

APPARATUS AND METHOD FOR CONSTRUCTING BUILDING BOARDS USING LOW FRICTION SURFACES

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Application Ser. No. 14/153,156, filed January 13, 2014, the contents of which are fully incorporated by reference for all purposes.

TECHNICAL FIELD

[0002] This disclosure relates to an apparatus and method for constructing building boards. More specifically, the present disclosure relates to a building board forming line that utilizes pressurized air to reduce associated frictional forces.

BACKGROUND OF THE INVENTION

[0003] There are a variety of known processes for constructing building boards. One known method employs a forming line consisting of one or more forming tables. The building board, which may be a gypsum based building board, is sequentially assembled over the forming tables. A roll of a facing material, such as paper or a fibrous bounds mat, is unwound over the first forming table to form the lower surface of the board. The forming tables may include rotatable belts to transport the facing material. An overhead mixer is included for depositing a volume of cementitious slurry upon the inner surface of the facing material. An additional roll is included for providing an opposing facing material.

[0004] These known methods suffer from several disadvantages. For example, the friction between the facing material and the forming table often damages or mars the resulting building board. This may result in the board being unsuitable for its intended use. Furthermore, known manufacturing techniques often result in an uneven distribution of cementitious slurry during formation. Most often the slurry disproportionally accumulates along the center line of the board, closest to the outlet of the overhead mixer. As a result, the edges of the resulting board are insufficiently strong and are prone to chipping or disintegration.

[0005] Over the years, various devices have been created for improving the board manufacturing process. For example, U.S. Pat. No. 2,722,262 to Eaton discloses an apparatus for the continuous production of a paper encased gypsum plaster strip. The apparatus includes a table over which a continuous strip is passed. The apparatus further includes a block and side guide members for shaping the strip and associated gypsum.

[0006] US Pat. No. 3,529,357 to Hune et al. discloses method and apparatus for the high-speed drying of gypsum boards. The apparatus includes jet nozzles that impinge heated air on the this edge portions of the materials throughout a drying process.

[0007] Yet another manufacturing method is disclosed by U.S. Pat. No. 5,342,566 to Schafer et al. Schafer discloses a method and apparatus using air jets to support a gypsum board prior to cutting. The air cushion provides a lifting force but does not impart any forward motion.

[0008] U.S. Pat. No. 4,298,413 to Teare discloses method for producing fabric-reinforced thin concrete panels that are suitable as backer board for construction materials. Constructed panels can be transferred in seriatim to an air-float stacking unit positioned over a stacking table.

[0009] Finally, U.S. RE 41,592 to Lynn et al. discloses a manufacturing method for producing gypsum/fiber board with improved impact resistance. The method utilizes airjets to support the gypsum fiber board during processing.

[0010] Although the aforementioned methods each achieve their own unique objectives, all suffer from common drawbacks. The devices and methods described herein are designed to overcome the shortcomings present in background art. In particular, the devices and methods described herein employ pressurized air for the purpose of transporting building boards, ensuring adequate slurry spread, and/or preventing the boards from being damaged or marred during manufacture.

SUMMARY OF THE INVENTION

[0011] This disclosure permits smooth exterior finishes to be applied to wall boards with minimal finishing materials, time, and expense.

[0012] It is therefore one of the objectives of this invention to provide a gypsum board forming device that promotes the uniform distribution of slurry adjacent a pinch point.

[0013] It is yet another objective of this invention to provide a gypsum board forming device the promotes the spread of slurry to the edges of an associated forming table.

[0014] Various embodiments of the invention may have none, some, or all of these advantages. Other technical advantages of the present invention will be readily apparent to one skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] For a more complete understanding of the present disclosure and its advantages, reference is now made to the following descriptions, taken in conjunction with the accompanying drawings, in which:

[0016] FIG. 1 is a side elevational view of a production line for producing building boards in accordance with the present disclosure.

[0017] FIG. 2 is a side elevational view of an alternative production line for producing building boards in accordance with the present disclosure.

[0018] FIG. 3 is a cross sectional view of an air plenum in accordance with the present disclosure.

[0019] FIG. 4 is a cross sectional view of an air plenum in accordance with the present disclosure.

[0020] FIG. 5 is a cross sectional view of an air plenum in accordance with the present disclosure.

[0021] FIG. 6 is a cross sectional view of an air plenum in accordance with the present disclosure.

[0022] FIG. 7 is a side elevational view of an alternative production line for producing building boards in accordance with the present disclosure.

Similar reference characters refer to similar components throughout the several views of the drawings.

DETAILED DESCRIPTION OF THE DRAWINGS

[0023] The present disclosure relates to a board forming device that employs pressurized air to reduce the friction between the board and the underlying forming tables. The device employs a series of air nozzles that are formed within the face of the forming tables. An air source delivers pressurized air to the nozzles. As completed or partially completed boards travel along the forming tables, an air cushion is created to reduce the friction between the board and the underlying table. The pressurized air can also be used to transport the boards and promote the even distribution of slurry during formation. The various components of the present invention, and the manner in which they interrelate, are described in greater detail hereinafter.

[0024] With reference now to FIG. 1, a board forming line **10** in accordance with the present disclosure is illustrated. Line **10** assembles building boards **18** along a series of forming tables (**20a** and **20b**) by way of an overhead slurry mixer **22**. Mixer **22** includes a series of outlets (**24a**, **24b**, and **24c**) for supplying slurry at different locations along line **10**. Mixer **22** can also supply slurry at varying densities and/or consistencies. As illustrated, the first and second outlets (**24a** and **24b**) deposit slurry at two different locations along the first forming table **20**. Third outlet **24c** deposits slurry at a third location along the second forming table **20b**. This configuration is provided only as a representative example, and other configurations for the forming line will readily be appreciated by those of ordinary skill in the art.

[0025] In accordance with the invention, each forming table **20** includes a series of nozzles **26** within its upper face. Nozzles **26** can be perforations, orifices, ports, or other openings formed within the surface of tables **20a** and **20b**. The nozzles **26** can have a minimum open diameter of 0.001 to a maximum open diameter of 0.0250 inches. The associated airflow rate will have a minimum velocity of 1 scfm (standard cubic feet per minute) to a maximum velocity of 490 scfm per a running foot of equipment. The minimum ported or air escape wall thickness of the air supply manifold shall be no less than 0.002 inches and no greater than 1.500 inches.

[0026] In one embodiment, tables **20** are elongated belts that rotate about pulleys for use in transporting the board **18** during assembly. In this case, nozzles **26** are formed within the upper surface of the belt. In yet another embodiment, tables (**20a** and **20b**)

are stationary and board **18** is transported via a directed air cushion supplied by nozzles **26**.

[0027] With continuing reference to FIG. 1, it can be seen that an air plenum chamber **28** is associated with each of the forming tables **20a** and **20b**. Each plenum **28** has a similar construction and only one is described in detail. Plenum **28** is designed to accumulate pressurized air for delivery to nozzles **26** within forming table **20**. As such, each plenum **28** is in fluid communication with both the nozzles **26** and an air source **32**. In the depicted forming line, two separate air sources **32** are provided for each of the two plenums **28**. However, other configurations are within the scope of the present disclosure. For example, a single plenum **28** can be provided along one or more forming tables **20**. Additionally, a single air source **32** can be provided for multiple plenums **28**.

[0028] A supply roll **34** is included at a first end of forming line **10**. Roll **34** supplies the bottom facing sheet **36** to forming table **20**. Facing sheet **36** can be formed from a number of different materials. For example, facing sheet **36** can be formed from paper or from a fibrous mat. In either event, facing sheet **36** is delivered over the top of the first forming table **20a**. In the event a belt is included, facing sheet **36** is transported via movement of the belt. Slurry mixer **22** deposits slurry upon the exposed surface of facing sheet **36** as it is transported along forming line **10**.

[0029] Air supply **32** supplies pressurized air to each of the nozzles **26** such that a cushion of air "**C**" (note FIG. 4) is formed between the bottom surface of facing sheet **36** and upper surface of table **20**. Air cushion **C** reduces the coefficient of friction between the facing sheet **36** and table **20** as board **18** is transported along forming line **10**. As described below, nozzles **26** can be orientated to transport board **18** along line **10**.

[0030] In the embodiment of FIG. 1, the nozzles **26** are evenly distributed across the length and width of the forming tables **20**. Additionally, the longitudinal axis of each nozzle **26** is oriented perpendicularly to the face of the forming tables **20**. In the embodiment of FIG. 2, angled nozzles **38** are used. Namely, each nozzle **38** is angled in relation to the upper surface of the forming tables **20**. The longitudinal axis of each nozzle **38** is positioned at an angle with respect to the surface of forming table **20**. As such, the pressurized air is delivered in a direction that corresponds with the movement

of board **18** along the forming line **10**. The angle of nozzles **38** and the pressurization from source **32** can be optimized to transport board **18** along the length of the forming table **20**. This would eliminate the need for the belts, pulleys, and motors that are currently employed in transporting boards. Alternatively, angled nozzles **38** can be formed within the surface of the belts such that nozzles **38** are used in conjunction with the belts in transporting board **18**.

[0031] FIG. 3 is a front elevational view of the board forming line and shows the plenum **28**, air source **32**, and nozzles **26**. This figure illustrates that nozzles **26** can be evenly distributed across the width of table **20**. Furthermore, air source **32** delivers air at a uniform and consistent pressure across the width of table **20**. The embodiment of FIG. 4 is the same in most respects to embodiment of FIG. 3. However, the air source **42** in FIG. 4 is designed to provide air in pressurized bursts. In other words, air is supplied at intervals and at a set frequency. This can be accomplished via a rotary orifice. This embodiment has the benefit of vibrating the bottom facing sheet **36** and the deposited slurry during board formation. This, in turn, promotes the distribution of the slurry and eliminates unwanted air pockets. It also can ensure that the facing sheet **36**, to the extent it is a fibrous mat, becomes partially embedded within the slurry.

[0032] FIG. 5 illustrates an alternative arrangement of angled nozzles **44**. More specifically, the longitudinal axis of each nozzle **44** is again angled with respect to the surface of forming table **20**. In this case, however, nozzles **44** are angled outwardly toward the peripheral edges of table **20**. Furthermore, nozzles **44** within the first half of the table are oriented opposite to nozzles **44** in the second half of the table. The first and second halves are referenced with respect to a longitudinal axis bisecting table **20**. This embodiment is advantageous in promoting the spread of the deposited slurry to the outer peripheral edges of the board.

[0033] FIG. 6 illustrates yet another embodiment wherein different pressures are supplied to different areas along the width of forming table **20**. More specifically, an air source **32** can deliver highly pressurized air to the nozzles proximate to the longitudinal axis of table **20**. Different air sources **32** can deliver air at progressively lesser pressures to the peripheral extents of the board. By delivering high pressure air to the

center of the table and low pressure air to the peripheral edges, a more uniform distribution of slurry is achieved.

[0034] FIG. 7 illustrates flipper arms **46** that are conventionally used along board forming lines. These arms **46** are employed flipping completed board such that the bottom facing sheet **36** becomes exposed. In this embodiment, each of the arms **46** includes nozzles **26** similar to the nozzles formed within the upper surface of the forming tables **20**. The nozzles **26** are connected to a source of pressurized air **32**. This embodiment, allows an air cushion to be formed between the flipper arms **46** and the completed board **18**. This embodiment has the advantage that the boards **18** are not damaged or marred while by being flipped.

[0035] In a further aspect of the invention, the air provided by the air sources **32** can be heated. Thus, in addition to providing a lifting or propelling force to the boards, the supplied air can serve to further dry the boards. This would reduce the drying otherwise required by traditional board dryers. If the heated air is sufficient, heated air source **32** could altogether eliminate the need for external board dryers. This would represent a vast improvement by removing the opportunity for edge damage and paper, ply delamination associated with traditional drying mechanisms.

[0036] The air lift forming tables described above can be used throughout the entire wet forming process of the board as an alternative to the traditional post extruder forming belts. It is also within the scope of the present invention to utilize air lift forming tables in transfer or booking/staging areas within a board plant. These areas are known to cause surface damage to boards. Hence, by utilizing the air lift tables described herein, the damage or marring of completed boards can be avoided.

[0037] Although this disclosure has been described in terms of certain embodiments and generally associated methods, alterations and permutations of these embodiments and methods will be apparent to those skilled in the art. Accordingly, the above description of example embodiments does not define or constrain this disclosure. Other changes, substitutions, and alterations are also possible without departing from the spirit and scope of this disclosure.

WHAT IS CLAIMED IS:

1. A board forming device with low friction surfaces comprising:
 - a gypsum slurry mixing device including a slurry outlet;
 - a first forming table having a series of nozzles;
 - a first plenum chamber associated with the first forming table and in fluid communication with the nozzles;
 - a first air source supplying pressurized air to the first plenum chamber and the series of nozzles;
 - a lower supply roll supplying a bottom facing sheet to the first forming table, the slurry outlet supplying slurry over the bottom facing sheet;
 - a second forming table having a series of nozzles;
 - a second plenum chamber associated with the second forming table and in fluid communication with the nozzles;
 - a second air source supplying pressurized air to the second plenum chamber and the series of nozzles;wherein the pressurized air supplied to the nozzles reduces the friction between the bottom facing sheet and the first and second forming tables.

2. A board forming device comprising:
 - a gypsum slurry mixing device including a slurry outlet;
 - a forming table having an upper surface, a length and a width, a series of nozzles placed along with length and width of the forming table;
 - a plenum associated with the forming table and in fluid communication with the nozzles;
 - an air source supplying pressurized air to the plenum and the series of nozzles;
 - a supply roll supplying a bottom facing sheet to the forming table, the slurry outlet supplying slurry over the bottom facing sheet;wherein the pressurized air supplied to the nozzles reduces the friction between the bottom facing sheet and the forming table.

3. The board forming device as described in Claim 2 wherein the nozzles are evenly distributed across the length and width of the forming table.

4. The board forming device as described in Claim 2 wherein the air source supplies a continuous source of pressurized air.

5. The board forming device as described in Claim 2 wherein the air source supplies pressurized air in bursts at a set frequency, whereby the pressurized air bursts vibrate the bottom facing sheet and the deposited slurry.

6. The board forming device as described in Claim 2 wherein each nozzle includes a longitudinal axis that is perpendicular to the upper surface of the forming table.

7. The board forming device as described in Claim 2 wherein each nozzle includes a longitudinal axis that is angled relative to the upper surface of the forming table.

8. The board forming device as described in Claim 5 wherein the forming table includes a longitudinal axis bisecting the forming table into first and second halves and wherein the nozzles within the first and second halves are orientated at opposite angles.

9. The board forming device as described in Claim 5 wherein the forming table includes a longitudinal axis bisecting the forming table into first and second halves and wherein the nozzles within the first and second halves are orientated at opposite angles.

10. The board forming device as described in Claim 2 wherein the forming table includes a longitudinal axis and peripheral edges and wherein the air source

supplies air at a greater pressure proximate the longitudinal axis and air at a lesser pressure proximate the peripheral edges.

11. The board forming device as described in Claim 2 wherein the forming table includes transfer arms for flipping the board and exposing the bottom facing sheet and wherein each transfer arm includes a series of nozzles that are connected to the air source.

12. The board forming device as described in Claim 2 wherein the nozzles are angled so as to impart directional movement to the boards.

13. A method for producing building boards, the method utilizing a supply roll of a facing sheeting, a slurry mixing device, a fluid source, and a forming table including a series of nozzles, the method comprising the following steps:

unwinding the facing sheet over top of the forming table;

depositing a volume of cementitious material from the mixing device to the unwound facing sheet;

supplying a pressurized fluid from the fluid source to the series of nozzles, whereby a pressurized fluid cushion is created between the unwound facing sheet and the forming table, the fluid cushion reducing the frictional forces otherwise generated between the facing sheet and the forming table.

14. The method as described in Claim 13 wherein the fluid source supplies a continuous source of pressurized air.

15. The method as described in Claim 13 wherein the fluid source supplies pressurized air in bursts at a set frequency.

16. The method as described in Claim 15 comprising the further step of vibrating the deposited cementitious material via the pressurized air bursts.

17. The method as described in Claim 13 wherein the nozzles are angled and comprising the further step of moving the unwound facing sheet via the fluid cushion.

18. The method as described in Claim 13 comprising the further step of supplying the pressurized fluid at greater pressures at selection locations upon the forming table so as to promote the even distribution of the deposited cementitious material.