United States Patent [19]

Brandt

[11] **3,875,278**

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[54] **MASONRY WALL CONSTRUCTING PROCESS**

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[52] **U.S. Cl.** **264/90,** 264/102, 264/261, 264/328, 264/DIG. 78

[51] **Int. Cl.** **B28b 1/24**

[58] **Field of Search** ..... 264/101, 102, 261, 328, 264/90, DIG. 78; 425/405, DIG. 60

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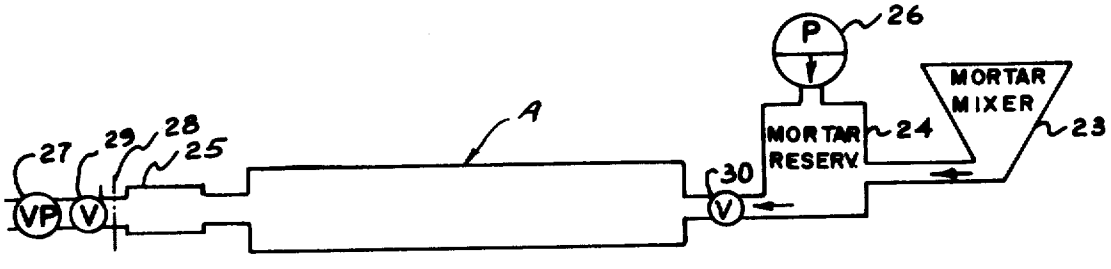
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Assistant Examiner—Thomas P. Pavelko
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[57] **ABSTRACT**

A process for forming a masonry wall member from a plurality of individual blocks bonded by mortar is disclosed. The blocks are arranged in a mold in a predetermined pattern and the mold closed to hermetically seal the mold and maintain the blocks therein in spaced relationship. A source of mortar is connected to the interior of the mold and a vacuum is created within the mold by means of a vacuum pump. When the desired evacuation is reached, further pressure reduction is discontinued while retaining the vacuum within the mold. The mortar is then permitted to flow into the mold to completely fill the interstices between the blocks as well as pores therein. A positive pressure may also be applied to the mortar to additionally facilitate filling of the mold with mortar.

4 Claims, 7 Drawing Figures



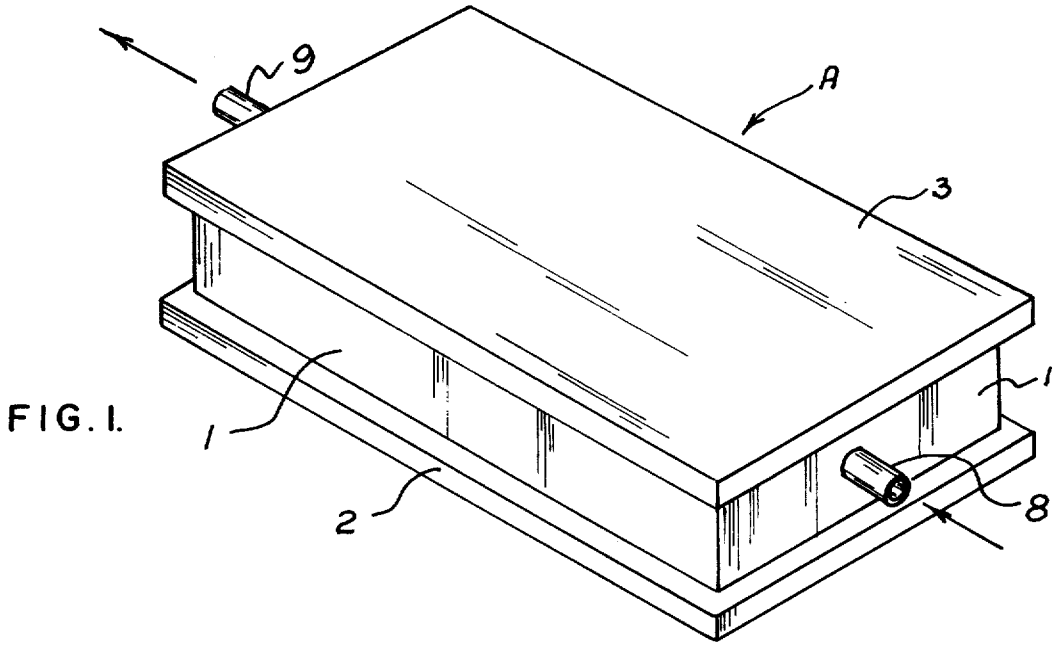


FIG. 1.

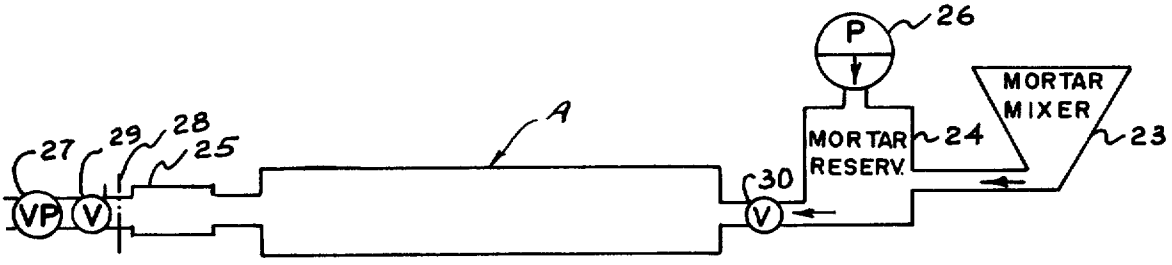


FIG. 2.

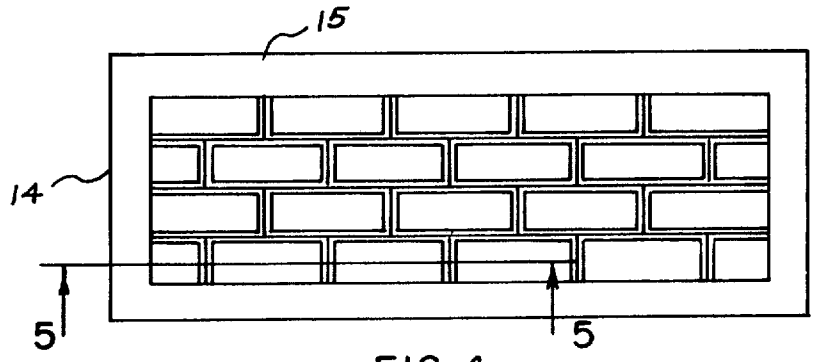


FIG. 4.

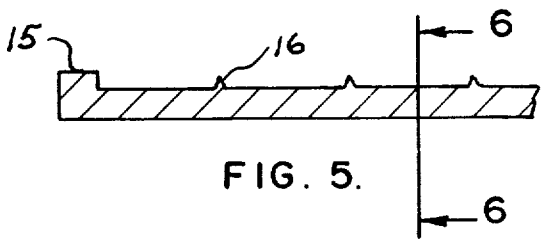


FIG. 5.

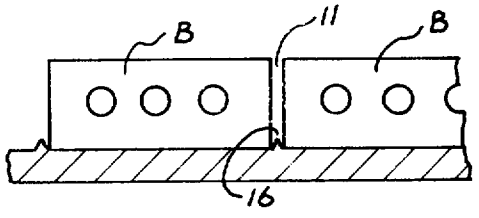


FIG. 6

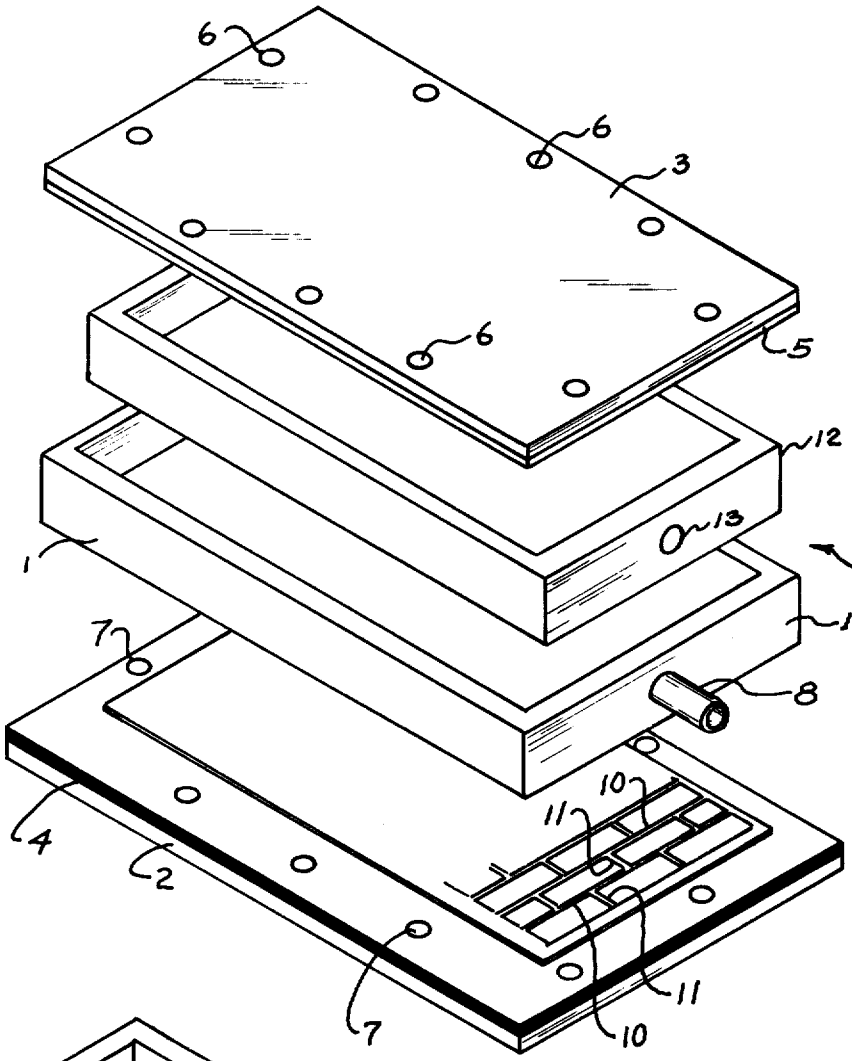

6
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3
6
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A
1
1
7
8
10
11
4
2
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11
10

FIG. 3.

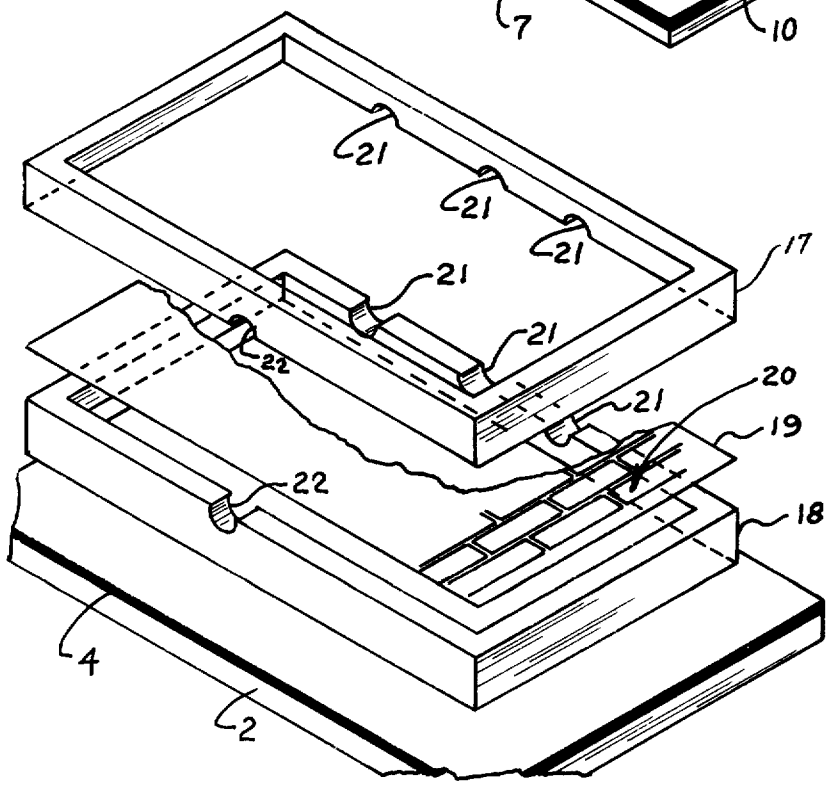

21
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17
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22
18
4
2

FIG. 7.

MASONRY WALL CONSTRUCTING PROCESS

BACKGROUND OF THE INVENTION

This invention relates generally to the construction of masonry walls, but more specifically, relates to the prefabrication of masonry walls from construction blocks or bricks by means of vacuum injecting of mortar material into a hermetically sealed container to provide for complete filling of the interstices between the arranged bricks, and then allowing for hardening of said mortar.

With the advent of modular type of construction becoming in vogue in more recent years, for the purpose of expediting the construction and resurrection of homes and buildings, various types of processes have been devised mainly for the purpose of accelerating home building, but in addition, to provide for cost reduction. For example, a number of construction companies now provide the service of constructing and furnishing custom made masonry walls, wherein the wall is formed at a plant site, and then shipped to the location where it is to be used according to engineering and architectural specifications for constructing a building or a home. Usually, these walls are constructed and furnished to the contractors at specified dimensions, and generally a plurality of such walls are ordered so that they can be mass produced efficiently at the construction plant, and then transported to the various job sites where they are required.

It is known that one particular contractor constructs a masonry panel at its plant site by means of the arrangement of a plurality of bricks into a mold, and then lowers an air bag onto the top of the formed bricks to generally seal them in, and thereafter, pumps mortar through a series of ports into the form for filling the spaced between the arranged bricks. This procedure is helpful in allowing for the reasonably rapid construction of preformed brick walls, at least more rapid than can be achieved by a series of bricklayers at a job site, but the concept of pumping under pressure the mortar mix into a form or mold box approximating six by twelve feet in dimension, and containing a large number of bricks to provide a wall of that size, leaves an undesirable number of voids or pits between a certain number of the arranged bricks impairing the compressive strength of the brick wall when used. This supplier after the mold box has been removed from its brick wall, and the wall erected, then utilizes tuck pointers to fill the always remaining pockets or void spaces that appear on the surface of the wall.

Various prior art patents have considered methods for prefabricating glass block panels and ceramic tile sheets, but not masonry walls, mainly through the use of pressure injecting of fluid grout material into a mold holding a plurality of adjacent tiles, or simply arranging a series of glass blocks so as to provide some space between the same, introducing a curable cementitious bonding material into the frame and then vibrating the assembly to provide compacting and eliminating of voids between the glass blocks. These embodiments and methods are shown in the United States patent to Abernathy, et al., U.S. Pat. No. 3,192,567, and in the patent to Russell, et al., having U.S. Pat. No. 2,972,783.

The only use of reduced pressure or vacuum pressure, for mass producting panels is shown in the two patents to Kastenbein, U.S. Pat. No. 2,855,653, and Robinson, U.S. Pat. No. 2,781,554, but the use of vacuum or low pressure in the embodiments shown are simply to hold the tile members in place while the grout is inserted between the grooves formed intermediate adjacent tiles, and said vacuum pressure is not used for the purpose of providing efficient injecting of such grout between a series of tiles hermetically sealed in a container.

In view of the foregoing, it is the principle object of this invention to provide a method for deposition of mortar between a plurality of bricks arranged in a hermetically sealed container and in a manner which totally eliminates all voids or air pockets that generally form intermediate such bricks under known methods.

It is a further object of this invention to provide an efficient and rapid method for prefabricating a brick wall, and reducing the amount of manual labor required to achieve the same.

It is a further object of this invention to provide an apparatus that incorporates pattern means for expediting the arrangement of a series of bricks in a container, with the same pattern means being utilized for forming a uniform and pleasingly appearing joint between adjacent bricks in a fabricated wall.

Another object of this invention is the provision of an apparatus that can quickly form a brick wall in better alignment and plumbness.

These and other objects will become more apparent to those skilled in the art upon reviewing the following summary, and the description of the preferred embodiment in view of the drawings.

SUMMARY OF THE INVENTION

This invention includes a container formed of the usual side walls and bottom wall and further incorporating a closure member that may be employed for hermetically sealing the same when in use in forming a prefabricated wall from construction blocks, bricks, or the like. The container further includes the use of patterned means, such as a layer of resilient or elastic material that may rest upon the bottom wall of the container, so that as the construction blocks are arranged therein and the closure member fastened upon the container, the pressure of the closure member upon the blocks forces their partial embedment into the resilient material thereby forming a slight compressibility of the material intermediate adjacent blocks to enhance the joint appearance after formation of the wall. Other forms of spacers or the like either for reducing the size of wall that may be formed from a mold box having a maximum dimension that might be in the vicinity of 72 square feet, may be used for reducing the size of wall that may be constructed in this apparatus, or such spacers may be used for forming window openings, door openings, or other apertures that might be required in a custom designed wall.

The aforesaid container and its internal components are designed for cooperating with a vacuum pump that may be coupled to a side wall of the container, and communicating therein, as through some form of a valve, so that as the container has been sealed with the bricks properly arranged therein, the atmospheric pressure within the container may be vacuumed, as for example, down to ten millimeters of mercury, all in preparation for the subsequent injection of a mortar mix into the container. A reservoir is further adapted for communicating with various ports leading to the container, and these ports may be located spacedly along

the side walls of the container so that when the mortar mix is released for vacuum attraction into the mold, it will conveniently enter into the container at a plurality of locations to provide for its pervading throughout all of the interstices between the arranged blocks, thereby filling these voids to capacity, and providing a dense mixture of mortar between each brick for enhancement of the walls eventual compressive strength as when used in construction. It might be remarked that the vacuum injection of the mortar mix into the container reduces the pressure and forces that are usually urged upon the arranged bricks as occurs in the now used pressure injection process. Pressure injection, as now used in the trade, can cause undesirable shifting of bricks due to the force of the incoming mortar, whereas in vacuum injection the mortar mix is just drawn into the containers without exerting too much force.

To further facilitate the injection of the mortar mix into the enclosed container, and to provide for its complete pervasion throughout the spacing intermediate arranged bricks, it is desirable to provide a chamber coupling with the container and arranged intermediate it and the vacuuming means so that after the bricks have been properly arranged within said container, and it has been hermetically sealed, and then vacuumed, the vacuum pump may be shut off, its valve closed, and then mortar mix may be injected into the sealed container allowing it to fill all of the spacings between said bricks, and also fill this additional chamber to insure that the mortar mix has traveled through all portions of the container filling all of the interstices between the arranged bricks.

The type of mortar mix employed in this particular invention may be of the usual type employed in cementing concrete blocks or bricks together, and includes as ingredients, a fine aggregate, some cement, water, and desirably, a mortar additive that adds flowability to the mix. An example of this type of mortar additive is the type that may be acquired from the Dow Chemical Company, of Midland, Mich., and sold under the brand name Sarabond. It is believed that this Sarabond brand mortar additive comprises a synthetic polymer, including a combination of polymer and copolymer in a fifty percent solid suspension. The composition, more specifically, is a vinylidene chloride polymer latex which add the attributes to a mortar mix as aforesaid. The product is in an emulsion form and adds fluidity to the mortar mix, in addition to increasing its bonding stress, tensile strength, after the prefabricated wall has hardened and cured. For example, test specimen brick walls have been formed by the process of this invention, in additon to manually being formed, and each of the brick walls formed had the approximate dimensions of 3½inches wide, 16¾inches in length, by 15¾inches in height. The brick wall formed manually when tested for compressive strength fatigued under the Face Brick Prism test at the application of 2619 p.s.i. On the other hand, the brick wall of the same size and formed through the use of this invention, utilizing a Portland Cement mortar mix incorporating the Sarabond mortar additive when tested under the Face Brick Prism test for compressive strength fractured at the application of 5935 p.s.i. Hence, the wall formed through the use of this invention exhibited an increase of 126.6 percent compressive strength over manually laid bricks. In addition, and it might be remarked, that the injection of the mortar mix into the bricks arranged in the container of this invention in forming the machine made wall of this test took only a total of 7 seconds, over the many minutes of time it took to manually apply a mortar mix between the bricks when forming the manually laid brick wall of this test.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, FIG. **1** discloses a perspective view of the hermetically sealed container of this invention showing the injection and outlet ports of the same;

FIG. **2** provides a schematic view of the various components employed in the process of forming prefabricated brick walls under this invention;

FIG. **3** discloses an exploded view of the container means of this invention further showing the pattern means provided upon the bottom wall of the same;

FIG. **4** provides a plan view of the bottom wall of this invention;

FIG. **5** provides a sectional view taken along the line **5—5** of FIG. **4**;

FIG. **6** discloses a sectional view taken along the line **6—6** of FIG. **5**, and further showing the arrangement of a series of bricks upon the bottom wall pattern member of this invention; and

FIG. **7** discloses a partial exploded view of a part of modified container and pattern member of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In referring now to FIGS. **1** and **3** of the drawings, there is disclosed the apparatus A of this invention shown as a container having side walls **1** of a form like member, and incorporating a bottom wall **2** and a top closure member **3**, which when these components are brought together and rigidly secured, comprises an enclosure in which the prefabricated wall of this invention may be formed. To insure the tight sealing of this container when closed, the bottom wall **2** may include a layer of some elastic or resilient material, as at **4**, so that when the side walls **1** are rested in contact upon the same, and pressed against the same, it will provide for hermetic sealing at this juncture. In addition, the top wall **3** also includes a layer of some form of a sealing or gasket like material which is resilient and will additionally provide for air tight sealing at this location. Furthermore, and as shown in FIG. **3**, one means for clamping the bottom wall and top closure member against the form walls **1** may be achieved through the use of a series of fasteners, as for example a series of bolts and nuts (not shown) which may be inserted through the series of aligned apertures **6** and **7** as provided through the members **2** and **3**. Obviously other forms of clamping means can be utilized.

By also referring to FIGS. **1** and **3**, it can be seen that a series of ports, one comprising a cementitious material or mortar mix inlet port **8** is provided through one side wall, and it is through this port that the mortar mix may be injected into the container, while an outlet port **9** is provided at the opposite side wall and it is through the use of this latter port that the vacuuming means may withdraw atmospheric pressure from teh enclosed container, in addition to providing access to a secondary chamber which will also fill with the mortar mix during formation of a prefabricated wall. Obviously, there may be one or more inlet ports or outlet ports

provided at various locations around the side walls, all depending upon the size of prefabricated masonry wall to be constructed. But, in the embodiment shown, which comprises the prototype apparatus utilized in constructing the test walls, as previously described, it was only necessary to utilize one inlet and one outlet port. If the size of wall to be constructed through the use this invention be of any greater size, as for example, in what has become the standard form of prefabricated wall being generally 6 feet by 12 feet in dimension, then additional inlet ports should be strategically located around various of the side walls for the purpose of providing convenient access of the mortar mix into various interior locations of the container during injection of the same.

It should be noted from FIG. **3** that the bottom resilient layer **4** discloses one means of providing a pattern for arranging the construction blocks or bricks into the container during set up for formation of a prefabricated wall. In this particular instance, the cushioning material of this layer **4**, which might comprise a polyurethane, or other polymer or soft rubber, and has imprinted thereon a pattern which guides the workman in positioning of the various bricks onto this bottom wall during their arrangement prior to the hermetic sealing of the container into closure. This pattern, as shown at **10**, may comprise an imprinting of the same thereon, and includes the usual dimensions or spacings, as at **11**, providing the joint or interstices between each arranged brick and where the mortar mix eventually will settle between bricks after injection into the container. To further aid in the arrangement of bricks into the container, as during set up, this layer **4**, and more particularly its pattern **10**, may be molded so that its joints **11** are formed in bas-relief so that they provide a guide for insertion of the bricks therebetween, and in addition provide somewhat of a concave joint for the mortar, to enhance the appearance of the finally prepared masonry wall. Furthermore, and even where the pattern **10** and joints **11** are not formed having a slight rise, after the masonry blocks are arranged upon the liner **4**, and as the entire container, including its closure member **3**, are brought together into sealed closure, since the design of the side walls **1** exhibit a height slightly less than the width of the standard bricks, the bricks will then be squeezed or slightly pressed into the liners **4** and **5**, providing a slight compressibility or protruding of the pattern means and joints **10** and **11** a short distance interstitially between the bricks thereby providing a pleasing appearance to the mortar joint after the wall has been formed. As is well known, the usual procedure in tuck pointing is to utilize a brick joiner for providing some concavity to the mortar joints between laid bricks, and this principle can be achieved through the use of this invention by utilizing a resilient material to form the liners **4** and **5**.

Where it is desired to construct a wall to smaller dimensions, various types of spacers, as for example, the spacer **12** shown in FIG. **3**, may be inserted within the form walls **1** of the container so as to reduce the dimensions of the prefabricated wall being constructed. Furthermore, and where the apparatus may be of large dimensions, as when it is desired to construct large segments of a wall, spacers of various configuration such as shown at **12** may be used at various locations inwardly of the formed walls **1** so as to provide openings for doors, windows, or the like. Obviously, the height of the spacers **12** should be equivalent to the width of the bricks being used, so that the edges of this spacer will depress slightly into the resilient liners **4** and **5** and prevent the mortar mix from oozing therebetween. Where the spacers are to be used as a liner along the inner surfaces of the walls **1**, as shown in FIG. **3**, then it may include an aperture **13** for alignment with each inlet and outlet port **8** and **9**, so that the mortar mix may enter into its interior and form a filling between the arranged bricks. On the other hand, where the spacer **12** is being used to form an aperture interiorly of the side walls **1**, then there should be no apertures **13** provided therein so that no mortar mix can get within the confines of the spacer.

FIGS. **4** through **6** disclose another form of liner **14** that may be utilized in place of the liner **4** previously described. In this particular instance, it can be seen that the resilient material is molded having a series of raised edges, as around its periphery **15**, in addition to providing a uniformly and pleasingly appearing mortar joint between each brick after this cementitious composition has been injected into the same.

The various types and modifications for providing pattern members for use in arranging bricks into this container are numerous, and another example as shown in FIG. **7**. In this particular instance, the bottom wall **2** and its liner **4** are the same as previously described, and the type of side wall formed as shown in FIG. **3** will also be provided. But, instead of utilizing a spacer, such as spacer **12** previously described, in this particular modification the spacer will comprise an upper component **17** and a lower component **18**, which when brought together one on top of the other, have a height equivalent to the previously described spacer **12**. In addition, intermediate the upper and lower components of this spacer there may be arranged a pattern member **19** which may be constructed of any type of metal, plastic, or other reinforcing material, and will have previously had the pattern for the bricks to be arranged punched therein, as shown at **20**. Hence, it can be seen that this pattern member **19** is arranged approximately one half the width of the concrete block or brick above the bottom wall **2**, and preferably will be located somewhere at the location of the mid-height of the inserted blocks. Hence, when cementitious material is injected into the ports **21** of the spacer, it will pervade around the various interstices of the bricks arranged within the container, in addition to flowing upwardly and downwardly of this pattern member **19**, providing for its permanent embedment within the prefabricated wall. Hence, in this manner, the prefabricated wall will have the enhanced compressive strength desired from a brick-mortar wall, but in addition, this reinforcing member will add significant tensile strength to the prefabricated wall. The usual outlet portion **22** is shown and is formed by bringing the upper and ower components **17** and **18** of this spacer together.

It is also likely that usual clip angles and L-bolts (not shown) may be cemented into the formed wall and provide the means for joining a plurality of these masonry panels together.

A schematic drawing as to how the principle of this invention may be put into operation is disclosed in FIG. **2**. As shown, a mixer **23** may be provided for the continuous and proximate mixing of the mortar composition used in this invention, and the mixer after completing this operation transfers its mix to a reservoir **24**,

which is designed having a capacity for holding enough mortar to fill the requirements of the apparatus container A as it injects its mix through the inlet port **8** of the same, in addition to filling the residue chamber **25** connecting with the container A through the outler port **9.** Some means **26** may be provided upon the reservoir **24** for exerting a slight pressure thereon so as to prevent any air bubbles or the like from being drawn into the vacuumed container A during the mortar injecting process. Connecting with the container A through the chamber **25** is a vacuum pump **27,** and which is used for vacuuming the container after it has become ladened with the arranged bricks. The valve may be provided at the location of **29,** in addition to a filter as at **28,** so that when the container has ben vacuumed, or approaches vacuuming, the valve may be shut off for removing the pump from the system, and in addition, the filter acts to prevent any residue mortar or dirt, as from a previous cycle, from entering into the vacuum pump and damaging the same. Also, a valve **30** may be provided at the inlet port for use in closing off the container as while it is being vacuumed.

An example of the operation of the principle of this invention is as follows. A cementitious mixture of materials comprising a fine aggregate within the range of from 30percent to 45percent by weight of the total composition, cement at 30percent to 45percent of the total composition, by weight, water within the vicinity of 10percent to 20percent by weight, and, if desired, a mortar additive such as the Sarabond brand additive as previously described may be included within the range of from 5percent to 15percent of the final mortar mix and all added to the mixer **23,** and thoroughly agitated to provide a mortar mix having a consistency of flowable viscosity to provide for its easy passage through the various tubes and ports employed in this apparatus. A high vacuum pump was coupled to the vacuum box through the outlet port **9** and the container. With its closure member **3** removed, the bottom **2** was then lined with a thick rubber sheet type of material, forming the lower liner **4** of this invention. Then, the form or side walls **1** were lowered into place upon the bottom wall **2** and its liner **4.** It might also be remarked that the container of this particular test was manufactured from magnesium to provide sufficient strength from this lightweight of material. After the bricks were arranged upon the liner **4** within the container, the lid or closure member **3,** with its rubber liner **5** was lowered in place upon the walls and fastened through the use of a series of clamps. The mortar reservoir was coupled with two inlet ports provided in the side walls, with the vacuum pump, as previously described, being connected to a single outlet. The valve **30** provided at the inlet port **8** was shut off, so as to prevent the ingress of any mixed mortar, while the valve at the outlet port was opened, and the vacuum pump rendered operative to reduce the pressure within the sealed container down to approximately ten millimeters of mercury. The vacuum pump was run for approximately five minutes to achieve this pressure reduction. The valve on the vacuum pump side of the container was closed, and then the valve on the injection side of the container was opened and the mortar was drawn rapidly into the device, and in this particular instance, within seven seconds. After it appeared that the mortar had completed its injection into the container, apparently increasing the pressure within the container to approximately atmospheric pressure, the lid was removed and mortar mix allowed to set to hardening. It was quite obvious that the mortar mix had filled all of the voids or air spaces in the container, being attracted to the same by the force of the vacuum pressure, leaving the face side and back side of the formed masonry wall free from any residue material and having uniformly appearing mortar joints due to the slight protrusion of the gum rubber liners intermediate the arranged bricks. Finally, and in this particular instance, the side walls **1** of the container were separated to allow the brick wall to be totally exposed and removed from the container.

In view of the foregoing, numerous variations in the construction of this mortar injecting apparatus, in addition to its method of use, within the scope of the appended claims, will occur to those skilled in the art in light of the foregoing disclosure. The described embodiments are merely illustrative of the principle and operation of this invention.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. In the process of prefabricating a masonry wall member from a plurality of construction blocks including bricks or the like through the use of a form container and a vacuum pump, including arranging a series of such blocks in the form container and into the configuration of a wall member desired, rigidly enclosing the arranged blocks within the container to allow for their hermetic sealing therein, reducing the pressure in the closed container down to an approximate vacuum, discontinuing any further pressure reduction by ceasing the vacuuming of the sealed container by the operation of the vacuum pump while maintaining the developed vacuum within the sealed container, providing a source of flowable cementitious for the interior of the container, then drawing the flowable cementitious material into the container through the influence of the developed vacuum to fill all the interstices uniformly and completely between the arranged blocks, and thereafter discontinuing the drawing of material into the container and allowing the wall to set and commence cure.

2. The invention of claim **1** and including applying a pressure upon the cementitious material as it is being drawn into the container by the approximate vacuum force.

3. The process of claim **1** wherein the flowable cementitious material has the following approximate composition:

Fine Aggregate	30% to 45%
Cement	30% to 45%
Water	10% to 20%
Flow Enhancing Mortar Additive	5% to 15%

and totaling about **100%.**

4. The process of claim **1** and including disposing a pattern means in the form container to facilitate the initial arrangement of the series of blocks into the same.

* * * * *