June 15, 1971 R. L. STORER 3,585,092

APPARATUS AND METHOD FOR FABRICATING WALL SECTIONS

Filed Sept. 29, 1969 2 Sheets-Sheet 1

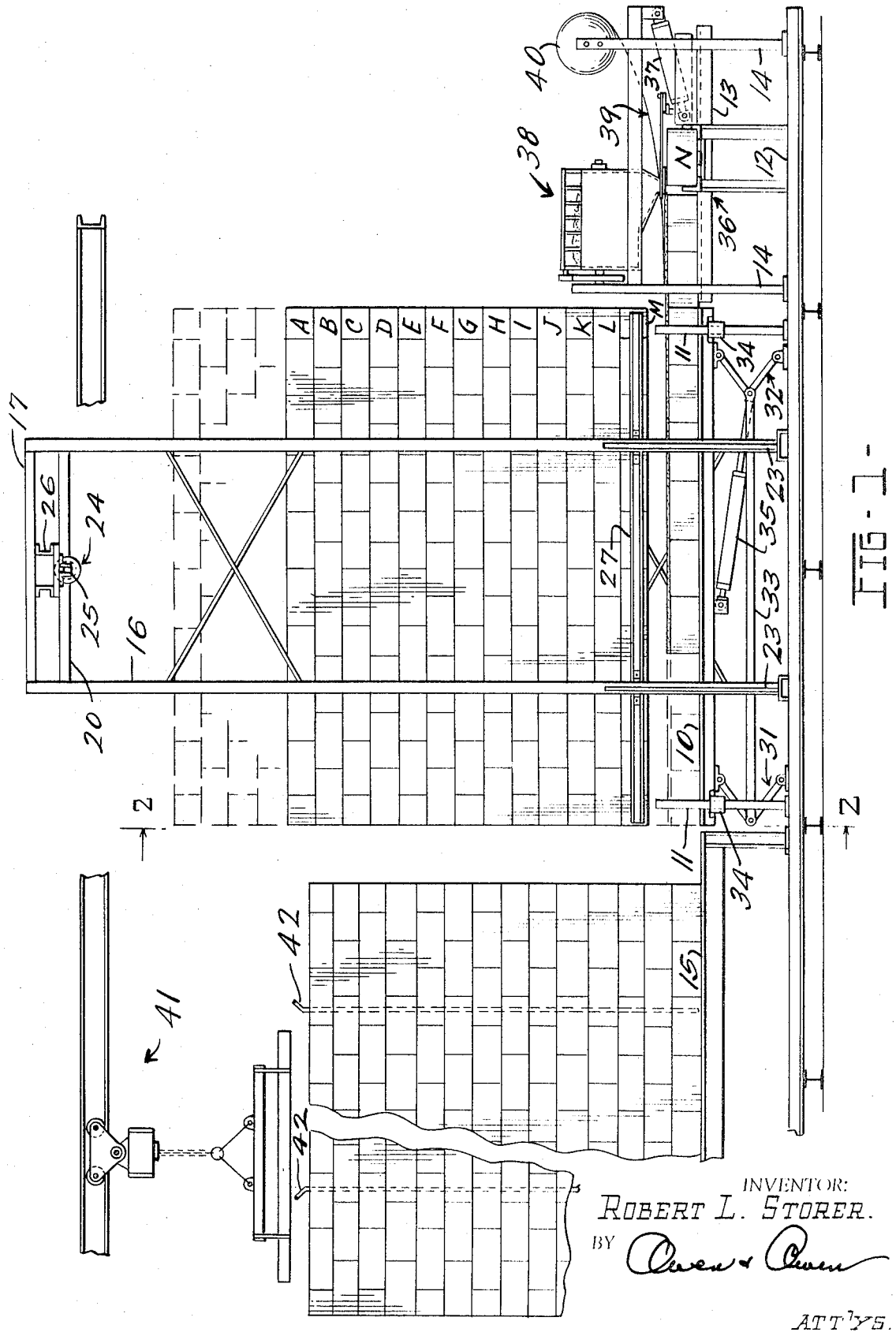


FIG. 1.

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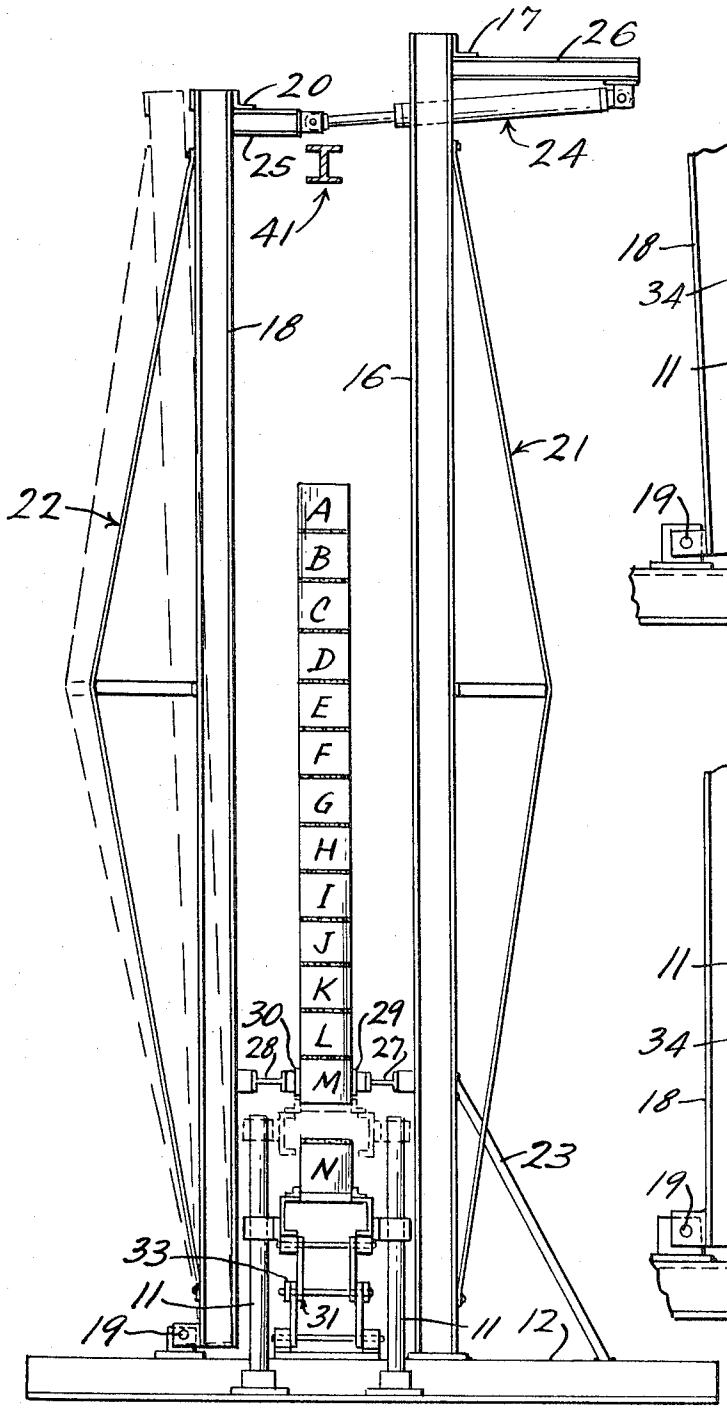


FIG-2-

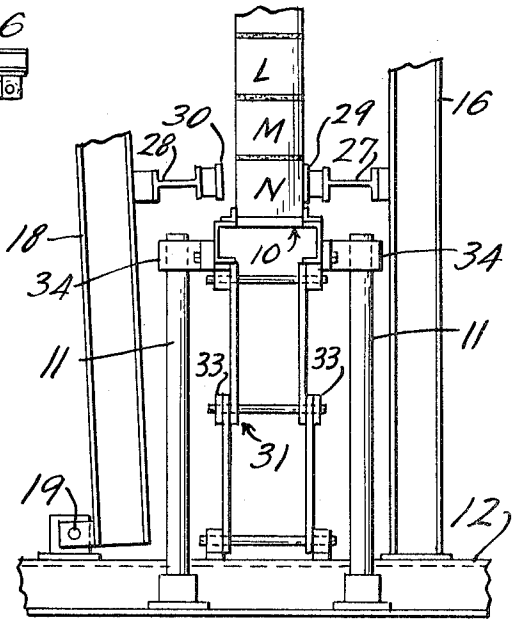


FIG-4-

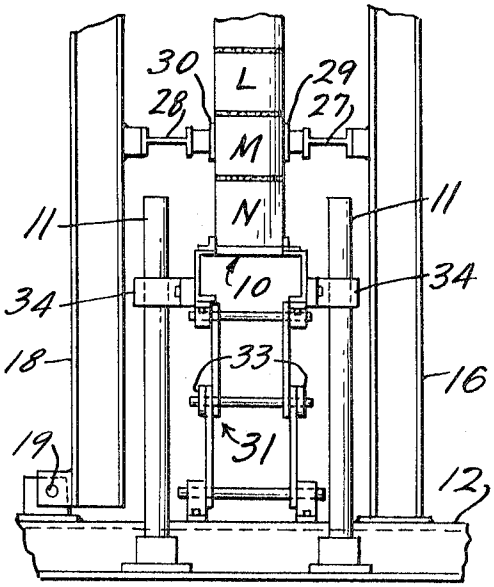


FIG-3-

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3,585,092

APPARATUS AND METHOD FOR FABRICATING WALL SECTIONS

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U.S. Cl. 156—182 17 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for constructing modular sections of concrete block or brick walls which sections are subsequently transported to the construction site and installed. The apparatus includes a horizontal bed upon which each course or row of blocks is assembled with head and bed mortar applied thereon. Above the horizontal bed is a clamp and support frame which engages the faces of the previously formed row to hold it above the horizontal bed. An elevating mechanism is provided to raise the horizontal bed to force the row thereon into engagement with the row above held by the clamps and, upon release by the clamps, to raise the bottom row and previously formed upper rows to a position where the clamps will engage the newly formed bottom row. The method of the apparatus is to construct the wall section from the top down by adding new rows under those already formed until the desired section height has been attained.

BACKGROUND OF THE INVENTION

This invention relates to an apparatus for constructing modular brick or concrete block wall sections which are subsequently transported to the erection site and jointed to form a wall or divider of desired configuration. More particularly, the instant invention includes a method and apparatus for carrying out the method of fabricating a wall section composed of a vertical array of rows of individual bricks and blocks by sequentially building the rows in a vertical stack by adding rows beneath previously constructed rows so that the wall is, in effect, built from the top down.

A number of prior art machines have been developed for laying bricks or concrete blocks with mortar in which the brick or block laying machine constructs a wall in the sequence used by a mason in which rows of the bricks or blocks are continuously laid one upon another to build up the wall to desired height. For example, U.S. Pat. 3,438,171 discloses one such machine which, as is the case in all known prior art machines, requires the bricks, mortar and laying apparatus to progressively move upwardly as the height of the wall being built increases. One disadvantage, in addition to the increased cost of the mechanism which must move upwardly as the work progresses, is the fact that the mechanism itself must be heavy enough to provide the setting force to push the uppermost blocks down upon the row beneath them in order to properly embed them in the mortar.

One suggested approach to overcome the necessity of providing a heavy machine capable of exerting such a setting force has been to attach a portion of the machine to the wall being built to effectively pull down upon the last row of bricks being set against the previously laid rows. Such device is disclosed in U.S. Pat. 3,325,960. However, this type of device must also move upwardly, along with the mortar and bricks, as the height of the wall being built increases.

It is a primary object of this invention to provide a method and apparatus for constructing a block or brick wall in which the brick applying and mortar applying mechanisms remain at the same level and which is capable of applying a uniform setting force upon the bricks being laid against the bricks previously laid.

SUMMARY OF THE INVENTION

The apparatus of the present invention provides a brick or block laying device in which subsequent rows of blocks or bricks are formed beneath previously laid rows which are suspended above the newly formed row until that newly formed row is firmly engaged with the bottom surface of the last previously formed row. After this has been done, the entire wall section is raised away from the work surface and a subsequently formed row is laid. This process is repeated as the wall is built from the top down until the desired height has been reached.

Through use of the instant invention, it is possible to fabricate modular wall section at a factory site for subsequent transportation to the installation site. This has a number of advantages. First, weather conditions inside a factory or warehouse can be closely controlled so that variations in temperature and humidity will not effect the speed of the construction or ultimate strength of the mortar bond. Second, a repetitive machine-type operation is effective to eliminate many variables which occur through human error, variations in materials and mortar consistency, etc. Finally, such prefabricated wall sections have other advantages such as the reduction of the amount of excavation necessary for a subterranean wall because the need for working space for a mason is eliminated. Transit and storage costs of individual bricks, mortar and equipment to the construction site are reduced. Other advantages will be apparent to those skilled in the art from the following description of a preferred embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in perspective of a preferred embodiment of the apparatus of this invention, showing a central wall supporting and erecting zone with a block feeding and mortar applying apparatus to one side thereof;

FIG. 2 is a cross sectional view of elevation of the apparatus of FIG. 1, taken along line 2—2 of FIG. 1;

FIG. 3 is an expanded view of a portion of the cross sectional view of FIG. 2, showing some details of the movable support bed for the wall section under construction; and

FIG. 4 is a cross sectional view similar to FIG. 3 but showing the movable support bed in a different position.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

It is to be understood that the apparatus and method concepts of this invention can be utilized in the construction of brick or block walls of any nature, or of any other type of construction where a plurality of individual sized pieces are adhesively adhered or bonded to one another in vertical rows. From the following description of the preferred apparatus, reference will be made only to the use of concrete blocks, it being understood that the concepts described herein can be used with equal facility for bricks or other types of construction materials.

The apparatus shown in FIG. 1 includes a horizontal support bed **10** which is guided for reciprocating vertical movement by four fixed vertical guide pins **11** secured to a base **12** which extends across the floor below the support bed **10**. A fixed table **13** is positioned to have its inner end closely adjacent one end of the support bed **10** and is supported by legs **14** secured to the base **12**. At the other end of the support bed **10** is a storage pallet **15** upon which a modular wall section may be placed after it has been constructed in the apparatus of this invention.

Referring to FIG. 2, a fixed pair of vertical frame members **16** extend upwardly from the base **12** and are spaced apart from one another, as seen in FIG. 1, and joined by an upper cross member **17**. On the other side of the support bed **10** is a pair of movable vertical frame members **18** with their lower ends pivotally secured to the base **12** by a pivot connection **19** and with their upper ends joined together by a movable upper cross member **20**. The distance between the pair of movable frame members **18** is the same as the distance between the pair of fixed frame members **16**. These frame members **16** and **18** are preferably fabricated from structural steel I-beams and can be reinforced with an integrally formed truss **21** or **22** as shown in FIG. **2**. The attachment of the fixed frame member **16** to the base **12** may be reinforced by an angular strut **23**.

Connected between the upper cross members **17** and **20** is a hydraulically actuated, double acting piston and cylinder **24** pivotally secured to rigid extensions **25** and **26** from the cross members **20** and **17**, respectively.

Extending horizontally between the pairs of the frame members **16** and **18** are a pair of opposed clamping rails **27** and **28** which, as best seen in FIG. 1, are generally coextensive with the support bed **10** and are secured rigidly to the inner faces of the pairs of frame members **16** and **18**, respectively. The clamping rails **27** and **28** may also be fabricated from structural steel I-beams and preferably have on their inner surface a semi-resilient pad **29** or **30** which will engage the faces of the concrete blocks being clamped between the clamping rails **27** and **28**, as will be subsequently explained. As will be subsequently explained, the position of the piston and cylinder **24** at the top of the rails **16** and **18** gives the mechanism a large leverage to apply a large clamping force between the rails **27** and **28** which are located closer to the pivot **19**.

A pair of toggle connections **31** and **32** are pivotally attached to a lower surface of the support bed **10** at each end and the base **12** and have their movable pivot connected by a link arm **33** so that movement of the toggle connections **31** and **32** will cause vertical movement of the support bed **10** relative to the base **12**, as the support bed **10** is guided by its sleeves **34** which move along the guide pins **11**. This arrangement assures that the support bed **10** will remain parallel to the base **12** and rails **27** and **28**. A hydraulically actuated piston and cylinder **35** is connected between the lower side of the support bed **10** and the moving pivot of the toggle connection **32** so that extension of the piston and cylinder **35** causes upward movement of the support bed **10** while retraction thereof causes downward movement of the support bed **10**.

The table **13** at the right end of the support bed **10**, as seen in FIG. 1, contains a horizontal track upon which individual blocks are placed to form a new row of blocks on the support bed **10** when in its lower position. The blocks are placed in a carrier **36** which is moved to the left toward the support bed **10** by a hydraulically actuated ram **37** whose stroke is substantially the same as the length of one of the blocks so that sequential actuation of the ram will push each block from the right hand most position to the next position to the left, to thus form a complete row on the support bed **10**.

Positioned above the table **13** is a mortar mixer and applicator, generally designated by reference numeral **38**, which is adapted to apply both head and bed mortar on each of the blocks as they pass thereunder in the carrier **36** on their way to the support bed **10**. The details of construction and operation of the mortar mixer and applicator **38** do not constitute a part of this invention. Such applicators are known to those skilled in the art and need be only effective to apply sufficient head and bed mortar to connect the blocks to those within the row and to the row immediately above.

If additional strength for a particular wall section is desired, strips of reinforcing screen or wire **39** may be fed upon the upper surface of the row of blocks being formed from a reel **40** positioned at the right hand side of the table **13**.

Finally, an overhead crane, schematically illustrated in FIG. 1 and designated by reference numeral **41**, or other suitable transport device is provided to transport a panel which has been built over the support bed **10** to the storage pallet **15**.

SEQUENCE OF OPERATION

Operation of the apparatus may be better understood if it is assumed that a portion of the wall being constructed has already been completed and is supported, as best seen in FIG. 2, by the closed clamping rails **27** and **28** which engage the sides of the lowermost row of blocks M. Resting upon this lowermost row of blocks M are the previously laid rows A–L.

(1) With the previously formed wall comprising rows A–M held above the support bed **10**, a newly formed row N is pushed over the support bed **10** by adding one block at a time on the carrier **36** and moving it to the left with the ram **37** until a complete row N has been formed.

(2) With the new row N positioned on the support bed **10** below the previously formed rows A–M, and with mortar applied to the bed **10** on the upper surface of the new row N, the piston and cylinder **35** is extended to move the bed **10** and row N upwardly to press the mortar on the upper surface of row N against the lower surface of row M held by the clamps **27** and **28**. It is this engagement which embeds the mortar into the adjacent surfaces, which is important in creating a tight bond between the rows. The force applied between the blocks in the rows M and N is independent of the number of rows previously formed because the row M is secured between the closed clamping rails **27** and **28**. The amount of force to be applied and the length of time that this pressure between the rows M and N should be maintained is determined by the type of blocks being joined, the nature of the mortar, and the strength requirements of the end product. The predetermined force required can be easily attained by control of the output pressure from a constant displacement hydraulic pump used to supply hydraulic fluid to the piston and cylinder mechanism **35**, as will be appreciated by those skilled in the art. Through use of this arrangement, uniform pressures may be applied between all rows of blocks in the wall, and pressures much greater than those obtainable by hand or by conventional block or brick laying machines may be obtained.

(3) Following the application of pressures to bond the faces between the rows M and N, the force urged the support bed **10** upwardly is relaxed to release the pressure against row M but to maintain the position of the row N in contact with the row M.

(4) At this time, the hydraulic piston and cylinder **24** is extended to pivot the movable frame members **18** and the attached clamp rail **28** away from the fixed frame member **16** to disengage the clamping rails **27** and **28** from the row M. The entire wall including rows A through N is now supported by the support bed **10** in its intermediate position.

(5) With the wall resting upon the support bed **10** and the clamps **27** and **28** in open position, the piston and cylinder **35** is further extended to raise the support bed **10** and the entire wall including rows A through N upwardly to its uppermost position at which the newly formed row N is at the level of the clamping rails **27** and **28** as shown in FIG. 4. At this position, the newly formed row N has replaced the row M as being the bottom row positioned between the clamping members **27** and **28**, as was shown in FIGS. 1 and 2.

(6) With the newly formed row N at the level of the clamping members **27** and **28**, the hydraulic controls to the piston and cylinder **24** are shifted to retract the piston so that the clamping members **27** and **28** now engage row N to hold the entire wall of rows A through N above the support bed **10**.

(7) Finally, the hydraulic control to the piston and cylinder **35** are shifted to retract the piston so that the support bed **10** returns downwardly to its lower position even with the table **13** so that a new row, which would be designated as row O, can be formed upon the support bed **10.** As is evident from the above description, the cycle repeats until the desired number of rows has been formed for a wall of a predetermined height.

The apparatus described is effected to carry out the process of building a block wall from the top down which is advantageous in that the apparatus itself, mortar and blocks all remain at one level during the entire operation and need not be raised as the height of the wall increases. In addition, the apparatus is capable of applying a uniform and large setting pressure between the rows of blocks, regardless of which row is being constructed.

Modular wall panels constructed by the apparatus of this invention can be transported, in vertical position, to the construction site by existing equipment and can be stored in vertical position prior to use in a relatively small space. Using 8 x 8 x 16 inch hollow concrete blocks, an 8 x 12 foot wall weighs about four thousand pounds. Larger panel sections, such as 10 x 20 feet, can be constructed and may include additional reinforcing members, such as the screen **39** and vertically extending reinforcing rods to reinforce the mortar bond and to assist in transportation of the panels. For example, using the apparatus shown in FIG. 1, a plurality of reinforcing rods **42** extend vertically through the spaces in the blocks in the panel shown on the pallet **15** and have hooks at their upper end which may be used for moving the wall section by a crane or other lifting device. The reinforcing rods **42**, are inserted through the vertically stacked blocks after the panel has been completed or can be suspended to hang vertically over the support bed **10** at a position in alignment with the holes in the blocks so that as the rows are built up, they slide upwardly on the reinforcing rods **42** which are mortared or adhesively attached to the insides of the block.

The apparatus previously described can be manually controlled such that actuation of the piston and cylinders **24** and **35** and the ram **37** is controlled by an operator who manipulates a plurality of fluid control valves effective to control the action of these elements by interconnecting them with a hydraulic pump. The entire operation may be automated by a mechanical or electrical programmer which automatically controls the sequence of operation of these elements. The type of controller or power actuation of these elements which would be the most effective for a given installation will be apparent to those skilled in the art and the selection and design of such is not considered to be part of this invention. It is also to be understood that the movement effected by the pistons and cylinders **24** and **35** and the ram **37** can be accomplished by mechanical, electrical pneumatic or hydraulic equivalents to perform the sequence of operations described above.

Other modifications will be apparent to those skilled in the art and may be made without departing from the scope of the following claims.

I claim:

1. An apparatus for constructing sections of walls composed of a plurality of vertically stacked rows of end-to-end positioned blocks, comprising in combination, a bed for supporting a row of blocks placed in end-to-end relationship, a clamping device positioned above said bed and movable from an open position wherein a row of blocks may pass thereby to a closed position wherein a row of blocks is held by said clamping device above said bed, and means for moving said bed from a lower position at which said row of blocks supported thereon is below said clamping device, to an intermediate position where the upper surface of such row of blocks supported on said bed is pressed against the lower surface of a row of blocks held by said clamping device in said closed

position, and to an upper position where such row of blocks supported on said bed is positioned adjacent said clamping device in its open position whereby movement of said clamping device to its said closed position will clamp said row of blocks supported on said bed.

2. The apparatus of claim **1** which further includes means for applying mortar to said upper surfaces of said row of blocks supported on said elongate bed.

3. The apparatus of claim **1** wherein said bed extends horizontally beyond said clamping device and includes means for moving blocks in end-to-end fashion from said extended position to a position below said clamping device.

4. The apparatus of claim **3** which further includes means for applying mortar to the upper surface and ends of said blocks being moved from said extended position to said position below said clamping device.

5. The apparatus of claim **1** wherein said clamping device comprises a pair of parallel, opposed rails spaced above said bed and movable from an open position wherein said rails are spaced apart a distance larger than the width of said blocks to a closed position wherein said rails press upon opposed faces of the blocks therebetween.

6. The apparatus of claim **5** wherein one of said clamping rails is fixed relative to said bed and the other clamping rail reciprocates toward and away from said fixed rail.

7. The apparatus of claim **1** wherein said clamping device comprises a first pair of spaced apart vertical frame members secured at the ends of said bed on one side thereof, a first clamp rail secured between said first pair of vertical frame members and extending laterally above said bed, a second pair of vertical frame members positioned opposite said first pair on the other side of said bed, a second clamp rail secured between said second pair of vertical frame members opposite said first clamp rail, and means for reciprocating said second pair of frame members from an open position where said clamping rails are spaced apart on opposite sides of said bed a distance greater than the width of said blocks to a closed position where said clamping rails engage and hold the opposed faces of the blocks of a row positioned therebetween.

8. The apparatus of claim **7** wherein the lower ends of said second pair of vertical frame members are secured for pivotal movement toward and away from said first pair of vertical frame members and means secured between the upper ends of said first and second pairs of vertical frame members for causing said second pair to pivot toward and away from said first pair to thereby close and open said clamping device.

9. An apparatus for constructing sections of walls composed of a plurality of vertically stacked rows of end-to-end positioned blocks comprising, in combination, a horizontal bed having a support zone and a length longer than the desired length of the wall section to be constructed at one end of said horizontal bed adjacent said support zone for means positioning and moving in end-to-end relationship along said horizontal bed to the support zone a single horizontal row of blocks of said desired length, a clamping device positioned above said support zone and including a pair of opposed horizontal clamp rails extending opposite each other on opposite sides of said horizontal bed, said clamp rails having a length substantially coextensive with the said desired wall section length, means for reciprocating said clamp rails from an open position wherein rows of blocks in said wall section can pass freely therebetween to a closed position wherein said clamp rails engage the opposed faces of blocks to support a row of blocks therebetween, and means for selectively moving said support zone of said horizontal bed and the blocks supported thereby from a lower position remote from said clamp rails to an intermediate position at which the upper surface of the

blocks in a row supported by said support zone is pressed against the lower surface of blocks in a row held between said clamp rails to an upper position at which the lowermost row of blocks supported by said support zone is positioned between said clamp rails in open position whereby movement of said clamp rails to said closed position will engage and hold said lowermost row of blocks.

10. The apparatus of claim **9** which further includes means for sequentially applying head and bed mortar to said blocks forming said single row upon said horizontal bed.

11. The apparatus of claim **9** wherein said means for positioning and moving said blocks in end-to-end relationship onto said support zone includes a reciprocating ram having a stroke greater than the length of an individual block and positioned to push said blocks parallel to said horizontal bed.

12. The apparatus of claim **9** wherein said means for selectively moving said support zone includes a reciprocating device operatively connected to said support zone section of said horizontal bed and effective to guide said support zone in vertical movement from its said lower position through said intermediate position, to said upper position, and thence back to said lower position.

13. The apparatus of claim **9** wherein said means for reciprocating said clamp rails from said open to closed position includes a reciprocating ram operably connected between said clamp rails and effective to selectively move one rail toward or away from the other rail.

14. A method of constructing modular sections of walls composed of a plurality of vertically stacked rows of end-to-end positioned blocks comprising the steps of holding the first constructed row of blocks, assembling a second row below said first row, moving said first and second rows into contact with each other, holding said second row with said first row supported thereon while assembling a subsequent row below said second row whereby said wall is constructed row-by-row from the top row down.

15. A method of constructing modular sections of walls composed of a plurality of vertically stacked rows of end-to-end positioned blocks comprising the steps of forming a first row of blocks on a support bed, moving said support bed and first row of blocks to an upper position, holding said first row of blocks in said upper position and moving said support bed to a lower position below said held first row, forming a second row of blocks on said support bed in said lower position, moving said support bed and said second row upwardly to press the upper surface of said second row against the lower surface of said held first row, releasing said held first row and moving said support bed and first and second rows until said second row is in said upper position, and holding said second row in said upper position and moving said support bed to a lower position to receive a subsequent row of blocks.

16. A method of construction modular sections of walls composed of a plurality of vertically stacked rows of end-to-end positioned blocks joined together by mortar comprising the steps of forming a first row of mortared blocks upon a support bed, vertically separating said first row from said support bed, clamping said first row in said separated position, forming a second row of mortared blocks upon said support bed with mortar applied to the upper surface thereof, moving said second row and said first row towards each other to press together the upper surface of said second row and the lower surface of said second row, vertically separating said second row from said support bed and clamping said second row on said separated position whereby the third and subsequent rows may be built below said second row to construct said wall section from the top row down.

17. A method of constructing wall sections composed of a plurality of stacked rows of end-to-end positioned blocks by repetitively (1) forming a row of blocks on a support bed, (2) separating the formed row from the support bed, (3) forming another row on the support bed below the previously formed row, (4) and joining the two rows together in a vertical stack and adding subsequent rows below the last previously formed row to construct the wall section from the top down.

References Cited

UNITED STATES PATENTS

1,818,741	8/1931	Palatini	52—749
3,036,947	5/1962	Marra	156—580X
3,139,369	6/1964	Sullivan et al.	156—563
3,231,646	1/1966	Conder et al.	52—749X
3,350,833	11/1967	Larger	52—749

FOREIGN PATENTS

290,319	7/1966	Australia	52—749

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U.S. Cl. X.R.

156—312, 558, 580; 52—749