by adding secondary crease lines at a specific, controlled distance from inner conventional crease lines, tapered edge width may be precisely dictated regardless of exact placement of taper bands used in a forming process.

[0075] A number of implementations have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the disclosure.

ABSTRACT

A gypsum board extrusion apparatus includes a bottom extruder plate configured to form a face side of a gypsum board during extrusion. The bottom extruder plate has a profiled surface with a thickness variation in a shoulder region. The profiled surface includes a ramped profile extending inward from edges of the bottom extruder plate. The ramped profile is configured to form the gypsum board with a controlled thickness variation that reduces surface irregularities in the shoulder region.