A. O. CROZIER.

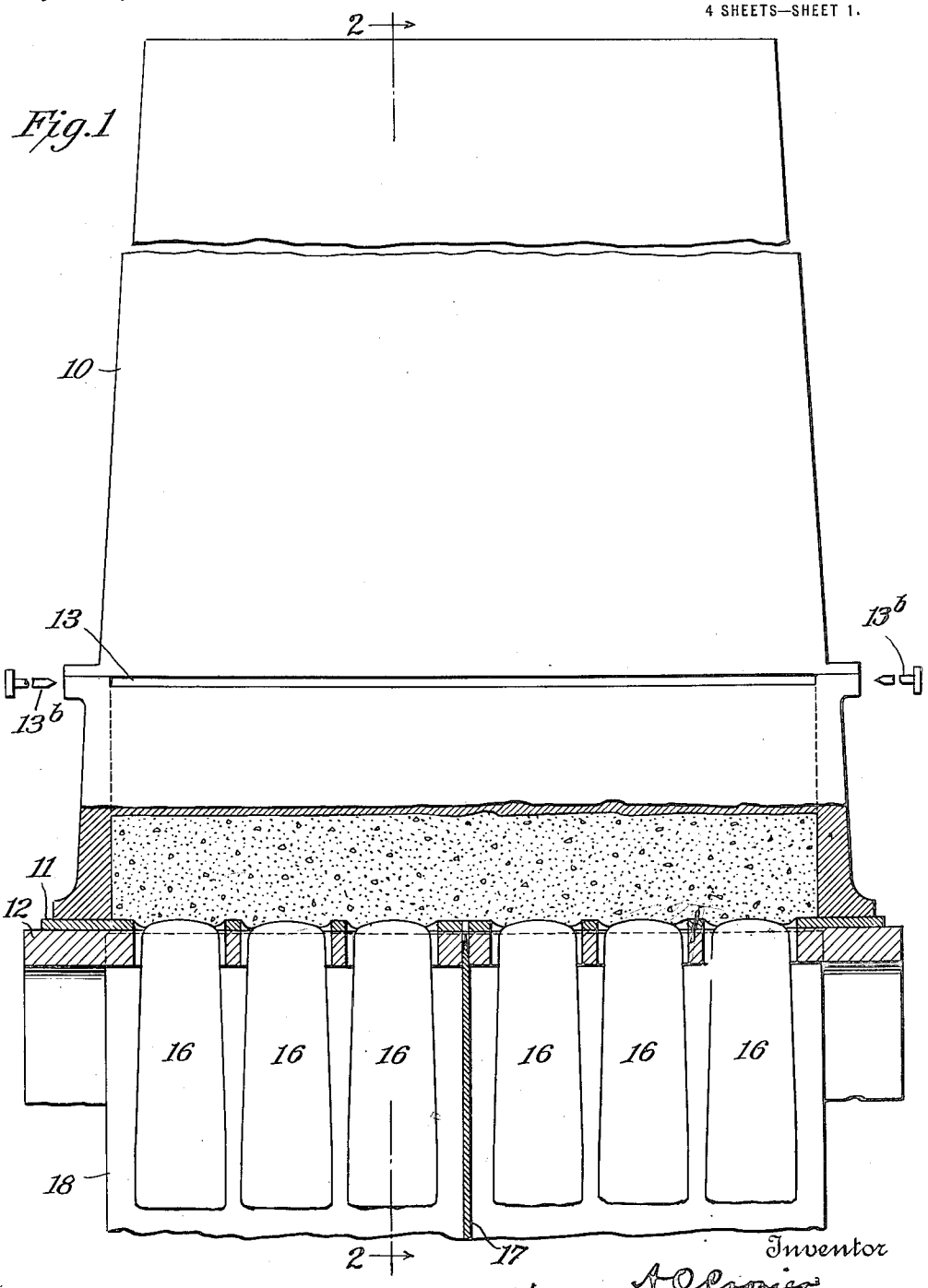
MANUFACTURE OF HOLLOW CEMENTITIOUS PRODUCTS.

APPLICATION FILED JUNE 12, 1920.

1,416,691. Patented May 23, 1922.

4 SHEETS—SHEET 1.

Fig. 1



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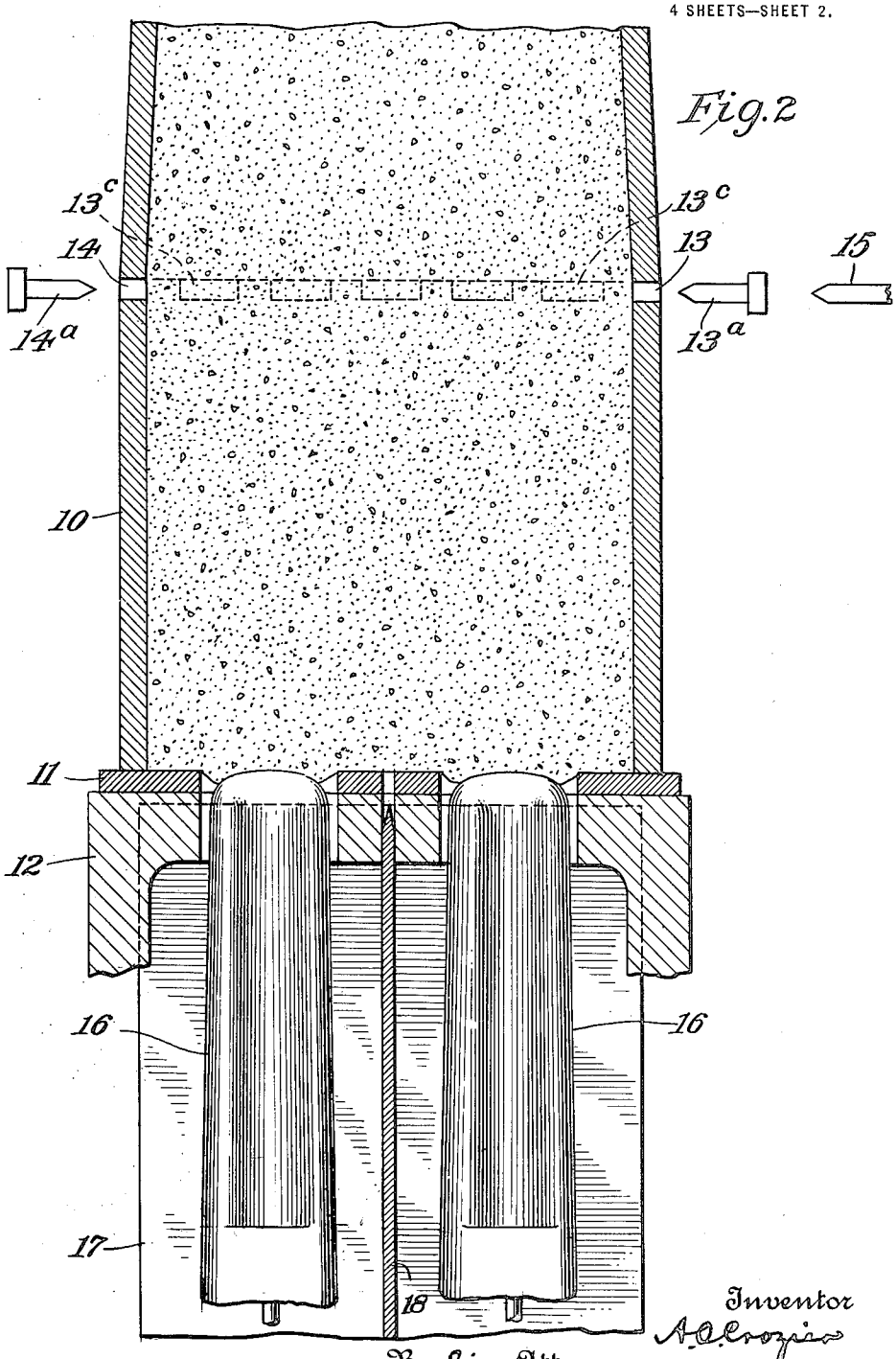
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4 SHEETS—SHEET 2.

Fig. 2



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4 SHEETS—SHEET 3.

Fig. 3

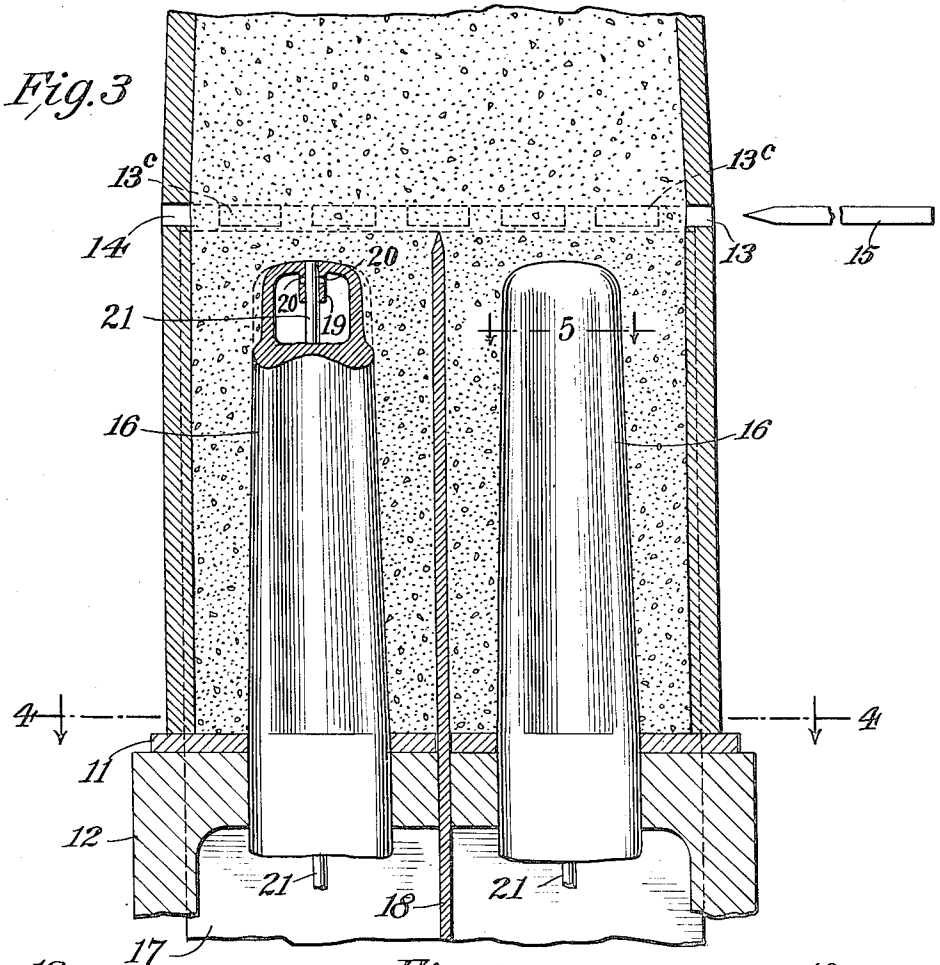
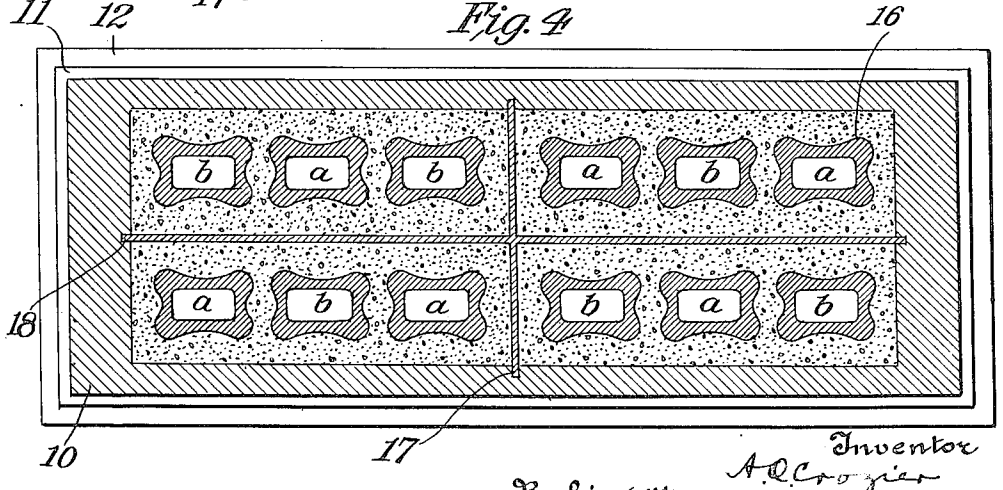


Fig. 4



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4 SHEETS—SHEET 4.

Fig. 5

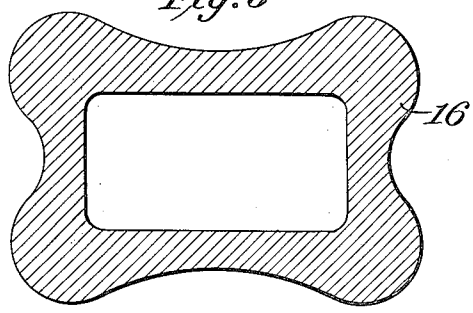


Fig. 6

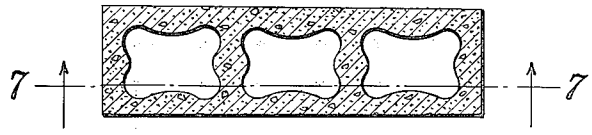
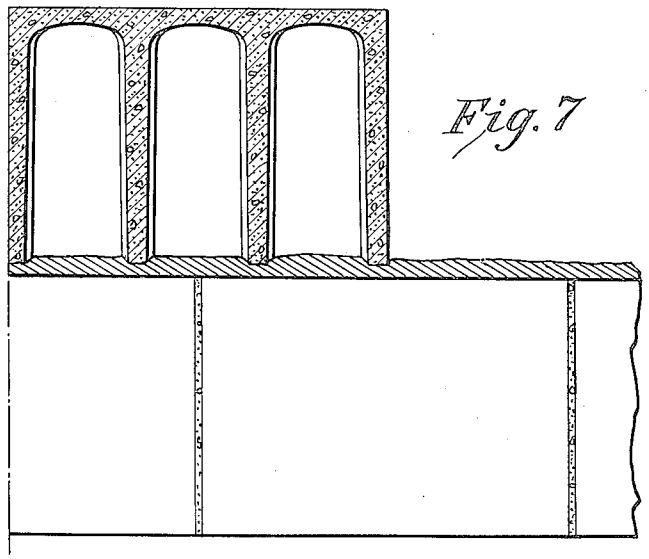


Fig. 7



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UNITED STATES PATENT OFFICE.

ALFRED OWEN CROZIER, OF NEW YORK, N. Y.

MANUFACTURE OF HOLLOW CEMENTITIOUS PRODUCTS.

1,416,691. Specification of Letters Patent. Patented May 23, 1922.

Application filed June 12, 1920. Serial No. 388,525.

To all whom it may concern:

Be it known that I, ALFRED OWEN CROZIER, a citizen of the United States of America, residing at New York, in the county and State of New York, have invented certain new and useful Improvements in the Manufacture of Hollow Cementitious Products, of which the following is a full, clear, and exact description.

This invention relates to the manufacture of hollow cementitious articles, for example building blocks or tile, and its chief object is to provide a process which will produce hollow articles or products of high quality rapidly and economically. To this and other ends the invention consists in the novel features hereinafter described. More particularly the invention relates to the art in which products are formed by severing and removing successive sections from a mass of cementitious material, and in its broader aspects the invention contemplates forming cavities in the successive sections, preferably before severance and removal from the mass, by displacing cementitious material from such sections while they are imprisoned in a suitable rigid container, the displacement of the material being effected in practise by forcing cores into the said sections.

In carrying out my improved process or method in the preferred manner the material I employ is a cementitious mixture, for example sand and cement, of a more or less sloppy or slushy consistency, that is to say, containing an amount of water in excess of that needed for the desired hydration of the cement. This consistency of the concrete minimizes the entrapping of air in the mass and the consequent formation of air bubbles, void spaces or cavities therein, and enables me, by subsequent treatment, to practically eliminate any air bubbles, void spaces or cavities that may be formed.

A mass of cementitious material of the consistency indicated is provided, preferably in the form of a vertical column, in an upright tubular shaft or trunk. The difference in the specific gravities of the water and the solid constituents causes the latter to sink and the excess water to rise, thus attaining an effective unwatering of the lower portion of the column or other mass. Moreover, the water has a marked lubricating effect, enabling the sand particles to slide or move more freely upon or past each other and thus fit themselves together more closely. At the same time the lower portion is compacted by the weight of the superincumbent material. The extent of the compacting thus effected depends, in general, upon the height of the mass and may be such as to give such lower portion practically the maximum density that can be attained in a cementitious mixture, but such density is not always necessary or even desirable, and in some cases I prefer to have the height of the column such that the density of the lower portion, due to the weight and compacting or concentrating effect of the portions above, is not only less than the aforesaid maximum density but is indeed less than desired in the articles which are to be formed from said lower portion. In such case the additional compacting or "densification" is effected by other means, as explained hereinafter.

The column having been established, I next force into its lower portion, in most cases upwardly from the bottom thereof, one or more rigid cores of suitable size. Preferably the cores are tapered, and since they can enter the column only by displacing a corresponding volume of the material, they will, by reason of the aforesaid taper, displace part of the material laterally, thereby compacting the material surrounding them. As the cores advance into the material the surfaces of the cores slide upon the contiguous particles and move them about, thus fitting them together more closely than could be done by mere pressure.

The lower portion of the column can now be severed, preferably by forcing or driving into the column at a proper distance above the tops of the cores a blade or knife of suitable thickness. The column being rigidly supported during this operation, the introduction of the knife may perform at least two important functions. In the first place, it severs a mass or body of the material from the bottom of the column; and in the second place, as will be explained more fully hereinafter, it may exert a powerful downward pressure on the severed portion or the portion being severed, thereby giving the same any additional compactness necessary or desirable at this stage.

The cores can now be withdrawn, after which the severed lower portion of the column may be removed by lowering the pallet

or other base on which the column was formed, leaving the upper part of the column resting on the knife, while the pallet is carried away with the article or articles formed thereon as above described. Such articles are made from a cementitious mixture which a few moments before was of a slushy consistency, but nevertheless they are now found to be stiff, compact or dense enough to stand alone without deformation by their own weight. I thus attain in a few minutes a result which in a straight casting or molding method of using slush-concrete would require for its attainment a period of time measured by hours or even days.

Upon removal of the articles from the pallet the latter can be replaced, but I prefer to leave the articles on the original pallet during at least a part of the time of hardening or setting of the cementitious material, in which case a fresh pallet is placed in position below the column. The severing knife is now withdrawn, preferably as rapidly as possible. The entire column may then fall practically as a whole, and strikes the pallet with sudden force. The heavy impact thus produced may be an important aid in compacting the material that now becomes the lower portion of the column, and under favorable conditions may be sufficient to permit a further reduction of the total height of the column.

The operations or steps described above are now repeated, it being understood that during the progress of the work fresh material of the proper consistency is added to the top of the column to compensate for the removals from the bottom, the additions being made preferably before retraction of the severing knife so that the mass of the added material will increase the force of the blow or concussion when the column is allowed to fall suddenly upon the pallet or other abutment.

It will be readily understood that the apparatus for practising my method or process can be of very simple character, and it is accordingly necessary to illustrate and describe herein only such parts of the apparatus as are, ordinarily, essential to the practise of the invention in an efficient manner; omitting entirely, for the sake of simplicity and clearness of illustration, the elements or mechanisms for actuating the few moving members or parts of the apparatus.

Referring now to the accompanying drawing,

Fig. 1 is a front view of a vertical shaft or container in which the cementitious column may be formed.

Fig. 2 is a section on line 2—2 of Fig. 1, looking in the direction of the arrows and showing also the severing knife in position to enter the column at the bottom thereof, and the cores (which produce the hollow spaces in the products) in their initial positions.

Fig. 3 is a view similar to Fig. 2 but showing the cores forced into the lower portion of the column to form hollow spaces therein and aid in the desired compacting or "densifying" effect.

Fig. 4 is a horizontal section on line 4—4 of Fig. 3.

Fig. 5 is an enlarged horizontal section of one of the cores, on line 5—5 of Fig. 3.

Fig. 6 is a horizontal section of a hollow block or tile such as may be made by my process.

Fig. 7 is an elevational view of several such blocks or tile laid in a wall, one of the blocks or tiles being shown in section on line 7—7 of Fig. 6.

In using the apparatus illustrated for practising my invention for making hollow blocks or tile, the upright hollow shaft 10, in which the column of slushy concrete or cementitious material is formed, is preferably constructed to provide a column about twenty-four inches wide and about eight inches thick, at the base. The shaft is closed at the bottom by a removable abutment, as a plate or pallet 11, supported by a vertically movable table 12.

At a proper distance above the bottom (in the present instance, for making hollow tile, the distance is preferably about eight inches) the shaft is provided at front and back with horizontal slots 13, 14, to receive the horizontal severing knife 15.

The cores 16, which form the hollow spaces or cavities in the products, may enter the column from any suitable point but preferably they enter vertically, from below, and to accommodate them the table or support 12 is provided with suitable guide openings and the pallet 11 is formed with apertures of proper size and spacing to register therewith.

The shaft contains slush concrete, thereby forming a vertical column of the latter which has its lower portion unwatered and compacted as hereinbefore described. The height of the column determines in large measure the extent of the unwatering and compacting, and upon reflection it will be understood that no definite height for the column can be stated, so many and so diverse are the factors involved in practise, as for example the average consistency of the mixture, the relative proportions of its ingredients, the specific gravity of the sand or other inert material used, the distance and hence the force of the blow resulting when the column is suddenly dropped as described, the degree or extent to which the compacting of the lower portion is to be carried, etc. Moreover, tamping or poling the column at the top, which may be resorted to if desired,

aids the unwatering and compacting effect. It will be seen, however, that with a given mixture the height necessary to produce the desired density in the lower portion of the column can readily be determined by experience.

The column being thus established, with the cores 16 in the position indicated in Figs. 1 and 2, the cores are forced upwardly into the lower portion of the column, thereby displacing some of the material and producing tubular hollows or cavities in the product. The direction of displacement of the material depends largely upon the shape of the cores. If these have parallel sides and flat tops the major portion if not all the displacement will be directly upward, in which case the cores act more like punches. On the other hand if the cores are tapered, or have their upper ends rounded or tapered, at least part of the displaced material will be crowded laterally or in a horizontal direction, thereby strongly compacting the surrounding material.

Preferably the cores are shaped as in Figs. 3, 4 and 5, that is, they have a slight taper and are rounded on top, and though of a general rectangular or oblong cross section their sides are preferably incurved as indicated in Fig. 5.

If, as is usually the case, the total space occupied by the cores is considerable, say half or even more than half of the total space below the slots 13, 14, they may lift the entire column, especially if the material in the lower portion of the column is too stiff or dense. To obviate this trouble the cores may be raised singly, one after the other, or in groups. For example, in Fig. 4, the cores marked *a* may be raised first, then those marked *b*. In this way the total lifting force exerted at any instant is considerably lessened so that they will enter the column instead of raising it. As a further protection against lifting of the column, and to minimize any tendency that may exist for the cores to distort the relatively thin webs and walls bounding the paths of the cores, the mass below the path of the severing knife or saw may be held down during the inward movement of the cores by suitable stops, as 13^a, 14^a, inserted in the slots 13, 14, and 13^b, inserted in the openings 13^c in the side walls of the container 10, the stops being inserted just before the cores start up and withdrawn before the severing knife begins its inward movement.

If that part of the column which is penetrated by the cores is larger than is desired for the finished products it may be cut up before or after it is severed and removed from the shaft. In the former case the dividing of the cored portion is preferably effected by one or more knives, which may enter the column vertically from below, through a suitable slot or slots in the table 12 and pallet 11, or horizontally from the front, rear, or sides of the shaft through a vertical slot or slots therein. In the particular arrangement illustrated, in which the horizontal dimensions of the base of the column are about eight by twenty-four inches, products of convenient size, each about four by eight by twelve inches, can be made by one transverse and one longitudinal cut. These cuts are made, preferably, by a cross-shaped knife composed of blades 17, 18, moving vertically in slots in the table 12 and pallet 11 and having their outer edges guided by vertical grooves in the walls of the shaft. These knives or blades can be introduced into the column at any suitable time, as for example before, after, or during the upward movement of the cores, or even after the horizontal severing knife 15 has been advanced.

The next step in the preferred practise of the invention is to sever the lower portion of the column, as by forcing or driving the knife 15 through slot 13 and out through slot 14, thereby completely separating the lowermost part of the column from the upper part. Preferably the knife is of material thickness, so that its introduction into the column may effect additional compacting or densifying. If the cutting edge of the knife is bevelled equally on both sides, as in Fig. 3, the compacting effect is divided with substantial equality between the parts of the column above and below the knife. With the bevel entirely on the bottom, the compacting action is expended entirely upon the severed portion of the column, and with the bevel entirely on the top no material compacting effect is produced upon the severed portion; whereas with one side bevelled more than the other, the compacting effect will be greater toward that side having the most bevel, as will be readily understood. In this way it is possible to distribute the compacting effect in the most advantageous manner, as experience may indicate.

If the lower portion of the column is divided into parts while it is imprisoned, the knives employed for the purpose may also have a substantial compacting effect, but in most cases this additional compacting is unnecessary and I therefore prefer to have the dividing knives as thin as possible consistent with the strength and stiffness required to enable them to make a clean cut.

As shown in Fig. 3, the tops of the cores are preferably brought close to the path of the knife 15, thus leaving only a thin layer of concrete above the cores. This layer may in some cases be too thin to withstand the rather strong suction produced by the withdrawing movement of the cores and hence may collapse, with injury to the product. To prevent this possibility provision may be made for admitting air above the cores be-

fore or as they are retracted. For such purpose each core may be made hollow, as indicated in Fig. 3, with a tubular stem 19 extending downwardly and having one or more lateral air-ports 20. During the upward movement of the cores these ports are closed by a rod or valve 21, which extends preferably to the upper surface of the core, but just before the downward movement begins the rod or valve is retracted, thereby opening the ports and admitting air. In this way no vacuum is formed, or if any suction is produced it is relieved before injury results. Moreover, relief of the suction enables the cores to be withdrawn more easily, as will be readily understood.

The severed lower portion of the column is removed downwardly from the shaft 10 by lowering the pallet 11 and table 12. Preferably the pallet and table begin to descend just as or shortly after the cores reach a point at which their tops are a little below the upper face of the pallet. As the latter moves down, the severed portion of the column slides out of the shaft and when free of the shaft it is carried away on the pallet to set and harden.

If the severed portion is subdivided while it is still imprisoned in the shaft, as is preferable in practise, the subdividing knives may be withdrawn before, after, or during the downward movement of the cores.

After the severed portion has been removed a fresh pallet is placed on the table and raised to the position shown in Fig. 1, after which the horizontal severing member is withdrawn, preferably as rapidly as possible so that the descent of the column will be sudden, causing it to strike the pallet with a heavy impact, thereby further compacting the lower portion of the column. The steps described above are now repeated, and the process continued, fresh concrete of proper composition and consistency being supplied to the top of the column continuously or at suitable intervals to maintain the column at the right height.

One of the various types of products that can be made by my process is illustrated in horizontal section in Fig. 6 and in vertical longitudinal section in Fig. 7. As shown it consists of a relatively thin outer shell or concrete the sides of which are connected inside by one or more transverse webs, which are bulged at the center on both sides, as are also the end walls of the shell on the inside, thus forming in effect miniature piers or columns, while the top of the shell, between the webs and the side and end walls is arched or dome-shaped on the underside. The block or tile thus has very high resistance to vertical compression stresses even though the total amount of concrete is very small in proportion to the volume of the block. When laid in a wall, as in Fig. 7 for example, the bottom edges of the walls and webs embed themselves in the mortar spread on the course below, and the mortar which protrudes into the cavities in the tile aids materially in preventing horizontal displacement, as will be readily understood.

The invention is preferably practised as herein described, but may be varied in many respects. For example I may use reciprocating saws instead of knives to sever and cut up the lower portion of the column. The order or sequence of the steps can be varied, though of course the column or other mass from which the products are formed must be established first; and in general the cores should be introduced into the lower portion of the mass before such portion is severed, as I find that this order yields a better product, particularly in respect to uniformity or homogeneity of the material composing the walls and webs of the tile. Preferably the cores are retracted to their lowermost position before the table is lowered with the pallet and the severed portion of the column, but it is possible to lower both the table and the cores simultaneously, arresting the table (and pallet) when the block or blocks on the pallet have cleared the bottom of the shaft, but permitting the cores to continue their descent.

I claim—

1. In the art of making hollow cementitious products, the improvement comprising establishing in a suitable upright container a mass of unset cementitious material, forcing one or more cores into the lower portion of the mass to produce cavities therein, severing the cored lower portion of the mass from the upper portion, retracting the cores and removing the severed portion, and allowing the upper portion of said mass of cementitious material to descend in the container for the formation of another product.

2. In the art of making hollow cementitious products, the improvement comprising establishing in a suitable container a mass of unset cementitious material, forcing a plurality of cores vertically into the lower portion of the mass and forcing a substantial part of the material composing such portion upwardly into the upper portion of the mass, severing the cored lower portion of the mass, and retracting the cores and removing the severed portion.

3. In the art of making hollow cementitious products, the improvement comprising establishing in an upright hollow shaft an unset cementitious column of a height sufficient to effect a substantial compacting of its lower portion, displacing material from the compacted lower portion of the column into the upper portion to produce cavities in such lower portion, severing said lower portion, and removing the severed portion.

4. In the art of making hollow cementi-

tious products in which successive sections are severed from a mass of unset cementitious material, the improvement comprising forcing cores into such sections to displace material therefrom and form cavities therein while the sections are imprisoned in a rigid container.

5. In the art of making hollow cementitious products, the improvement comprising establishing in a suitable container a mass of cementitious material, driving one or more cores into a portion of the mass to produce one or more cavities therein and force the displaced material into the other portion of the mass, and severing the cored portion, retracting the cores, and removing the cored portion.

6. In the art of making hollow cementitious products, the improvement comprising establishing in a suitable container an unset mass of cementitious material containing more of the material than is required to make the desired product, forcing one or more cores into but not through the part of the mass that is to comprise the product, to form one or more cavities therein and expel the displaced material, and severing and removing the cored portion.

7. In the art of making hollow cementitious products, the improvement comprising establishing in an upright hollow shaft or container an unset cementitious column of a height sufficient to effect a substantial compacting of its lower portion, forcing one or more cores into the compacted lower portion of the column to produce cavities therein, severing the lower portion of the column in a plane above the cores after they have been introduced, and retracting the cores and removing the severed portion.

8. In the art of making hollow cementitious products, the improvement comprising establishing in an upright hollow shaft or container an unset cementitious column of a height sufficient to effect a substantial compacting of its lower portion, forcing a plurality of cores vertically into the lower portion whereby a substantial part of the material composing such portion is displaced upwardly into the upper portion of the column, severing the lower portion in a plane above the cores after they have been introduced, and retracting the cores and removing the severed portion.

9. In the art of making hollow cementitious products, the improvement comprising establishing in an upright hollow shaft or container an unset cementitious column of a height sufficient to effect a substantial compacting of its lower portion, displacing material from the compacted lower portion of the column into the upper portion to produce cavities in such lower portion, severing said lower portion in a plane above said cavities, and removing the severed portion.

10. In the art of making hollow cementitious products, the improvement comprising establishing in an upright hollow shaft or container an unset cementitious column of a height sufficient to effect a substantial compacting of its lower portion, forcing tapered cores upwardly from below into said lower portion, whereby part of the material is displaced upwardly into the upper portion, and part laterally, producing further compacting of the remaining material, severing the compacted lower portion of the column in a horizontal plane above the cores after they have been introduced, and retracting the cores and removing the severed portion.

11. In the art of making hollow cementitious products, the improvement comprising establishing in an upright hollow shaft or container an unset cementitious column of a height sufficient to effect a substantial compacting of its lower portion, forcing cores into the compacted lower portion to displace material therefrom into the upper portion, dividing the lower portion of the column into parts in vertical planes between cores, severing the lower portion of the column in a horizontal plane above said cores after they have been introduced, and retracting the cores and removing the divided lower portion of the column.

12. In the art of making hollow cementitious products, the improvement comprising establishing in a hollow shaft or container a column of unset cementitious material, and compacting the material at one end thereof, displacing material from the compacted portion of the column into the other portion to produce cavities in the former, severing the compacted portion of the column in a plane between the cavities and the remainder of the column after said cavities have been produced, and removing the severed portion.

13. In the art of making hollow cementitious products, the improvement comprising establishing in a hollow shaft or container a column of unset cementitious material and compacting the material at one end thereof, forcing cores into and withdrawing the same from the compacted portion of the column to produce cavities therein and admitting air into the cavities through openings in the cores themselves as the cores are withdrawn, and severing the cored portion from the remainder of the column.

14. In the art of making hollow cementitious articles, the improvement comprising establishing in a hollow shaft or container a column of unset cementitious material, passing cores into and out of the column at one end thereof to produce cavities therein and admitting air into the cavities through openings in the cores themselves as the cores are withdrawn, and severing the cored portion from the remainder of the column.

15. In the art of making hollow cementitious products, the improvement comprising establishing in a hollow shaft or container a column of unset cementitious material, forcing cores in succession into one end of the column to displace successive portions of the material and thereby produce a plurality of cavities, and severing and removing the cored portion of the column.

16. In the art of making hollow cementitious products, the improvement comprising establishing in an upright hollow shaft or container a column of unset cementitious material of a height sufficient to effect a substantial compacting of its lower portion, forcing cores upwardly into the lower portion of the column, forcing other cores upwardly into the lower portion of the column at points adjacent to paths of the first cores, and severing the cored portion of the column in a horizontal plane above the cavities produced by the cores.

In testimony whereof I hereto affix my signature.

ALFRED OWEN CROZIER.