United States Patent

Gollobitz

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[54] VERTICAL ASSEMBLY APPARATUS

[72] Inventor: **Gregory N. Gollobitz,** Boca Raton, Fla.

[73] Assignee: **Behring Corporation,** Fort Lauderdale, Fla.

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[52] **U.S. Cl.** ..... **29/200 A,** 29/430

[51] **Int. Cl.** **B23p 19/00**

[58] **Field of Search** ..... 29/200 A, 200 J, 200 P, 430

[56] **References Cited**

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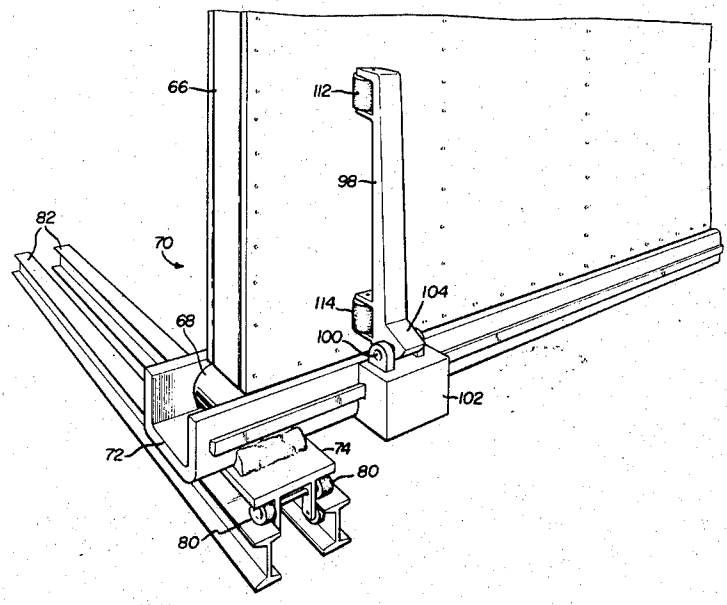
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Primary Examiner—John F. Campbell
Assistant Examiner—Donald P. Rooney
Attorney—Settle and Oltman

[57] **ABSTRACT**

Apparatus for assembling wall units for prefabricated buildings including a welding station where metal beams are assembled and welded together to form a wall unit, and a sheathing station where sheathing such as wallboard is applied to the wall units and fastened with screws. The wall units ride on a track from the welding station to the sheathing station, and the beams are assembled on the track at the welding station. The beams are assembled in a squared configuration with cap beams at top and bottom, and during assembly, the top beam is held above the assembly area by movable magnets. After the lower cap beam and the vertical beams are put in place, the upper cap beam is lowered by moving the magnets as with a solenoid to place the top beam on the ends of the vertical beams. The beams are then welded together. The wall unit is shifted to the sheathing station, and sheathing material is fastened to the wall unit, preferably with power screwdrivers. The screwdrivers may be mounted for both vertical and horizontal movement on a frame which rides on rails and shifts along a section of the assembly track. Completed wall units are transferred to holding units which may be moved along rails transversely of the assembly track.

12 Claims, 3 Drawing Figures



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SHEET 1 OF 2

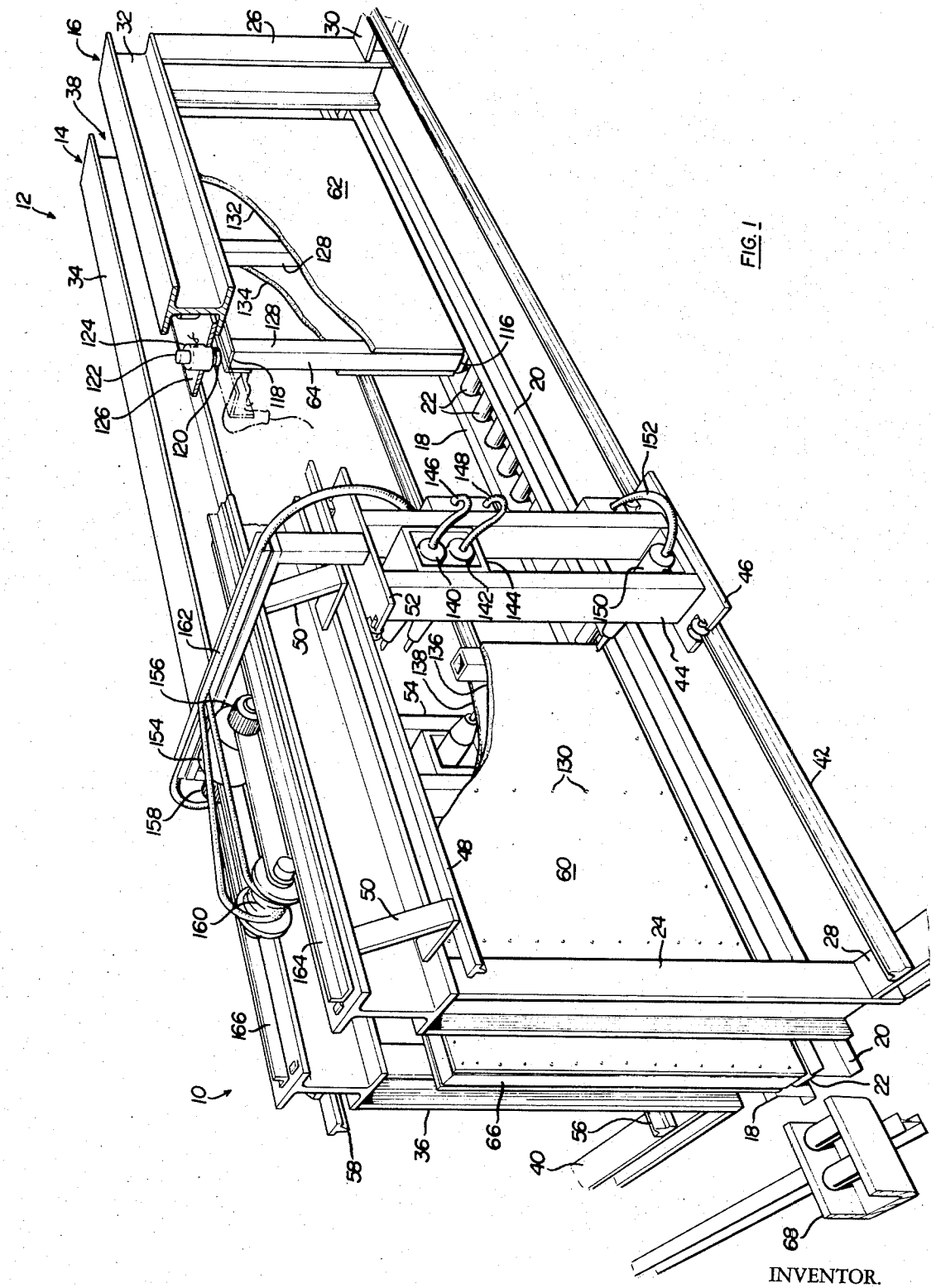


FIG. 1

INVENTOR.
GREGORY N. GOLLOBITZ.

BY

SETTLE & OLTMAN.
ATT'YS.

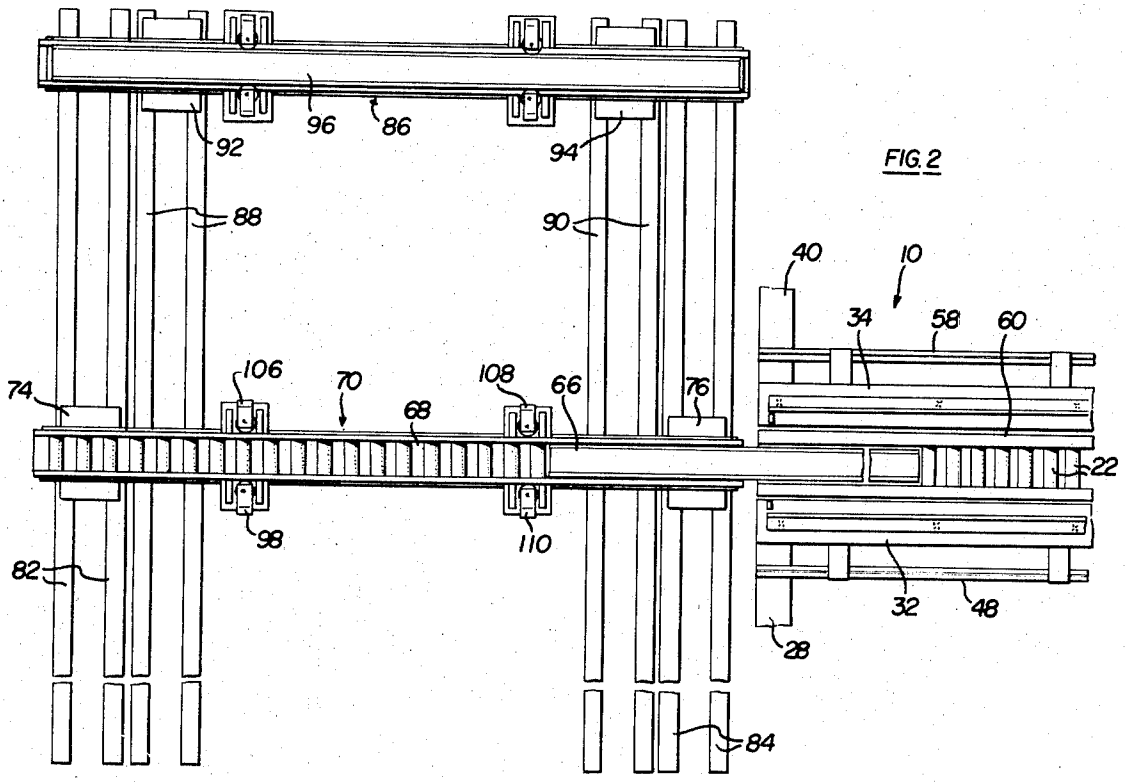


FIG. 2

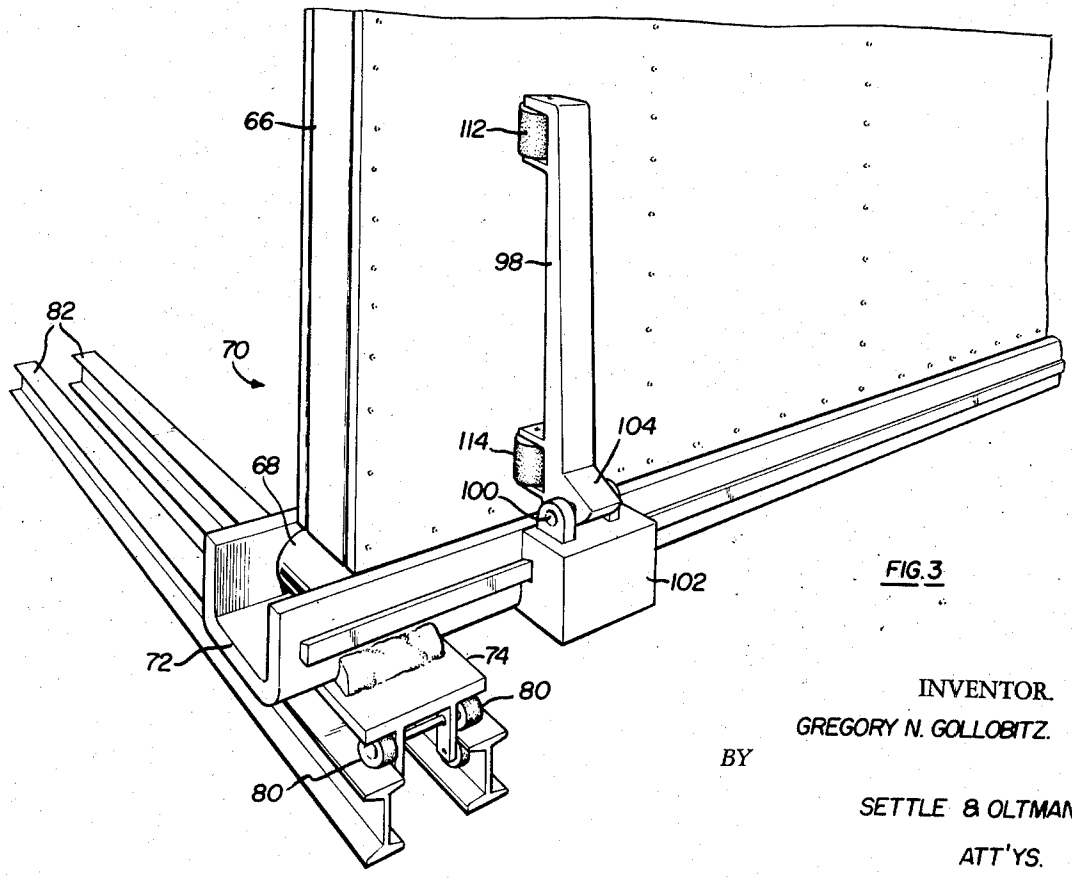


FIG. 3

INVENTOR.
GREGORY N. GOLLOBITZ.
BY
SETTLE & OLTMAN.
ATT'YS.

VERTICAL ASSEMBLY APPARATUS

BACKGROUND OF THE INVENTION

Manufactured housing is being developed and applied commercially on an ever increasing scale. Economies in time, materials, and labor can be achieved through manufactured housing. In order to realize these economies, however, the manufacturing methods and apparatus which are employed must make maximum use of the materials and labor at hand, rather than merely transposing site construction techniques into a factory. The present invention is concerned with the fabrication of walls for prefabricated buildings. A wall or a section of a wall is normally built as a unit or subassembly which is later put together with other walls, floor, and ceiling or roof units to form a module. The modules are transported from the factory to a building site, and are assembled together to form a building which may be a home, apartment, townhouse, school, office building or the like.

According to one method of manufacturing buildings, metal beams are assembled together into rectangular or square frames, and the beams are welded together to unitize the frames. Such frames are used for wall units, floor units and roof units. Commonly, the beams are assembled by laying them horizontally on a fixture which positions the beams properly so that they can be welded together. It has been found, however, that fabricating wall units in this manner has some drawbacks. For example, it is necessary to apply sheathing to both sides of most wall units, and if the beams are assembled on a horizontal fixture, it is necessary to turn the wall unit over after sheathing has been applied to one side in order to apply sheathing to the other side. Also, the horizontal wall fixture occupies considerable space, and where several assembly stations for wall units are provided in a factory, this requires a considerable investment in factory space.

SUMMARY OF THE INVENTION

In accordance with the present invention, wall units are assembled, welded, and sheathed in a vertical assembly fixture which occupies considerably less horizontal space than the horizontal fixture described previously, and in which assembly operations, welding operations, and sheathing operations can be carried out on both sides of the wall unit without inverting the wall unit. Such operations may be carried out on both sides simultaneously, if desired, but this is not essential. The vertical assembly apparatus includes an elongated track on which wall units may ride so that they may be shifted from one station to another. The apparatus includes an assembly and welding station where beams for wall units are assembled together on the track and welded together to form a wall unit. In one embodiment, the wall unit includes upper and lower cap beams with vertical beams extending between the cap beams. The lower cap beam is placed on the track, and the upper cap beam is initially held aloft with magnets. The vertical beams are placed between the cap beams, and then the upper beam in lowered onto the upper ends of the vertical beams. The beams are then welded together to form the wall unit. The wall unit is then shifted along the track to a sheathing station where sheathing material such as wallboard is applied to the wall unit. The sheathing material is preferably fastened

with screws, and power screwdrivers are provided at the sheathing station for this purpose. The power screwdrivers may be mounted on a frame which travels horizontally on rails to provide horizontal coverage of the wall unit, and the screwdrivers may be movable vertically on the frame to provide vertical coverage of the wall unit. However, other means of shifting the screwdrivers may be employed. The apparatus may also include a holder for receiving the wall units from the sheathing station, the holder serving to store the wall units until they are needed on a production line where wall units are assembled with roof and floor units. The holder may be movable relative to the rest of the apparatus for transporting the wall units to a module assembly station.

Accordingly, it is an object of the present invention to provide apparatus in which wall units may be assembled, welded, sheathed, and stored with the wall units remaining in a vertical position throughout the fabrication process.

Another object of the invention is to provide an apparatus having an assembly and welding station with means for assembling vertical beams with upper and lower cap beams for welding of the beams to form a wall unit, and a sheathing station to which the wall units are shifted and where sheathing material is applied to the wall units. This separation of assembly and sheathing functions into distinct stations economizes time and makes efficient use of labor.

Another object of the invention is to provide an apparatus with one or more holders for receiving wall units from the sheathing station and for storing the wall units until they are needed on a production line where modules are assembled.

A further object of the invention is to provide means at the assembly and welding station for positioning horizontal cap beams above and below vertical stud beams and assembling the beams together so that they can be welded.

Another object of the invention is to provide screwdriving means at the sheathing station for driving screws through the sheathing into the underlying beams for applying the sheathing to the wall units.

Other objects of this invention will appear from the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a vertical assembly apparatus showing the assembly and welding station, the sheathing station, and a portion only of the holding station;

FIG. **2** is a plan view of the holding station, which is shown only partly in FIG. **1**, with one holder positioned adjacent the end of the sheathing station, and with another holder shifted along rails transversely of the sheathing station; and

FIG. **3** is a fragmentary perspective view of a portion of the holder showing a wall unit being held in a vertical position in the holder.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrange-

ment of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

AS SHOWN ON THE DRAWINGS

The vertical assembly apparatus **10** includes a frame designated generally **12** including two sections **14** and **16**. The frame consists of horizontal track beams **18** and **20** which are parallel to each other, and to which rollers **22** are fastened so as to form a long, horizontally extending track. Attached to the track beam **20** are vertical posts **24** and **26**. The posts **24** and **26** may be anchored by means of footings **28** and **30** which are welded to posts **24** and **26** and anchored to the floor. Spanning the beams **24** and **26** is a crossbeam **32**. It may be seen that the frame section **14** includes another crossbeam **34** which likewise spans vertical posts **36** and **38** (post **38** not visible), the posts being attached to track beam **18** and anchored as with footings such as **40**.

Bridging the footings **28** and **30** is a rail **42** on which a screwdriving frame **44** rides by means of a truck **46**. Another rail **48** is suspended from the crossbeam **32** on braces **50**, and an upper truck **52** of the screwdriving frame **44** rides on the upper beam **48**. An identical screwdriving frame **54** is provided on the other side of the apparatus, and it rides on similar rails **56** and **58**.

The screwdriving frames **44** and **54** are located at a sheathing station **60** which is at one end of the main frame **12**. At the other end of the main frame **12**, there is an assembly and welding station **62**. At the assembly and welding station **62**, metal beams are assembled on the track **22** to form a wall unit **64**. Another wall unit **66** is shown at the sheathing station **60** after sheathing has been applied. A given wall unit may be shifted along the track **22** by rolling to transfer it from the assembly and welding station **62** to the sheathing station **60**.

Aligned with the end of the track **22** is another track **68** which is part of a holding unit **70** shown most clearly in FIGS. **2** and **3**. In the latter figures, the wall unit **66** is shown as it is being transferred from the sheathing station **60** to the holding unit **70**. The track **68** consists of rollers mounted on a channel member **72**. The channel member **72** is affixed to trucks **74** and **76** with wheels **80** which ride on rails **82** and **84** extending transversely of the tracks **22** and **68**. Thus, the holding unit **70** can be moved transversely of the apparatus **10** so as to shift the wall unit **66** away from the apparatus **10**. The wall unit can be stored in the holding unit **70** until it is needed on a production line (not shown) where the wall unit is assembled with a floor unit, a ceiling unit and other wall units to form a module. Since the holding unit **70** is movable, it can be shifted to the point on the production line where the particular wall unit is needed.

Another holding unit **86** is shown in FIG. **2**, this holding unit being mounted on tracks **88** and **90** and riding on those tracks on trucks **92** and **94**. A wall unit **96** is shown in the holding unit **86**. Thus, it is apparent that more than one holding unit may serve a given sheathing station **60**.

Referring again to FIG. **3**, it may be seen that there is a retractable arm **98** pivotally mounted at **100** on a block **102** which is attached to the channel **72**. The arm **98** is urged to a vertical position, but may be pivoted downwardly until the projection **104** stops on the block **102**. In FIG. **2** it may be seen that there are identical arms **106**, **108** and **110**, with arms **98** and **106** being arranged in a pair on opposite sides of the track **68**, and arms **108** and **110** being arranged in a pair on opposite sides of the track **68** at the other end of the track. Thus, the wall unit **66** is received between the pairs of arms and is held in a vertical position by the arms. Each arm has a pair of rollers **112** and **114** mounted on it so that the wall unit can be moved easily into position between the arms and can also be removed easily from the holding unit.

Referring to FIG. **1**, at the assembly and welding station **62**, a lower cap beam **116** is initially placed on the track **22**, and an upper cap beam **118** is raised to the upper portion of the station **62** and held in a raised position on magnets **120** (only one magnet shown). The magnet **120** is on the end of a solenoid core **122** which is controlled by an electrical coil **124**. An identical magnet and solenoid structure is provided at the far end of the station **62**, and the solenoids may be supported on a plate **126** which is affixed to the crossbeams **32** and **34**. Vertical stud beams **128** are positioned between the cap beams **116** and **118**, with the lower ends of the stud beams resting on the lower cap beam **116** and the upper ends of the stud beams under the raised upper cap beam **118**. The magnets **120** hold the upper cap beam **118** above the stud beams **128**. When all of the beams have been properly positioned, the solenoid coils **124** are pulsed electrically to move the solenoid cores **122** and the magnets **120** downward, and thus lower the upper cap beam **118** onto the upper ends of the stud beams **128**. The solenoids remain energized to hold the beams together while they are welded.

Welding is accomplished with conventional welding guns which may be of the metal-inert gas type. The welding may be accomplished either manually or automatically, and in the illustrated embodiment, manual welding is utilized. The welders may stand on platforms on opposite sides of the wall unit **64**, and it may be seen that no shifting of the wall unit is required in order to weld on both sides of the wall unit. This is not to imply that the wall unit must be in an absolutely vertical position; it could be slanted slightly if desired.

After the welding is accomplished, the wall unit may be shifted to the sheathing station **60** where sheathing material is applied. The sheathing may be entirely applied at the station **60** or, as illustrated in FIG. **1**, the sheathing may initially be applied with adhesive to the wall unit at the assembly station **62**. Thus, in the illustrated embodiment, the sheathing is assembled and temporarily affixed with adhesive at station **62**, and then the wall unit is moved to the sheathing station **60** where the sheathing is permanently affixed with screws **130**. The sheathing on the wall unit **64** is identified as **132** and **134**, and the sheathing on the wall unit **66** is identified as **136** and **138**. The sheathing may be wallboard material such as gysum board.

At the sheathing station **60**, the screws **130** may be driven with power screwdrivers, and these power screwdrivers may be either manually manipulated or

automatically manipulated. In FIG. 1, automatic manipulation of the screwdrivers is provided for. Two power screwdrivers **140** and **142** are mounted in a box **144** which is movably mounted on a screwdriver frame **44**. The screwdrivers **140** and **142** are operated pneumatically by air supplied through hoses **146** and **148**. A third screwdriver **150** is mounted at the bottom of the frame **44** for driving the row of screws at the bottom of the wall unit as shown. Air is supplied to screwdriver **150** via a hose **152**.

The screwdrivers **140** and **142** may be raised and lowered on the frame **44** by means of a mechanical drive (not shown). The entire frame **44** may be moved back and forth across the sheathing station **60** by means of a mechanical drive which includes a motor **154**, drive wheels **156** and **158** driven by the motor, and a reel **160** for handling air connections. The drive motor **154** is attached to a crossarm **162** which is mounted on the frame **44** and also on the other frame **54** on the opposite side of the apparatus. The drive wheels **156** and **158** ride on rails **164** and **166** mounted on top of the beams **32** and **34** respectively.

Thus, by proper coordination of the drive motor **154** and the motor for vertical manipulation of the screwdrivers **140** and **142**, these screwdrivers can be shifted both vertically and horizontally to drive the screws **130**. The screwdrivers have means for automatically feeding screws through them to the wall unit so that the entire screwdriving operation may be automatic. As previously mentioned, however, the invention embraces the provision of automatic power screwdrivers at the sheathing station **60** which screwdrivers are manipulated manually.

After the sheathing has been applied to the wall unit, it is shifted to the holding unit **70** as previously described and is then ready to be assembled with other wall units, a floor unit and a roof unit in order to provide a building module.

It may be noted that the sheathing is applied and the screws are driven while the wall unit remains in a vertical position. The wall unit remains in a vertical position while all of the assembly, welding, screwdriving and storage steps are carried out, and this cuts down on the space required for carrying out these operations as compared with horizontal jigs. A considerable amount of horizontal space is saved in this manner. It may be noted also that the operations just referred to can be carried out on both sides of the wall unit without inverting the wall unit. The operations could be carried out on both sides of the wall unit simultaneously if desired, although this is not essential. The assembling of the wall beams is aided by electromechanical means, and the driving of screws at the sheathing station may be accomplished automatically. By providing more than one holding unit to serve a single sheathing station, rapid and efficient utilization of wall units is assured. It may be noted, however, that the wall units can be removed from the holding units **70** for further storage when this is desirable.

Having thus described my invention, I claim:

1. Apparatus for assembling wall units for prefabricated buildings, comprising an elongated track on which a wall unit may ride, lowering means supported above said track and including a magnet and means for lowering said magnet with a horizontal beam held by the magnet so as to assemble the beam with other beams on said track comprising vertical beams and a second horizontal beam to provide a wall unit, said wall unit beams being welded together and then shifted along said track, and said apparatus including a sheathing station receiving said shifted wall unit at a section of said track remote from said lowering means which station has means including at least one power screwdriver for fastening sheathing to said wall unit with screws.

2. The apparatus as claimed in claim **1** in which said means for lowering said magnet includes a solenoid.

3. The apparatus as claimed in claim **1** in which said fastening means includes at least one power screwdriver on each side of said track.

4. The apparatus as claimed in claim **3** in which said power screwdriver is movably mounted for vertical movement on a frame shiftable horizontally of said sheathing station to provide screwdriving coverage of an area of a wall unit at said station.

5. Apparatus for assembling wall units for prefabricated buildings, comprising an elongated track on which a wall unit may ride, a frame having first and second rail means spaced from each other with one of said rail means at about the height of said track and the other of said rail means located above said track, lowering means supported above said track and including a magnet and solenoid means for lowering said magnet with a beam held by the magnet so as to assemble the beam with other beams on said track to provide a wall unit, and screwdriving means movably mounted on said rail means and shiftable along a section of said track for fastening sheathing material to said wall frame unit.

6. The apparatus as claimed in claim **5** in which said screwdriving means is shiftable along said rail means at a screwdriving station remote from said lowering means.

7. The apparatus as claimed in claim **6** further including holder means receiving the wall units from said sheathing station.

8. The apparatus as claimed in claim **7** in which said holder means includes a track separate from said first-named track and movably mounted on rails which are transverse to said first-named track, so that said holder may be aligned with said first-named track to receive the wall unit from said sheathing station and then shifted transversely away from said first-named track.

9. The apparatus as claimed in claim **8** in which said holder includes retractable arms projecting upward on opposite sides of said second-named track for bracing the wall unit thereon.

10. The apparatus as claimed in claim **9** in which said arms have wheels thereon.

11. Apparatus for assembling wall units for prefabricated buildings, comprising an elongated track on which a wall unit may ride, lowering means including a magnet supported above said track for attracting and holding a first horizontal beam in a raised position and for lowering said beam to assemble the same with other beams including vertical beams and a second horizontal beam resting on said track to form a wall unit, said wall unit being movable in a vertical position along said track.

12. The apparatus as claimed in claim 11 in which said lowering means includes a solenoid for lowering said magnet to thereby lower said first horizontal beam.

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