W. VERSHOFEN.

TOY BLOCK FOR BUILDING ARCHES.

APPLICATION FILED FEB. 13, 1913.

1,124,078. Patented Jan. 5, 1915.

Fig. 1.

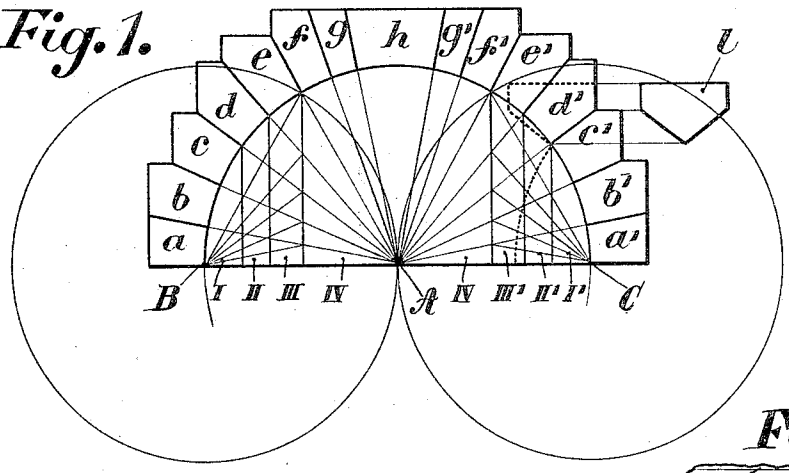


Fig. 7.

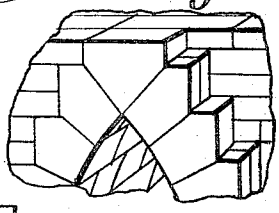


Fig. 2.

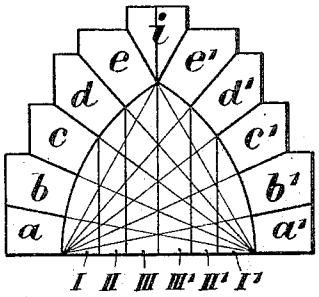


Fig. 4.

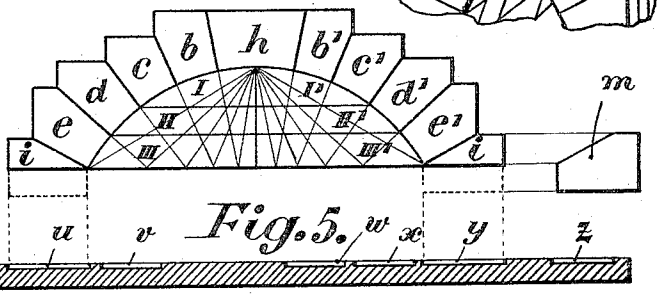


Fig. 5.

Fig. 3.

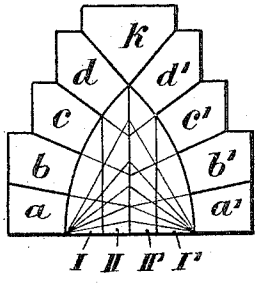
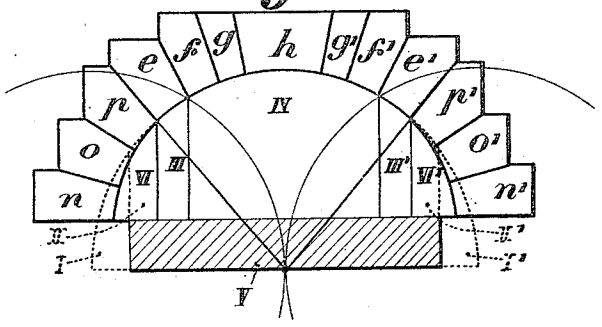


Fig. 6.



Witnesses:

M. E. McDade.

Chas. Kesler

Wilhelm Vershofen

by Otto L. Morris

Attorney.

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

UNITED STATES PATENT OFFICE.

WILHELM VERSHOFEN, OF JENA, GERMANY.

TOY BLOCKS FOR BUILDING ARCHES.

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To all whom it may concern:

Be it known that I, WILHELM VERSHOFEN, a subject of the German Emperor, residing at Jena, Grand Duchy of Saxe-Weimar-Eisenach, Germany, have invented certain new and useful Improvements in Toy Blocks for Building Arches, of which the following is a specification.

The building blocks forming the subject of this invention enable arches of widely-different shapes to be constructed therewith, and at the same time illustrate in the most suitable manner the structural and static conditions of masonry and arch building. Moreover, they have the advantage that in the case of each of the numerous shapes of arches such as are used in architecture, it is possible to continue the structure by means of building elements, the dimensions of which correspond to those of the actual blocks.

The invention itself consists in the special shape of the voussoir stones and key-stones, and of the centering used for erecting the arches. The cross-section of the stones is such that the outer edges, corresponding to the broken outer outline of the arch, always give in any of the combinations possible according to the invention, the proportion of the ordinary blocks of which the masonry is constructed, that is to say, about 1:2:4, and that the arcuate edges of all, or of a plurality, of the stones form in any of the various shapes of arches possible, portions of a system of circles, the centers of which lie in a single straight line which represents the diameter of the largest arch, *i. e.*, the semi-circular arch, while the joints of the voussoir stones coincide with the radii of the said circles or form extensions of the same. The centering, in turn, is characterized by the fact that it is sub-divided in a special manner; that is to say, it is formed of several parts, the widths of which correspond to the projections of the arcuate edges of the voussoir stones. The entire number of portions of the centering is used for constructing the largest arch, namely a semi-circular arch, and the several portions themselves can be formed into any desired shapes, in order to permit the same voussoir stones to be used for constructing arches of widely differing shapes, for instance, Roman and renaissance arches, Gothic and other pointed arches of all kinds, and, further, flat arches, such as are chiefly used in bridge building. While, as has already been stated, the voussoir stones remain the same in all possible constructions, there are only added a few special key-stones and springer stones for special cases, and, moreover, there is also provided a foundation ledge which contains, systematically arranged, a number of recesses into which the springer stones of the single arches can be inserted, to facilitate the construction and to take up the pressure or the thrust of the arch. It must further be mentioned that the new centering which, in view of its various uses, can be here described as a normal centering, may have drawn on it the radial construction of the stone section for all possible constructions, in order to give an idea of the static conditions.

Some constructions according to this invention are illustrated by way of example, in the accompanying drawing, to give an idea of the numerous shapes of arch constructions which can be obtained with the same stones and one and the same centering.

Figure 1 is a diagrammatic front elevation of a Roman, or semi-circular arch; Fig. 2 is a similar view of a Gothic arch; Fig. 3 is a modification of Fig. 2; Fig. 4 is a similar view of a flat arch; Fig. 5 is a longitudinal vertical section of a foundation ledge; Fig. 6 is a modification of Fig. 4; and Fig. 7 is a perspective view of the arch represented in Fig. 3, showing a portion of the masonry to which the arch is joined.

As will be seen from Fig. 1, the several voussoir stones *a*, *b*, *c*, *d*, *e*, *f*, *g* have their outer edges, which produce the broken outline of the arch, formed in the proportion of about 1:2:4, while their arcuate inner edges form portions of a circle drawn with the point A as a center, and the joints of the said voussoir stones constitute extensions of the radii of said circle. The horizontal upper edge of the key stone *h* has a length which is a multiple of the dimensions of the horizontal upper edges of the stones *b*, *c*, *d*, this construction enabling arches to be built without gaps, and to be constructed in a

regular manner, by means of ordinary rectangular stones or blocks in the proportion of about 1:2:4, which is of the greatest importance in illustrating the conditions of stone building.

According to this invention, there is provided a centering consisting of several portions I, II, III, IV, III′, II′, I′; that is to say, a centering sub-divided in such a manner that its joints are parallel with each other, the widths of the single portions, for instance of the portions II, III, II′ and III′, corresponding to the projections of the arc edges of the stones *d*, *e*, *d′* and *e′*. On this centering is drawn, for the purpose of illustrating the static conditions, the radial construction of the stone section, (first, for the semi-circular arch, and then for arches of various other shapes), as shown in Fig. 1. If in Fig. 1 the circles are considered as drawn from the springing points B and C, as centers, which circles touch each other at the center of the diameter of the semi-circular arch, it will be seen that these circles intersect the circle drawn from the center A, at the joints of the voussior stones *e* and *f*, or *f′* and *e′*. This arrangement, due to the special shape of the stones in section, illustrates, also, the systematic deduction of another shape of arch. If, for instance, the centering portion IV and the stones *f*, *g*, *h* and *g′*, *f′* are removed from the Roman arch, (Fig. 1), and then the arch portion consisting of the stones *a′*, *b′*, *c′*, *d′*, *e′*, and supported by the centering portions I, II and III is shifted toward the arch portion *a*, *b*, *c*, *d*, *e* left standing on the other side, there will be obtained the purely Gothic arch shown in Fig. 2, in which the partial arcs are drawn from the opposite springing points. In this case, also, the radial construction provided on the centering portions, expresses the static conditions, as can be seen also in Fig. 2. In this case, we have again the voussoir stones *a*, *b*, *c*, *d*, *e* and *a′*, *b′*, *c′*, *d′*, *e′*, used for the construction of semi-circular arches, a special key stone *i* being provided, which, however, may be made in two parts to permit its use for another construction of arch hereinafter described.

By using the same stones, it is possible to build not only the pointed arch shown in Fig. 3, but also various other forms of pointed arches, using merely another key-stone, as shown in Fig. 3, and another as shown dotted in Fig. 1. If the stones *e*, *e′* and *i* are removed from the arch construction shown in Fig. 2, and the centering portions III and III′ are also removed, there will be produced, after the bringing together of the two arch portions left standing, and after the insertion of a special key-stone *k*, the pointed arch shown in Fig. 3 to which, however, as well as to the Gothic arch shown in Fig. 2, it is possible to build on by means of ordinary rectangular blocks or stones in proportion of about 1:2:4.

If the stones *d* and *d′* and the key-stone *k* are removed, and the centering portions II and II′ are taken away, there will be produced, when the two remaining portions of the arch with the remaining portions I and I′ of the centering, are brought together, still another form of pointed arch, as will be understood. In that case, a key-stone I, (Fig. 1), can be used, which likewise permits the building to be continued with ordinary stones, as its outer edges also correspond to the proportion 1:2:4. This does not, however, exhaust the series of constructions which are possible according to this invention; on the contrary, by means of the same voussoir stones and centering portions with which it is possible to build the above-described semi-circular and pointed arches, there can also be produced flat arches of varying spans, such, for instance, as that shown in Fig. 4. The construction of this arch is obtained from the semi-circular arch shown in Fig. 1, by removing the voussoir stones *f*, *g*, *h*, *g′*, *f′* and the centering portion IV, joining the remaining portion of the arch with the centering portions I′, II′, III′ at the bottom to the portion remaining on the left hand side of Fig. 1 and then turning the construction in question around, so that the obverse faces of the voussoir stones shown in Figs. 1 and 2 are now at the back of the arch, and the reverse faces thereof at the front, both faces being the same. The voussior stones *a* and *a′*, however, must also be removed and replaced by the key-stone *h* which was previously used in Fig. 1 for making the Roman or semi-circular arch, as shown in Fig. 4, the arc of the said key-stone *h* being twice that of a stone *a* or *a′*. As springer stones for the flat arch, the two portions of the key-stone *i* in Fig. 2, or the stones *m*, (Fig. 4), must be used.

In the case of the flat arch shown in Fig. 4, in which the voussoir stones *b*, *c*, *d*, *e*, *h*, *b′*, *c′*, *d′*, *e′*, which were used for the other arch constructions, and the centering portions I, II, III, I′, II′, III′, which were also used before, it is also possible to build on with ordinary stones or blocks having the proportion of about 1:2:4, and thus to continue the masonry in a regular manner.

As regards the oblique lines shown in Figs. 1, 2 and 3 as extending from the extremities of the diameters of the arches, it may be stated that in Fig. 1 these lines represent the radii of the circles forming the purely Gothic arch shown in Fig. 2, the said lines being drawn in view of the fact that the joints of the voussoir stones are to constitute extensions of the radii of the circles which form the arches. As shown in Fig. 2 the joints of the voussoir stones *a′*, *b′*, *c′*, *d′*, *e′*

are extensions of the lines extending from the point B in Fig. 1, so that these lines are parallel, therefore, with the lines which extend from the center A of the Roman or semi-circular arch, Fig. 1. The same holds true, of course, for the pointed arch represented in Fig. 3, which is built from the construction shown in Fig. 2 by removing the centering portions III and III′ and replacing the stones *e*, *e′* and *i* by the special key stone *k*, as previously stated, the lines being engraved, drawn or otherwise marked on the various centering portions. As regards Fig. 4, the lines extending from the center of the key stone *h* are the same lines which, in Fig. 1, extend from the points B and C, the centering portions in Fig. 4 being turned at a right angle to those in Fig. 1.

The modification shown in Fig. 6 enables the construction of basket-handle arches, *i. e.*, arches having the curved portions thereof drawn from three different centers. This modification differs from the showing in Figs. 1 to 4 by the fact that the centering is sub-divided not only by vertical section-lines, but, also, in a horizontal plane, in such a manner that the portion V is formed which may consist either of a single ledge or of sections, the widths of which correspond to those of the portions II, III, IV, III′, II′, or it may be formed by two layers of ordinary stones. The construction of a three-centered arch further requires the use of six stones *n*, *o*, *p* and *n′*, *o′*, *p′*. As this arch is manifestly of the compound type, the dotted lines in Fig. 6 indicate the extremities of the corresponding semi-circular or Roman arch, in accordance with Fig. 1.

It is to be noted that the portions VI and VI′ of the centering shown in Fig. 6, as well as the portions I and I′ of that shown in Figs. 1 to 4 may be omitted, since the stones supported by these portions are held in position by adhesion only.

As stones *a′* to *p′* correspond to the stones *a* to *p*, the invention provides for the possibility of building arches of any kind by using only fifteen types of voussoir stones and four types of ordinary stones, (1/1, 3/4, 1/2 and 1/4 of an ordinary stone), so that only nineteen types of stones are necessitated for an extremely great number of constructions.

To the set of stones above described, there is preferably added a foundation ledge, (Fig. 5), provided with a number of recesses marked *u*, *v*, *w*, *x*, *y*, *z*, which are adapted to receive the springer stones for the single arches. For instance, for the flat arch shown in Fig. 4, the springer stones *m* are inserted into the recesses *u* and *y*, while for receiving the voussoir stones *a* and *a′* of the Gothic arch shown in Fig. 2, the two recesses *v* and *x* are used. In that way, the building of the arches is facilitated, and also the pressure or the thrust of the arch is taken up, which insures an ample stability for the various shapes of arches.

As will be seen from the foregoing, the invention renders possible the construction of arches of various shapes and systems, with the smallest possible expenditure of building elements. Accordingly, an extremely great number of differently-shaped arches may be built from the same stones and with the same centering, and in all cases the radial construction of the stone section appears on the centering and the building may be continued with ordinary stones.

I claim:—

1. A set of toy blocks for building arches comprising a series of voussoir stones whose outer edges have substantially the proportion of 1:2:4 and whose arcuate inner edges form parts of a system of circles, the centers of which lie in a line forming the diameter of a semi-circular arch; and a centering for supporting the arch during building consisting of a plurality of separate portions whose widths are equal to the projections of the arcuate edges of the said voussoir stones upon such line.

2. A set of toy blocks for building arches comprising a series of voussoir stones whose outer edges have substantially the proportion of 1: 2:4 and whose arcuate inner edges form parts of a circle, the center of which lies in a line forming the diameter of a semi-circular arch, the joints between said stones forming extensions of radii of such circle; and a centering for supporting the arch during building consisting of a plurality of separate portions whose widths are equal to the projections of the arcuate edges of the said voussoir stones upon such lines.

3. A set of toy blocks for building arches comprising a series of voussoir stones whose outer edges have substantially the proportion of 1:2:4 and whose arcuate inner edges form parts of a system of circles, the centers of which lie in a line forming the diameter of a semi-circular arch, the key-stone of said series consisting of two counterpart members adapted to form the springer stones of a flat arch; and a centering for supporting the arch during building consisting of a plurality of separate portions whose widths are equal to the projections of the arcuate edges ofthe said voussoir stones upon such line.

4. A set of toy blocks for building arches comprising a series of voussoir stones whose outer edges have substantially the proportion of 1:2:4 and whose arcuate inner edges form parts of a system of circles, the centers of which lie in a line forming the diameter of a semi-circular arch; a centering for sup-

porting the arch during building consisting of a plurality of separate portions whose widths are equal to the projections of the arcuate edges of the said voussoir stones upon such line; and a supporting ledge having recesses for the reception of the springer stones of the arch.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

WILHELM VERSHOFEN.

Witnesses:
WM. F. EBERHARDT,
ALFRED HOFFMANN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."