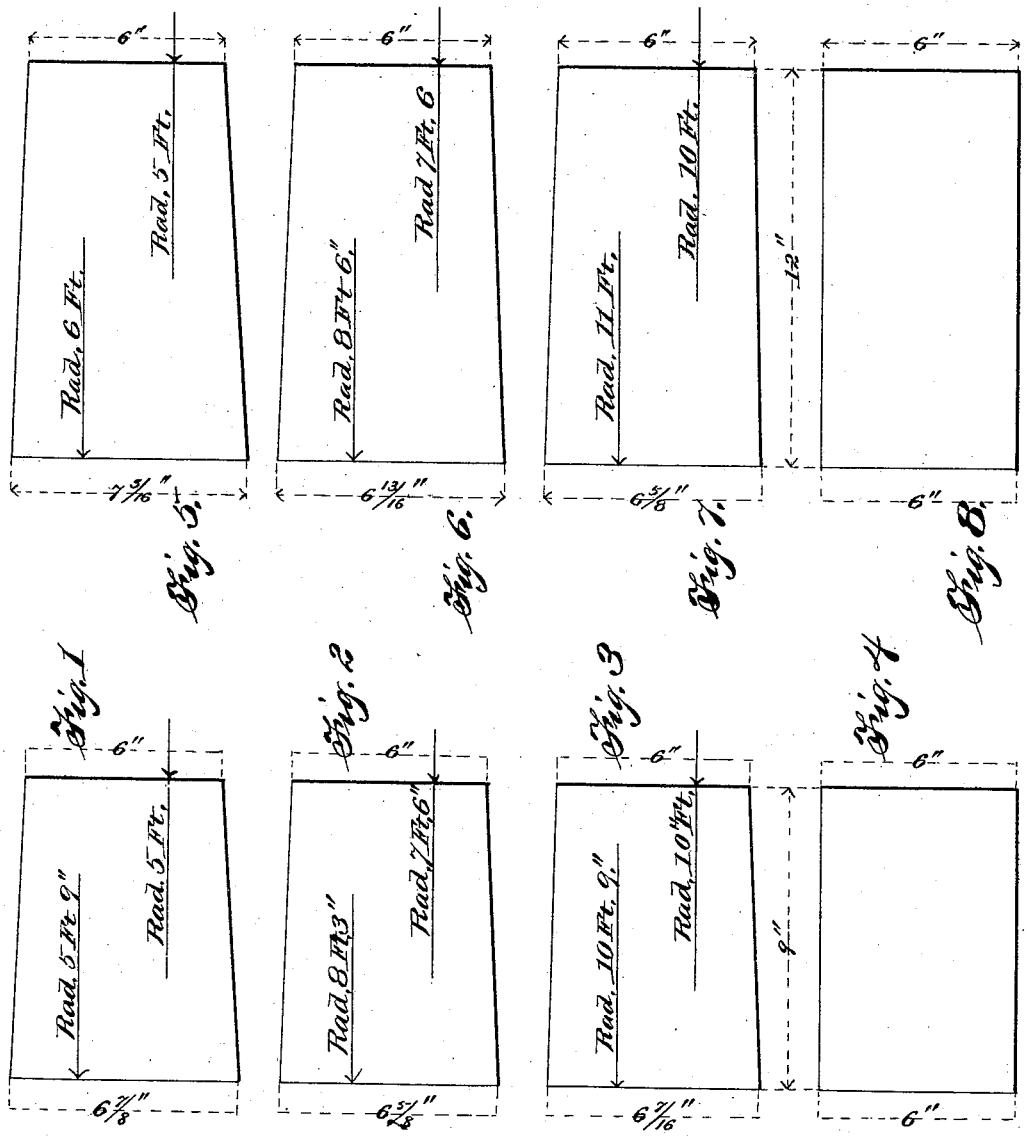
(No Model.) 4 Sheets—Sheet 1.

C. H. FOOTE.

WALL FOR CIRCULAR STRUCTURES.

No. 489,415. Patented Jan. 3, 1893.



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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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C. H. FOOTE.

WALL FOR CIRCULAR STRUCTURES.

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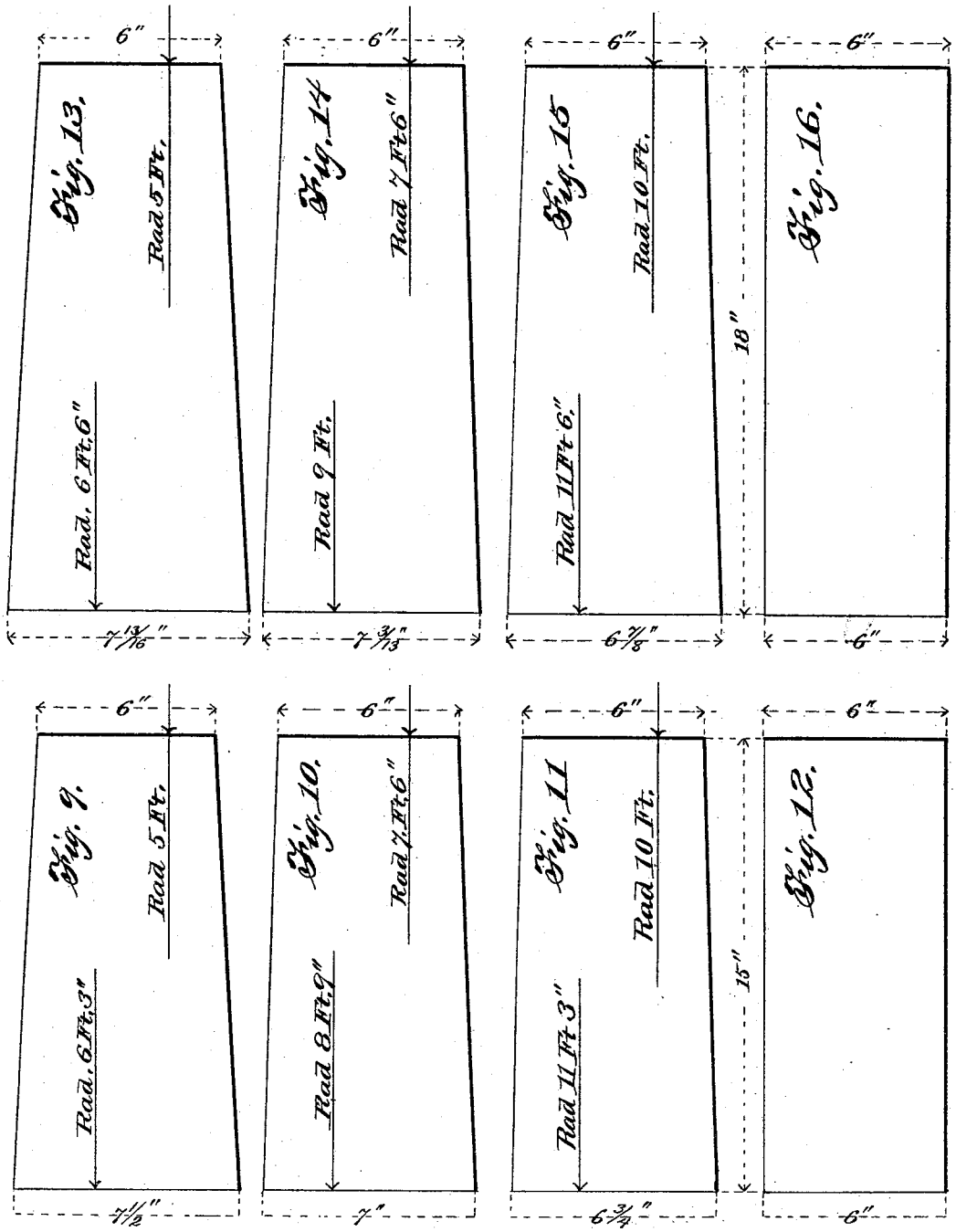

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(No Model.)

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C. H. FOOTE.

WALL FOR CIRCULAR STRUCTURES.

No. 489,415. Patented Jan. 3, 1893.

Fig. 17.

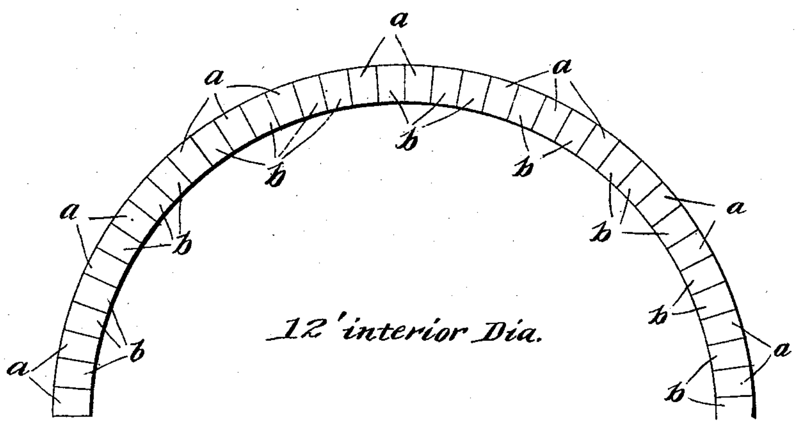
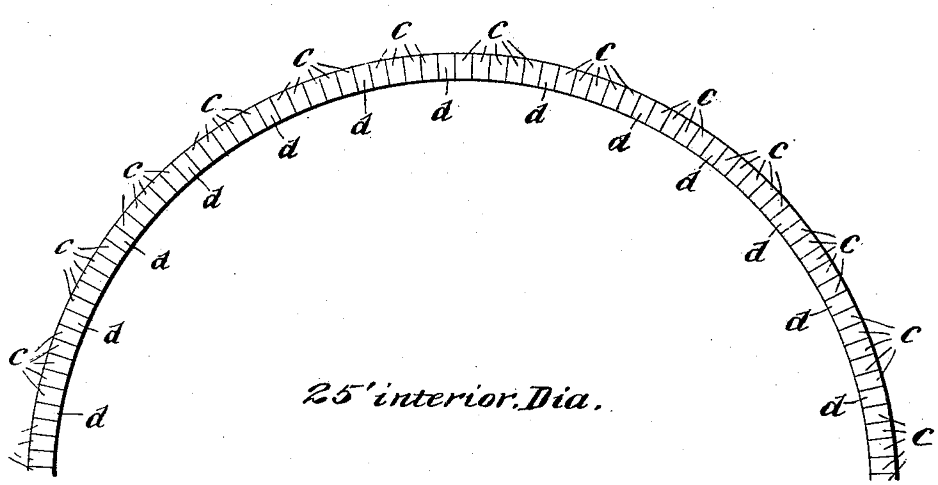


Fig. 18.



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(No Model.) 4 Sheets—Sheet 4.

C. H. FOOTE.

WALL FOR CIRCULAR STRUCTURES.

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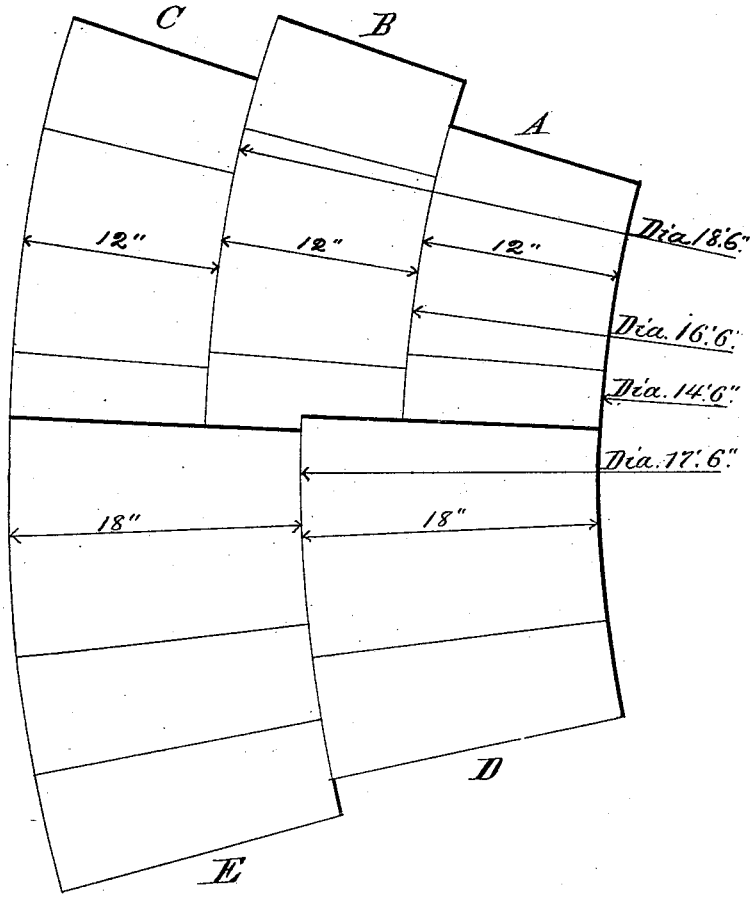

Fig. 19.

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UNITED STATES PATENT OFFICE.

CHARLES H. FOOTE, OF CHICAGO, ILLINOIS, ASSIGNOR TO REUBEN JENKINS, OF SAME PLACE; JOHN B. JENKINS EXECUTOR OF SAID REUBEN JENKINS, DECEASED.

WALL FOR CIRCULAR STRUCTURES.

SPECIFICATION forming part of Letters Patent No. 489,415, dated January 3, 1893.

Application filed December 28, 1891. Serial No. 416,304. (No model.)

To all whom it may concern:

Be it known that I, CHARLES H. FOOTE, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Walls for Circular Structures; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention has for its object to provide a construction for the circular walls of blast furnaces and other structures by which such walls may be built from a relatively few standard sizes of bricks. As is well known, blast furnaces are circular in section and conical, and in their construction or lining fire bricks are employed which are segmental in form. Heretofore the bricks for each course have been molded to the exact form required for the circle in which they were to be laid and, consequently, very many different sizes of bricks have been necessary in the construction of such furnaces. The bricks being what are known as fire bricks, moreover, require a long time for their manufacture, and, inasmuch as manufacturers and dealers have found it impossible to keep in stock a sufficient quantity of all the numerous sizes heretofore required, long delays have been necessary in furnishing brick to effect reconstructions necessitated by unexpected coolings of such furnaces.

The invention is also applicable to cylindrical structures wherein concentric circular courses or rows of varying diameter are required.

By the invention herein set forth it is made practicable to employ only a relatively few sizes of bricks and it is thus made possible for dealers to keep in stock and to at once supply all that may be required for a given piece of work.

To this end the invention consists, primarily, in a structure composed of segmental bricks formed on a limited number of circles varying within the limits of the measurements of the smallest and the largest in the structure to be formed, either with or without rectangular bricks.

It also consists in a construction of the conical stack comprising a group or plurality of adjacent laid courses, all formed from segmental bricks of a circle intermediate to the extreme courses of the group, or from such segmental bricks together with one or more rectangular bricks. The rectangular bricks contemplated will be for and used in only the courses of large diameter and will correspond in length with the segmental bricks with which they are to be laid. For example, for a conical structure varying from twenty-five or thirty feet to ten feet interior diameter and calling for a very large number of courses, each varying in diameter from every other within these limits, segmental bricks formed on only three circles, or segmental bricks formed on three circles together with square bricks in the courses of larger diameter, may be made to serve for all the numerous courses in the structure. That is to say, the entire structure may be properly made from bricks formed on the three diameters of ten, fifteen and twenty feet, and others which are square. Suppose the length of the face of all bricks in the line be the same, as for example six inches and that the bricks of each circle of ten, fifteen and twenty feet be made of three or four different lengths. If of three there will be only nine varieties or sizes of segmental bricks and only twelve of the segmental and square included. By this provision of a comparatively few definite sizes having definite relation to the size of the stack to be constructed, as will be more fully explained, the manufacturer of fire bricks may always keep in stock a sufficient quantity to enable him to furnish promptly the materials for repairs or original construction instead of being compelled to make them to order, as has heretofore been necessary.

In the accompanying drawings I have illustrated individual bricks of relative varying

dimensions as to their length and the radius on which they are formed, including rectangular bricks corresponding to the various sizes of the segmental ones. These are shown at Figures 1 to 16 inclusive in plan view. Fig. 17 illustrates a part of a course containing a single length of bricks and embracing bricks of different radiuses in illustration of the descriptive table hereinafter given in this specification. Fig. 18 is a similar illustration of a similar course of twenty-five feet diameter. Fig. 19 illustrates the application of the principle to courses containing circles of bricks radially interior or exterior to each other, showing a course of three circles on which is superposed a course of two circles, the bricks in the latter aggregating in length the length of the bricks forming the three circles in the subjacent course. Owing to the necessarily small scale of these drawings the exact curves of the ends of the segmental bricks are not indicated.

In Figs. 1 to 16 inclusive the radius on which the segmental bricks are formed is indicated by descriptive words on the figures themselves, the radius of the inner and narrow end and that of the outer and wider end of each brick being both given, the difference being of course the length of the brick, which latter is also indicated in the spaces just above the rectangular bricks shown at the bottom of the rows on each sheet. In these figures of the drawings the bricks are shown of four lengths varying from nine to eighteen inches and differing in length each from the next larger by three inches. The length of the bricks is dependent upon the thickness that it is desired to give to the wall and upon the number of bricks that it is intended to place end to end to make up that thickness. Considering first the case of a wall composed of a single thickness of brick, it will be noted that in using the standard sizes of bricks in accordance with my invention certain courses will be composed wholly of bricks of one standard type which will be what I term standard courses each of a diameter due to that of the type, composing it while the intermediate courses between any two standard courses will be composed of bricks of the two types of the two standard courses between which they are located. The relative number employed of each type increases in the successive intermediate courses in the direction of the standard course composed of that type, the relative number of the other type decreasing in that direction in a corresponding manner, so that this latter type vanishes at the standard course of the first mentioned type. This will appear from the accompanying table, which gives the number and type of brick the courses of a wall constructed in accordance with my invention and varying by six inches internal diameter from each other for all such courses between ten feet and twenty-five feet six inches inclusive, the face or inner end of each brick being six inches in length or horizontal dimensions.

Table showing number of blocks required for different circles varying by six inches in internal diameter, between and including ten feet and twenty-five feet six inches, each block being six inches in horizontal measurement upon its inner end or face.

Inside diameter of circle.	Blocks of circle of diameter of—			Square.	Total.
	10 feet.	15 feet.	20 feet.		
10 feet	63				63
10 feet 6 inches	59	7			66
11 feet	55	14			69
11 feet 6 inches	50	22			72
12 feet	45	30			75
12 feet 6 inches	39	39			78
13 feet	33	48			81
13 feet 6 inches	26	59			85
14 feet	18	70			88
14 feet 6 inches	9	82			91
15 feet		94			94
15 feet 6 inches		87	10		97
16 feet		80	20		100
16 feet 6 inches		73	31		104
17 feet		64	43		107
17 feet 6 inches		55	55		110
18 feet		45	68		113
18 feet 6 inches		35	81		116
19 feet		24	95		119
19 feet 6 inches		12	111		123
20 feet			126		126
20 feet 6 inches			126	3	129
21 feet			126	6	132
21 feet 6 inches			126	9	135
22 feet			126	12	138
22 feet 6 inches			126	15	141
23 feet			126	18	144
23 feet 6 inches			126	21	147
24 feet			126	24	150
24 feet 6 inches			126	28	154
25 feet			126	31	157
25 feet 6 inches			126	34	160

That is to say, explaining the foregoing table, in the use of bricks having six inches face horizontal measurement upon their inner ends, sixty-three bricks of the ten foot type make a complete course of ten feet interior diameter; ninety-four bricks of the fifteen foot type form a complete course of fifteen feet interior diameter, and one hundred and twenty-six of the twenty foot type form a complete course of twenty feet interior diameter. For courses of more than ten feet and less than fifteen feet interior diameter bricks of both the ten foot and the fifteen foot types are employed, the relative number of each of said types so employed varying according to the diameter of the course, substantially as indicated in the table. For example, for a course of twelve feet six inches diameter, which is as much larger than ten feet as it is smaller than fifteen feet, an equal number (39) of both said types should be employed, while for a course of eleven feet diameter fifty-two bricks of the ten foot type and seventeen of the fifteen foot type should be used. So for a course of thirteen foot diameter thirty-four bricks of the ten foot type and forty-seven of the fifteen foot type should be taken. Obviously if the bricks are of other length of face than six inches the number of bricks of a single type composing either of the standard courses will

be different from that required when they have this length of face.

The rule for properly differentiating the numbers of the different bricks of two standard courses to be employed in the intermediate courses or circles varying by six inches in interior diameter and the rule upon which the foregoing table is calculated, is indicated as follows: The difference between ten feet and eleven feet six inches is one foot six inches and the difference between fifteen feet and eleven feet six inches is three feet six inches. Now as three feet six inches is to one foot six inches (or as seven is to three) so is the number of bricks required of the ten foot circle type to the number of bricks required of the fifteen foot circle type to form the circle of eleven feet six inches. Let x equal the number of bricks required of the ten foot circle; then seventy-two minus x equals the number of bricks required of the fifteen foot circle. Inserting these quantities in the statement of the proportion and forming and working out the equation and we have x equals fifty plus, or the number of bricks of the ten foot circle type to be employed in the circle of eleven feet six inches and seventy-two minus fifty equals twenty-two, the number of bricks of the fifteen foot circle. In the same manner the required number of bricks of any two adjacent standard circles or courses to make a given intermediate course may be determined and the table above given verified or a similar table produced. In the same manner also a similar table for bricks of other length of face than six inches may be calculated, the number of bricks in each standard course being first determined. Expressing this principle as a formula or rule: The numbers of bricks of the types of two adjacent standard courses which should be used to form an intermediate course, are to each other inversely as the differences in diameter between the intermediate course and the said standard courses.

It is obvious from the nature of the structures herein contemplated, having mortar, cement or similar materiable as well as bricks in their composition, that variations from the table and rule are practicable and permissible within my invention since the quantity of mortar or cement between bricks may be varied, within certain limits. Exact conformity to the rule or table is, therefore, not essential to the practice of my invention. The bricks of the different types entering into an intermediate course should be laid in alternation, or as nearly in alternation as the relative numbers of the two types permit, in order that the aberration of those of one type in one direction from the true circle desired may be practically corrected by the aberration in the reverse direction of those of the other type.

In case it is desired to produce a circular course of a diameter greater than that of the greatest standard course or type, rectangular bricks are used, and such a construction is shown in Fig. 18, wherein a course of twenty-five feet in diameter is shown, composed of one hundred and thirty bricks, c, of the twenty foot circle type and twenty-seven bricks, d, of the rectangular type, interspersed equidistantly between the segmental bricks, and giving a circle of the desired diameter.

In Fig. 19 there is shown a portion of a compound wall, built in alternate courses of two and three bricks placed end to end. In the lower course, which is built up of three rows of bricks each twelve inches long, the row A, which is a circle of fourteen feet and six inches internal diameter, will be composed, in accordance with the table hereinbefore given, of nine bricks of the ten foot circle type and eighty-two bricks of the fifteen foot circle type. The row B, which is of sixteen feet and six inches internal diameter, will be composed of sixty-four bricks of the fifteen foot circle type and forty of the twenty foot circle type. The row C, which is of eighteen feet and six inches internal diameter, requires forty-two bricks of the fifteen foot circle type and seventy-four of the twenty foot circle type. In the upper course, which is composed of two rows of bricks, each eighteen inches long, the inner row D obviously requires the same number and types of brick as the row A, being of the same internal diameter, while the outer row, E, being of an internal diameter of seventeen feet and six inches, requires fifty-three bricks of the fifteen foot circle type and fifty-seven of the twenty foot circle type. It will thus be seen that with the comparatively few standard sizes of bricks enumerated, or with any others, more or less in number, which may be selected as desirable, the several circular courses may be given the desired diameter to impart to the furnace the conical shape desired. Thus, as already pointed out, a great saving in time and cost may be effected.

From an examination of Fig. 19 it will be seen that the invention is applicable to a cylindrical or other structure wherein successive concentric circular courses of varying diameter are employed as well as to the conical structure hereinbefore discussed. It is also obvious that the same advantages are attendant upon its use in a cylindrical or other structure containing such circles of varying diameter as in a conical structure of the furnace type.

I claim:

1. A structure composed of a plurality of layers of segmental bricks or blocks forming circular courses of varying diameters, said bricks or blocks being in sets in the form of true segments of a number of standard courses less than the total number of courses, said sets being adapted to form standard courses, each of a single type of brick, at about equal

intervals throughout the structure, the intermediate courses being composed in varying proportions of bricks of the types of the two standard courses between which they are located.

2. A furnace-wall or the like of conical form, composed of a plurality of superposed layers of segmental bricks or blocks forming circular courses of varying diameters, said bricks or blocks being in sets in the form of true segments of a number of standard courses less than the total number of courses, said sets being adapted to form standard courses, each of a single type of brick, at about equal intervals throughout the structure, the intermediate courses being composed in varying proportions of bricks of the types of the two standard courses between which they are located.

3. A structure composed of a plurality of layers of segmental and rectangular bricks or blocks forming circular courses of varying diameters, said segmental bricks or blocks being in sets in the form of true segments of a number of standard courses less than the total number of courses, said sets being adapted to form standard courses, each of a single type of brick, at about equal intervals throughout the structure, the intermediate courses being composed in varying proportions of bricks of the types of the two standard courses between which they are located, and those courses of greater diameter than the greatest standard course being composed in varying proportions of bricks of that standard course and rectangular bricks.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

CHARLES H. FOOTE.

Witnesses:
M. E. DAYTON,
L. HOLMBOE.