United States Patent [19]

Roberts

[11] **3,875,835**

[45] **Apr. 8, 1975**

[54] **DUCT BOARD CUTTING APPARATUS AND METHOD**

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[73] Assignee: **Johns-Manville Corporation,** Greenwood Village, Colo.

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[52] **U.S. Cl.** ..... **83/5;** 144/136 R

[51] **Int. Cl.** **B26d 3/06;** B27f 5/02

[58] **Field of Search** ..... 83/5; 144/136 R, 133 R, 144/245 F

[56] **References Cited**

UNITED STATES PATENTS

2,987,088	6/1961	Dennison	144/245 F
3,605,534	9/1971	Barr	83/5
3,733,975	5/1973	Terrasi	83/5

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Attorney, Agent, or Firm—Robert M. Krone; John D. Lister

[57] **ABSTRACT**

Duct boards, from a stack of duct boards, are properly aligned for feed into a cutting station and are successively fed from the feed station to the cutting station. Once in the cutting station the duct board is fed and guided between knife blades and a backing roll which cut the duct as required for a particular application. Drawing apparatus, rearward of the knife blades and the backing roll, draw the duct board through the knife blades and the backing roll while maintaining the duct board in proper alignment for the cutting operation throughout a major portion of the cutting operation.

6 Claims, 8 Drawing Figures

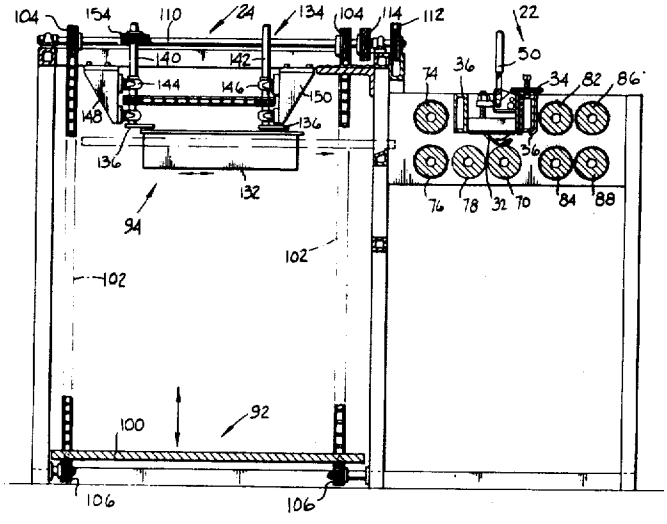


Fig. 1.

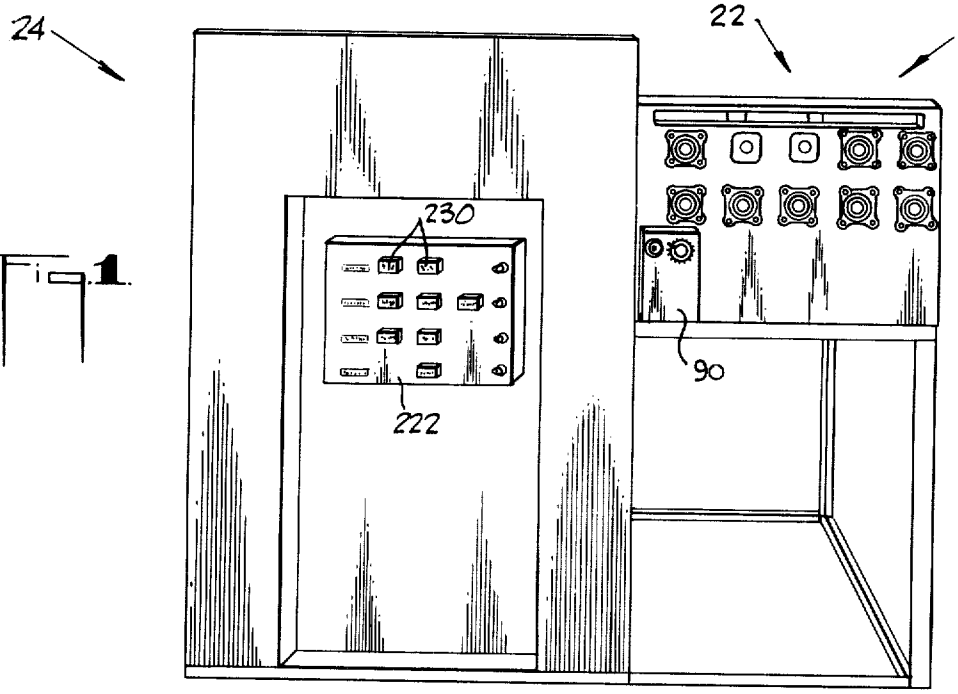


Fig. 4.

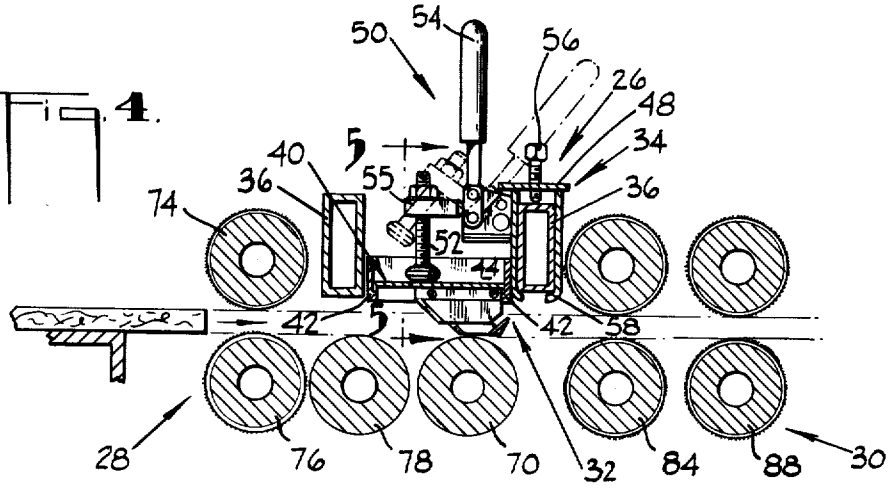
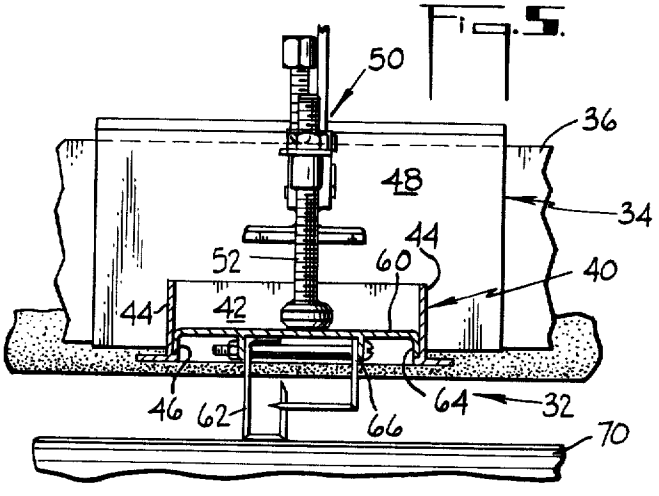


Fig. 5.



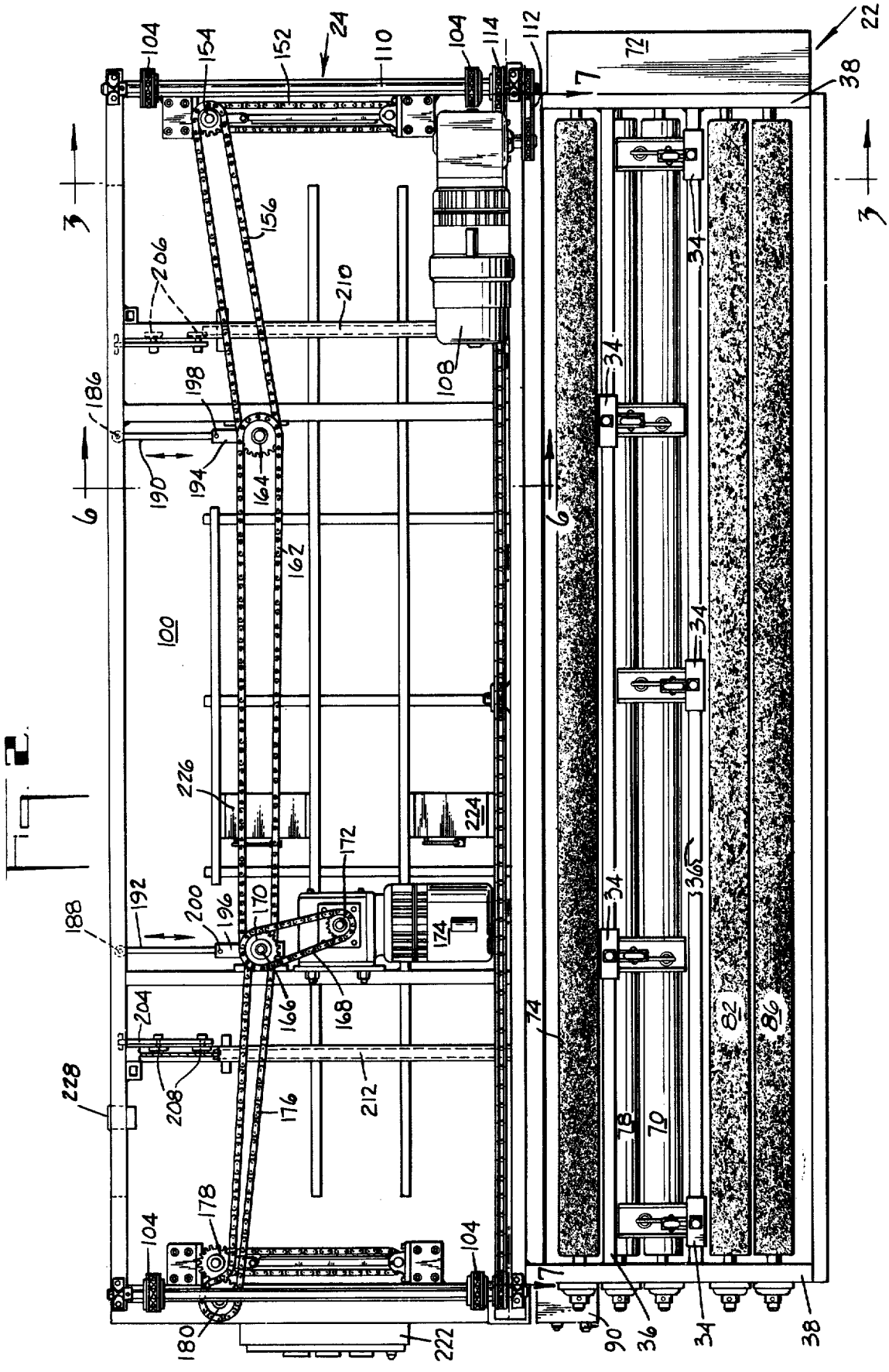

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Fig. 2

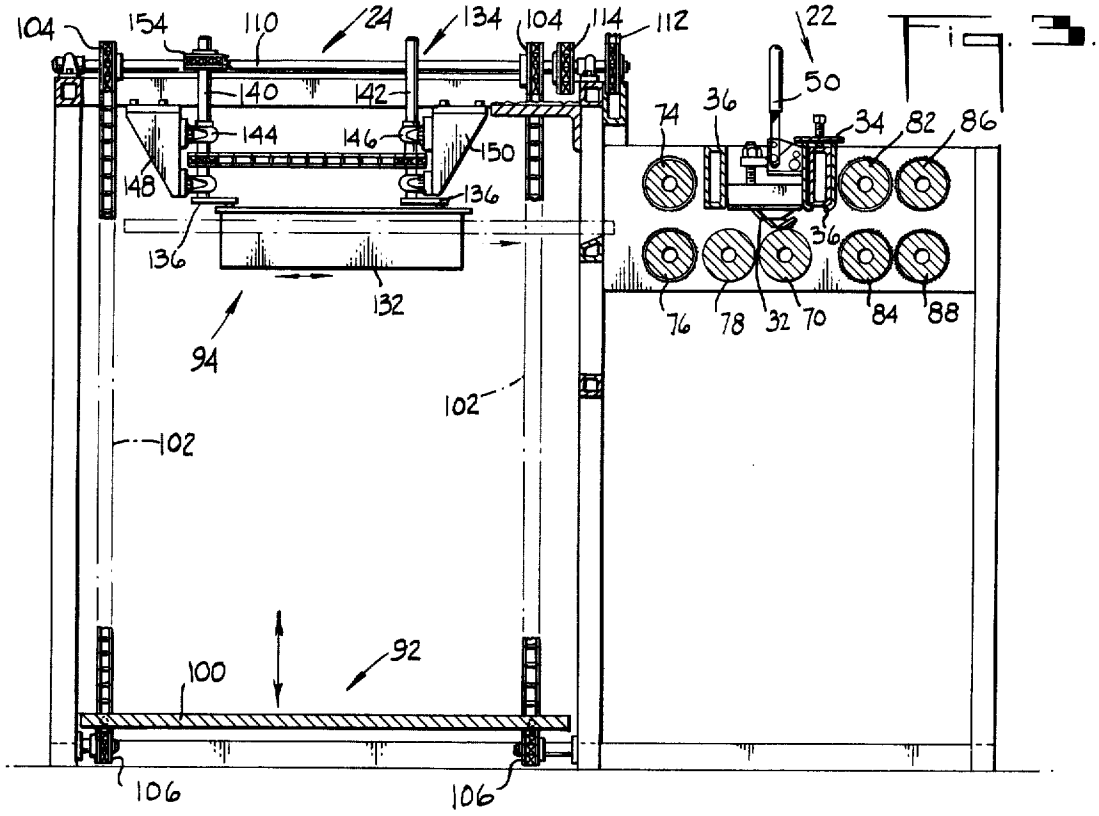
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Fig. 3.

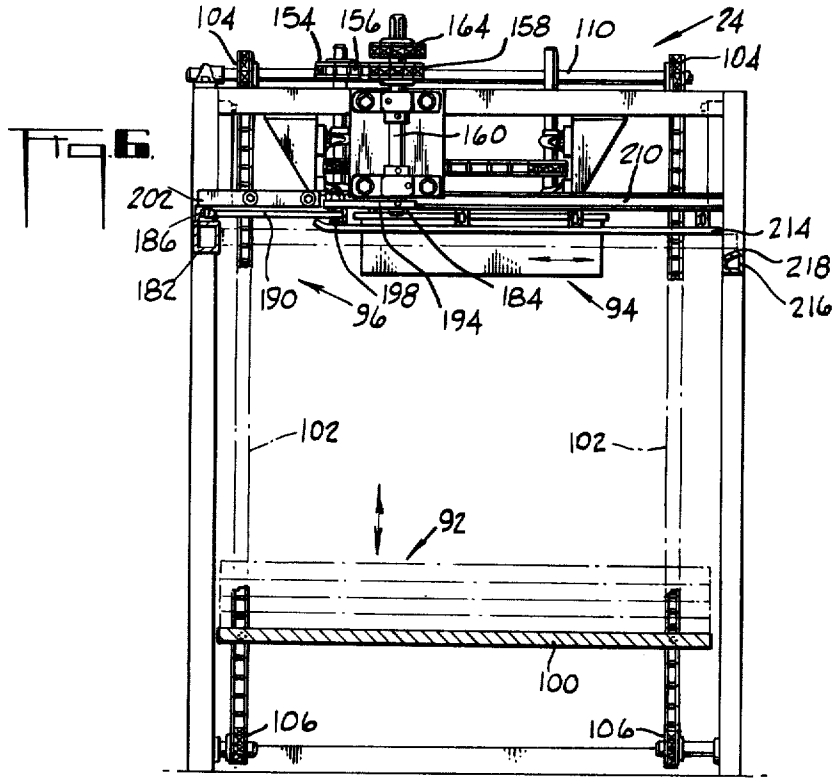
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Fig. 6.

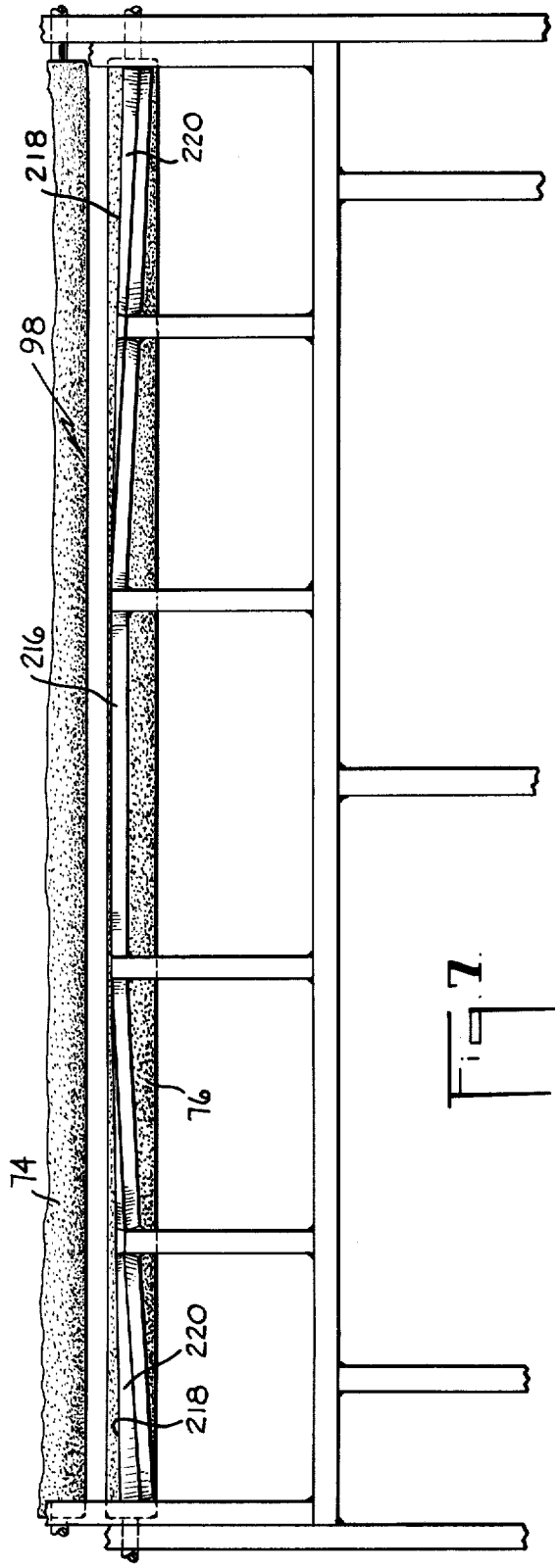

Fig. 7

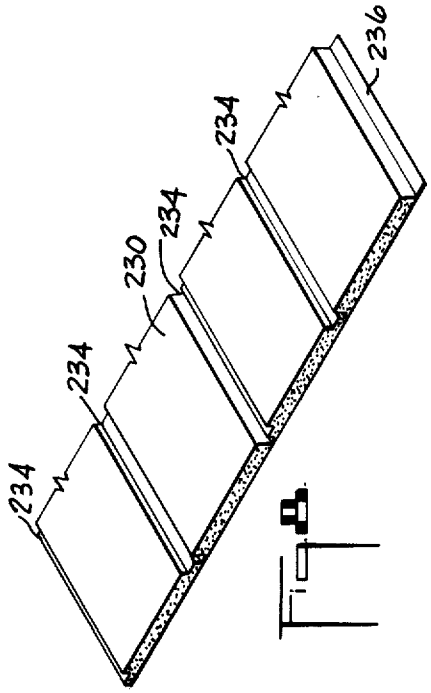

Fig. 8

DUCT BOARD CUTTING APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

The present invention relates to a duct board cutting apparatus and method and in particular to an improved apparatus and method wherein the duct board is automatically fed into a cutting station of the apparatus and maintained in proper alignment for the cutting operation throughout the cutting operation.

In the past, when duct board has been cut to enable it to be formed into a conduit it has either been cut by hand or on a machine such as that disclosed in U.S. Pat. No. 3,605,534 issued to W. H. Barr on Sept. 20, 1971. Cutting duct board by hand is extremely time consuming and thus undesirable. While duct board cutting machines such as the one disclosed in the above mentioned patent, are much better than having to cut the duct board by hand, a need has remained for an automatic apparatus and improved method for cutting duct board.

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to provide a duct board cutting machine and method for cutting duct board wherein duct board is automatically fed to and through a cutting station of the apparatus with the duct board being maintained in proper alignment for the cutting operation throughout the entire cutting operation.

Accordingly, the apparatus of the present invention includes a feed station where the duct board is stacked for processing through the board cutting machine. After the board has been stacked and the cutting process has started the boards in the feed station are properly aligned for feed into the cutting station of the apparatus. The uppermost board is fed and guided into the cutting station where feed and guide means guide the duct board between knife blades and a backing roll to cut the board. Once the uppermost board has passed from the stack to the cutting station, the stack is elevated to bring the next board into position for feed into the cutting station. Once the leading edge of a board passes through the knife blade means and the backing roll, it is gripped between two pair of drawing rolls which draw the board between the knife blades and the backing roll. The drawing rolls also maintain the board in proper alignment with the knife blades for the cutting operation and during the latter part of the cutting operation, when the board is not in contact with the feed rolls which are forward of the knife blade means and the backing roll, the drawing rolls alone keep the duct board properly aligned. With this apparatus and method the board is automatically cut in a proper manner without fear of the board becoming jammed or misaligned while passing through the apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view of the apparatus of the present invention;

FIG. 2 is a plan view of the apparatus of the present invention;

FIG. 3 is a cross-sectional view taken substantially along lines 3—3 of FIG. 2;

FIG. 4 is a cross-sectional view through the cutting station of the apparatus of the present invention;

FIG. 5 is a detail of a tool mounting assembly of the present invention taken substantially along lines 5—5 of FIG. 4;

FIG. 6 is a cross-sectional view of the feed station of the present invention taken substantially along lines 6—6 of FIG. 2;

FIG. 7 is a cross-sectional view of the feed station of the present invention, adjacent the cutting station, and taken substantially along lines 7—7 of FIG. 2;

FIG. 8 is a partial prospective view of a duct board cut on the apparatus of the present invention.

DETAILED DESCRIPTION AND PREFERRED EMBODIMENTS

The apparatus of the present invention generally indicated by reference **20** includes a cutting station **22** and a feed station **24.** The apparatus is designed to automatically cut fiber glass duct board so that it can be folded to form a duct.

As shown in FIGS. **1–5** the cutting station includes a cutting assembly **26,** a duct board feed and guide assembly **28,** and a duct board drawing and aligning assembly **30.** These three assemblies cooperate to effect an accurate cutting operation on the boards passed through the cutting station.

The board cutting assembly **26** includes a series of cutting tools **32** which are mounted on support brackets **34** that are affixed to a pair of support beams **36.** These support beams **36** extend between and are bolted, welded or otherwise affixed to lateral frame assemblies **38.** As best shown in FIGS. **4** and **5** each bracket **34** includes a rectangular tool support **40** made up of a pair of end plates **42** and side plates **44.** The sides plates **44** are each provided with shoulders **46** which extend between the end plates **42** adjacent the lower portions of the side plates **44.** The shoulders **46** provide support for the tools **32** which can be readily inserted into or removed from the tool support as will be explained hereinafter. The tool support **40** is welded or otherwise affixed to one leg of a channel-shaped member **48** which is slidably received on one of the support members **36.** A conventional toggle clamp **50** is also welded to the same leg of the channel member **48.** The toggle clamp is provided with a clamping element **52** which presses down on an upper surface of the tool **32** to clamp it in place when the toggle mechanism is in the position shown in FIG. **4.** When the toggle lever **54** is moved to the position shown in phantom line in FIG. **4,** an arm **55** of the toggle mechanism raises the clamping element **52** out of contact with the tool **32** to permit the tool to be removed from the tool support **40.** The channel member **48** is provided with a stud **56** that is threaded through an aperture in its web or a clamping mechanism similar to **50.** The stud is used to clamp the tool mounting bracket **34** in place at any desired location along one of the support beams **36.** As shown in FIG. **4,** the stud **56** cooperates with inturned flanges **58** of the channel member **48** to clamp the channel in place. By loosening the stud **56** the channel is unclamped from the support **36** and can be slid relative to the support to relocate the bracket when it is desired to cut a board in a different location.

All of the tool mounts are identical and as best shown in FIG. **2,** adjacent support brackets **34** are mounted on opposite support beams **36.** Due to the relative width of the channel members **48** and the tool supports **40,** the mounting of adjacent support brackets on the op-

posing support beams **36** allow the tools **32** to be located close to each other if required.

Each tool **32** includes a mounting plate **60** and a knife blade **62** which are best illustrated in FIG. **5.** As shown the mounting plate **60** is provided with a depending lateral flange **64** adjacent each side which rest on the shoulders **46** of the support bracket. Inward of these flanges is a second pair of depending flanges **66** through which screws or similar fastening means pass to mount the knife blade **62** on the mounting plate **60.** The knife blade shown is one designed to cut the board to form a shiplap joint when the board is folded to form a duct. While this is one form of tool which can be used in the present apparatus, various types of cutting blades can be used depending on the type of cut desired. Consequently, this blade is merely illustrative of the type of blade which can be used with the apparatus of the present invention. As shown the clamping element **52** of the toggle clamp mechanism presses down on the plate **62** to lock the tool **32** in place so that the knife blade **62** rides on a backing roll **70** or is spaced a short distance above the backing roll **70.**

The backing roll **70** is a metallic roll which extends for the entire width of the cutting station. The roll is mounted in conventional bearing assemblies, adjacent each end and is driven by a DC motor and conventional drive train (not shown) housed within a housing **72.** When the knife blade **62** is resting on the backing roll **70** the blade contacts the roll rearward of the cutting edges of the blade. With this relationship between the knife blade **62** and the backing roll **70,** a duct board with a facing sheet on its lower surface can pass between the knife blade and the backing roll without the knife blade cutting into the facing.

The duct board feed and guide assembly **28** is located forward of the knife blade and backing roll and includes a pair of feed rolls **74** and **76** plus a guide roll **78.** The feed rolls **74** and **76** are rotatably mounted at each end in conventional bearings and the longitudinal axis of these rolls extend parallel to the longitudinal axis of the backing roll **70.** The rolls **74** and **76** are each covered with an abrasive material **82** to reduce slippage between the rolls and the duct board being fed. A lower surface of the upper roll **74** and an upper surface of the lower roll **76** are spaced apart a distance less than the thickness of the duct board to be fed through the apparatus. With this spacing of the rolls, the rolls grip the duct board and as the rolls are rotated by the drive assembly in housing **72** the duct board is fed toward the knife blade and the backing roll.

The guide roll **78** is located between the backing roll **70** and the feed roll **76.** The guide roll **78** is rotatably mounted at each end in a conventional bearing and rotates aobut an axis of backing roll **70.** The upper surface of the guide roll **78** is located in the same horizontal plane as the upper surfaces of the backing roll **70** and the feed roll **76.** The guide roll **78** serves to support and guide the duct board as it travels from the feed rolls **74** and **76** to the backing roll **70** and the knife blade. The guide roll **78** is also rotated by means of the drive assembly housed within housing **72.**

The drawing and aligning assembly **30** is located rearward of the knife blade and the backing roll. The drawing assembly is made up of two pairs of rolls **82, 84** and **86, 88.** Each of these rolls is mounted in conventional bearings at each end and each roll rotates about an axis parallel with the axis of rotation of the backing roll **70.** The rolls are each covered with an abrasive material which is the same abrasive material utilized to cover feed rolls **74** and **76.** The axis of rotation of the rolls **82** and **84** lie in a common vertical plane and the axis of rotation the rolls **86** and **88** lie in the same vertical plane.

Lower surfaces of the upper rolls **82** and **86,** and upper surfaces of the lower rolls **84** and **88** are spaced from each other a distance less than the distance between the lower surface of roll **74** and the upper surface of roll **76.** With this spacing there is less slippage between the drawing rolls **82, 84, 86** and **88** and the duct board than there is between the feed rolls **74** and **76** and the duct board. Consequently even though the feed rolls and the drawing rolls are driven at the same surface speed by the DC motor and drive assembly in housing **72,** the drawing rolls maintain pull on the duct board to keep it from bunching up at the knife blade and backing roll.

The drawing rolls **82, 84** and **86, 88** serve a second function. Since the drawing rolls are pulling on the duct board, they guide the duct board. With the two pairs of rolls acting together to grip the duct board at spaced apart locations, the drawing rolls prevent the duct board from becoming misaligned even when the duct board is no longer gripped between the feed rolls **74** and **76.**

The DC drive motor of the cutting station is provided with a control **90** that permits the speed of the motor to be adjusted. Thus the rate at which the duct boards pass through the cutting station can be adjusted to suit a particular cutting operation.

The feed station **24,** includes an elevator assembly **92,** a pair of duct board aligning assemblies **94,** a duct board feed assembly **96,** and a duct board guide assembly **98.** These assemblies all cooperate to automatically feed duct board to the cutting station so that once duct board has been stacked in the feed station **24,** the process of cutting the duct board is completely automatic.

The elevator assembly elevator platform **100** which is secured to and raised and lowered by four endless drive chains **102.** A stud or similar fastening means projecting from a link of each of these endless drive chains is bolted or otherwise secured to each corner of the platform **100.** The endless drive chains are each trained about upper and lower sprockets with the upper sprockets **104** being drive sprockets and with the lower sprockets **106** being idler sprockets. The drive sprockets **104** are driven by means of a reversible motor **108** through a conventional drive train. The motor **108** drives a shaft **110** through a drive chain and sprocket **112.** The shaft **110** is rotatably mounted in conventional bearings and the drive sprockets for the chains **102** carrying one end of the platform **100** are affixed to the shaft. A fourth sprocket **114** is also affixed to this shaft. A drive chain **116** is trained about the sprocket and a sprocket **118** that is affixed to a shaft **120** that carries the other two drive sprockets **104** for the chains **102** carrying the other end of the platform **100.** Thus, the drive sprockets **104** for drive chains **102** are all driven by the motor **108** through a conventional drive train to raise and lower the platform **100.**

The duct board aligning assemblies **94** are located adjacent each side of feed station and are substantially identical in construction. Consequently, only the structure of the aligning assembly illustrated in FIG. **3** will be discussed in detail to avoid unnecessary repetition.

As shown each aligning assembly includes a elongate plate **132** which extends parallel to the direction of the duct boards as they pass through the cutting station. The plate **132** is mounted on a drive assembly **134** which includes a pair of drive arms **136.** Pins **138** adjacent each end of the bar **132** are rotatably carried at the outer ends of the arms **136.** The inner ends of the arms **136** are affixed to shafts **140** and **142.** The shafts **140** and **142** are mounted in bearings **144** and **146** that are bolted or otherwise affixed to frame support brackets **148** and **150.** The shafts **140** and **142** are each provided with a sprocket intermediate the bearings **144** and **146** which support the shafts. A drive chain **152** is trained about these sprockets so that the shafts **140** and **142** will be rotated in unison to effect an eccentric motion of the plate **132** to effect the alignment of the duct boards. The shaft **140** is provided with a second sprocket **154** through which the aligning assembly is driven by means of a drive chain **156.** As the shafts **140** and **142** are rotated, the bar **132** is moved inwardly and toward the cutting station and outwardly and away from the cutting station during each rotation of the shafts **140** and **142.** The alignment of the duct boards is effected as the bar **132** is moving inwardly and toward the cutting station.

As best shown in FIG. **6,** the drive chain **156** is also trained about a sprocket **158** mounted on a shaft **160.** The shaft **160** is rotated by a drive chain **162** that is trained about a sprocket **164** mounted on the shaft **160** and another sprocket (not shown) that is mounted on a shaft **166.** The shaft **166** is rotated through a drive chain **168** which is trained about a sprocket **170** mounted on the shaft **166** and a drive sprocket **172** of a motor **174.**

As shown in FIG. **2** the other aligning assembly is driven off of the shaft **166** by a drive chain **176.** The drive chain **176** passes around a portion of a sprocket **178** which drives the aligning mechanism, about an idler sprocket **180** and about a sprocket (not shown) on the shaft **166.** This construction is necessary to assure that the aligning assembly on this side of the machine will have the same inward and forward movement toward the cutting station as the other aligning assembly.

The feed assembly **96** includes a bar **182** which extends perpendicular to the direction of travel of the duct board through the cutting station and which is reciprocated back and forth by an eccentric drive assemlby **184.** The bar is provided with a pin **186** and **188** adjacent each end which projects upwardly from the bar and through an arm **190** and **192.** The pins **186** and **188** are rotatably mounted in the arms **190** and **192.** The arms **190** and **192** are in turn carried by arms **194** and **196.** The arms **194** and **196** are welded or otherwise secured to the bottoms of shafts **160** and **166** and the arms **194** and **196** rotate with these shafts. The arms **190** and **192** are secured to the arms **194** and **196** by pins **198** and **200** which permit relative rotation between these members.

Plates **202** and **204** are welded or otherwise secured to the ends of the bar **182.** The plates **202** and **204** project perpendicularly from the bar in a horizontal direction. Each plate carries a pair of rollers **206** and **208** respectively, which are received within channel members **210** and **212** extending in a direction parallel to the direction of movement of the duct board through the cutting station. With these guides to restrain lateral movement of the bar **182** the eccentric drive assembly **184** effects a reciprocating movement of the bar **182** when shafts **160** and **166** are rotated. In addition, since these shafts are the same shafts which are rotated to drive the aligning assemblies **94** the alignment of the boards is affected at the same time the boards are being fed into the cutting station **22.**

The guide assembly **98** includes a grid work **214** against which the uppermost duct board is pressed when the duct board is in position to be fed into the cutting station **22.** The guide assembly also includes a guide rail **216** which has an upper surface or edge **218** adjacent the feed roll **76** which lies in substantially the same plane as the upper surface of the feed roll **76.** A portion **220** of the upper surface of the guide rail **216** adjacent a leading edge of the guide rail and adjacent each end of the rail is inclined downward from the trailing edge **218.** The rail thereby presents a surface over which lateral portions of the duct board can slide so that they will be elevated to the proper elevation for feed between the feed rolls **74** and **76.** The grid **214** in combination with the rail **216** combine to assure that any duct board being fed from the feed station **24** into the cutting station **22** is substantially flat so that the duct board will not become jammed in the apparatus.

The machine includes a control assembly, which comprises a control panel **222** plus limit switches **224,** 226 and **228.** The limit switch **224** is provided to actuate the control mechanism to halt the raising of the elevator when a duct board is in contact with the grid **200.** The limit switch **226** is provided to actuate the control system to effect alignment of the duct board and the feed of the duct board into the cutting station **22.** The limit switch **228** is provided to stop the feed mechanism once it has been reciprocated through a cycle to allow another duct board to be positioned for feed into the cutting station.

In operation, the duct boards are stacked on the platform **100** while the platform is in its lowermost position. Once the desired number of boards have been stacked on the platform **100** a main switch **230** of the control panel is turned on and the motor **108** for aligning the elevator assembly is actuated to raise the platform **100** unit a duct board is in contact with the grid **200.** As a duct board comes in contact with the grid **200,** lever arms of the limit switches **224** and **226** are depressed and the switches are actuated. The limit switch **224** disengages the elevator motor **108** to stop the platform from rising any further. Simultaneously the limit switch **226** actuates the motor **174** for the aligning and feed assemblies **94** and **96** to effect the alignment and feed of the uppermost duct board into the cutting station **22.** The plates **132** are wide enough that the uppermost duct board plus the two succeeding duct boards are all contacted by the plates. In this way the duct boards are contacted three times by the aligned assemblies **94** to assure that they are properly aligned before they are fed into the cutting station. Once the feed bar **182** has been reciprocated forward and back to its initial position, the limit switch **228** is contacted to stop the motor **174.** As soon as the duct board passes from the feed station the lever arms of the limit switches **224** and **226** return to their original position. Thus the limit switch **224** actuates the motor **108** for the elevator assembly to raise the elevator platform **100** to place the next duct board in position to be fed into the cutting station. The limit switch **226** actuates

the aligning and feed assemblies and the cycle described above is repeated.

As the duct board is pushed from the feed station, it rides up over the guide rail **216** and between the feed rolls **74** and **76.** The feed rolls **74** and **76** grip the leading edge of the duct and feed the duct over the guide roll **78** and between the knife blades **62** and the backing roll **70.** As the duct board passes between the knife blades **62** and the backing rolls **70** the duct board is cut, as shown in FIG. **8,** to form a board **232** having cutout portions **234** which enable the board to be folded into a duct. While the cuts can have various cross-sectional configurations depending on the type of joint to be formed, the facing sheets **236** on the lower side of the board remain in one piece. After exiting from the knife blades and backing roll, the duct board passes between the drawing rolls **82, 84,** and **86, 88.** These rolls grip the duct board as it passes from the cutting blades and backing roll to maintain the duct board in proper alignment throughout the cutting operation and to keep the duct board under tension for proper cutting. Once the duct board has exited from the rolls **86** and **88** it is ready for packaging or for installation.

What is claimed is:

1. Duct board cutting apparatus comprising;

cutting station means for cutting a board composed of fibrous material, said cutting station means including a knife blade means affixed to a support of the apparatus and backing roll means rotatably mounted on said apparatus beneath said knife blade means, said knife blade means contacting said backing roll means rearward of leading cutting edges of said knife blade means whereby a facing on a duct board can pass between said knife blade means and said backing roll without being severed,

means for rotating said backing roll,

means forward of said knife blade means and said backing roll for feeding and guiding board between said knife blade means and said backing roll means,

feed station means for automatically feeding board to said feed and guide means of said cutting station said feed station means including means for aligning said board prior to the feed of said board to said cutting station, and means for guiding said board into said feed and guide means of said cutting station which elevates lateral portions of said board relative to a central portion of said board to flatten said board to prevent said board from becoming jammed during passage into the cutting station, and

means rearward of said knife blade means and said backing roll means for drawing board between said knife blade means and said backing roll means and for keeping board in proper alignment for cutting as the board passes between said knife blade means and said backing roll means, said drawing roll means including a first pair and a second pair of rolls which are rotatably mounted on said apparatus on axes extending parallel to the axis of rotation of the backing roll with said first pair being mounted forward of said second pair, said first pair and said second pair of rolls each including an upper roll and a lower roll which lie in a common vertical plane with a lower surface of the upper roll being spaced from an upper suface of the lower roll a distance less than the thickness of the board being cut, and means for rotating said first pair and said second pair of rolls.

2. Duct board cutting apparatus as defined in claim **1** wherein:

said feed and guide means forward of said knife blade means and said backing roll includes a third pair of rolls which are rotatably mounted on said apparatus on axes extending parallel to the axis of rotation of the backing roll, said third pair of rolls including an upper roll and a lower roll which lie in a common vertical plane with a lower surface of the upper roll being spaced from an upper surface of the lower roll a distance less than the thickness of the board being cut and greater than the distances between the lower and upper surfaces of the first and second pair of rolls, and means for rotating said third set of rolls.

3. Duct board cutting apparatus as defined in claim **2** wherein:

said means for rotating said third pair of rolls rotates said third pair of rolls with a surface speed equal to the surface speeds of said first pair and said second pair of rolls.

4. Duct board cutting apparatus as claimed in claim **1** wherein:

said feed station means includes means for feeding an uppermost board from a stack of boards into said cutting station, and means for bringing a succeeding board into position to replace said uppermost board.

5. Duct board cutting apparatus as claimed in claim **4** and further comprising:

aligning means for aligning said uppermost board for feed into said cutting station.

6. Duct board cutting apparatus as claimed in claim **5** wherein:

said aligning means comprises a pair of elongate members extending generally parallel to the direction of travel of said board through said apparatus, said elongate members being mounted on said apparatus adjacent sides of said apparatus, and means for moving said elongate members toward each other and in the general direction of travel of said uppermost board as said uppermost board is being fed into said cutting station.

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