

Sept. 9, 1924.

1,508,325

A. HENDERSON

CONCRETE BUILDING CONSTRUCTION

Filed Oct. 20, 1923

5 Sheets-Sheet 1

Fig. 1.

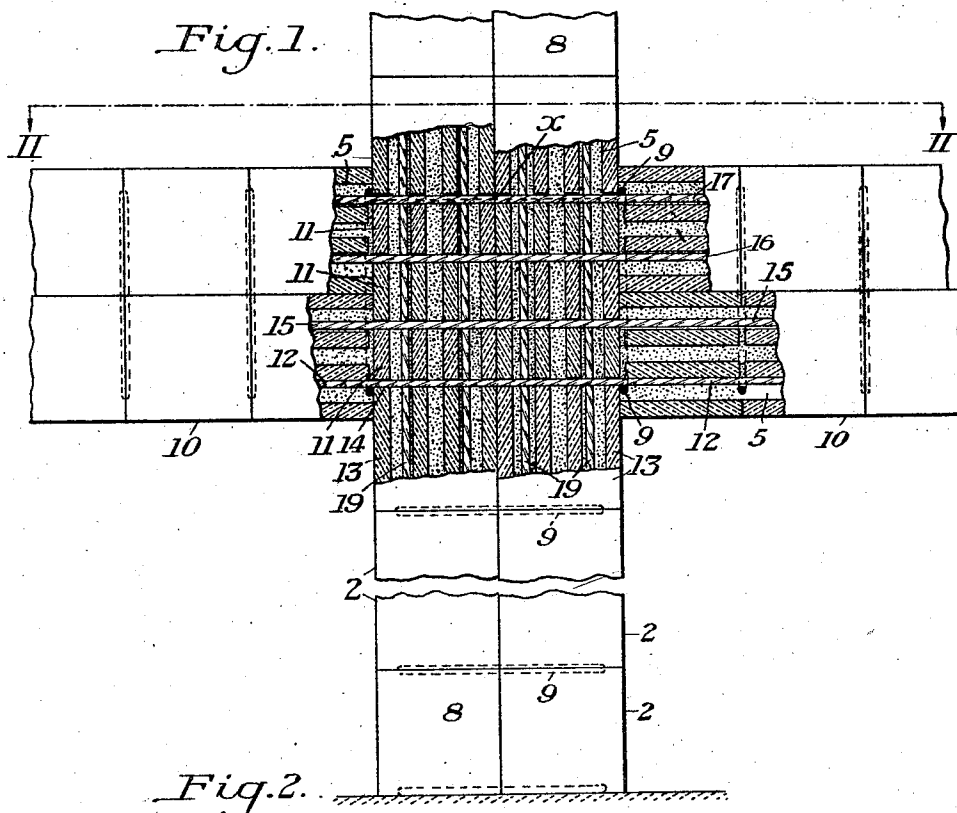
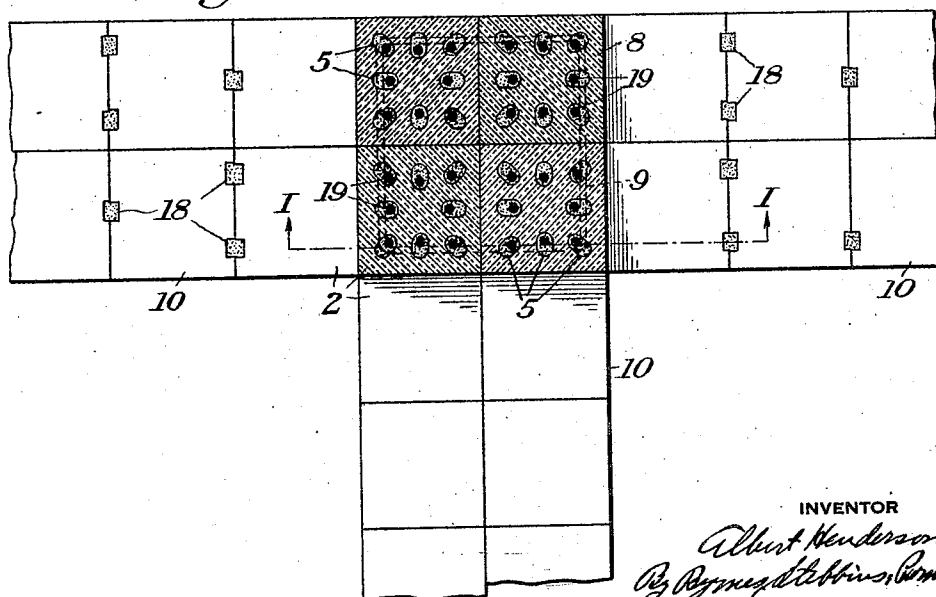


Fig. 2.



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Fig. 3.

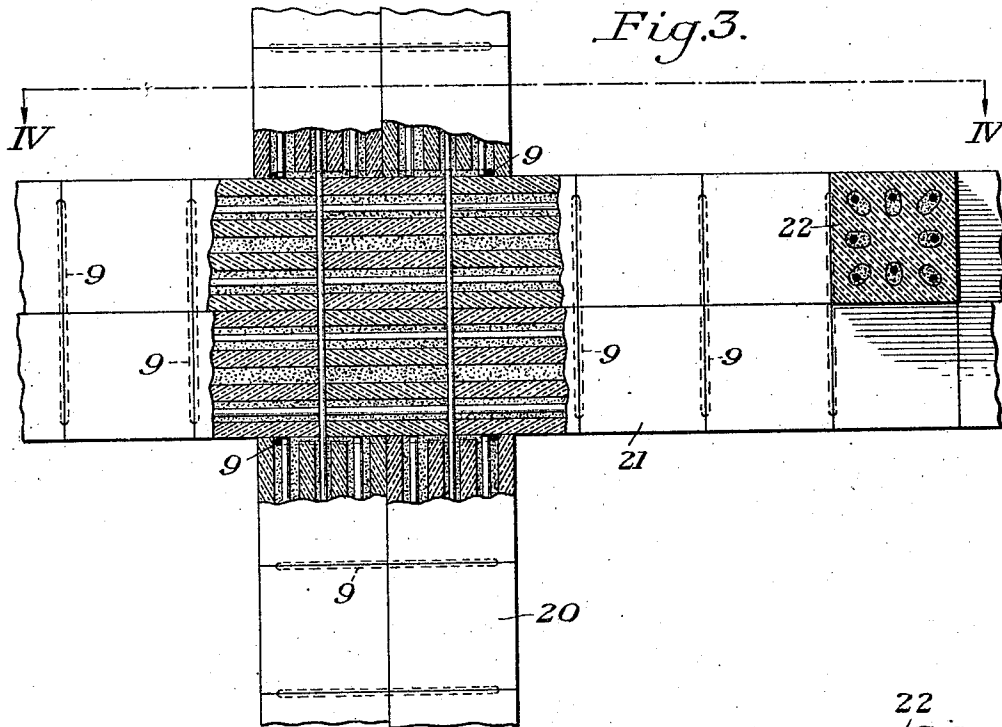
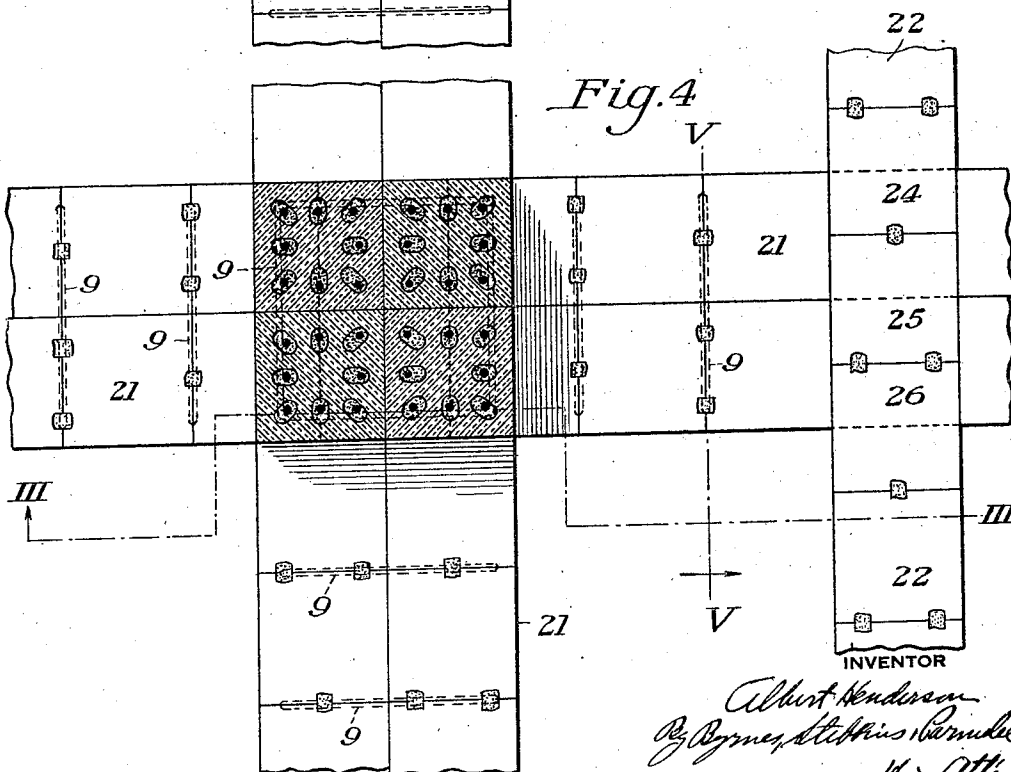


Fig. 4



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Fig. 5.

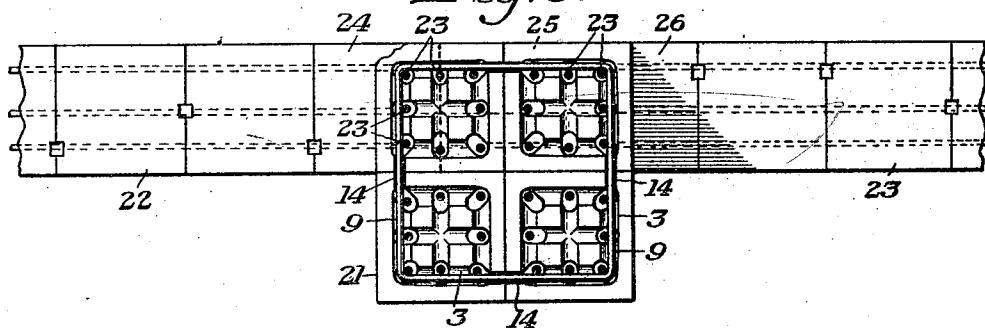


Fig. 6.

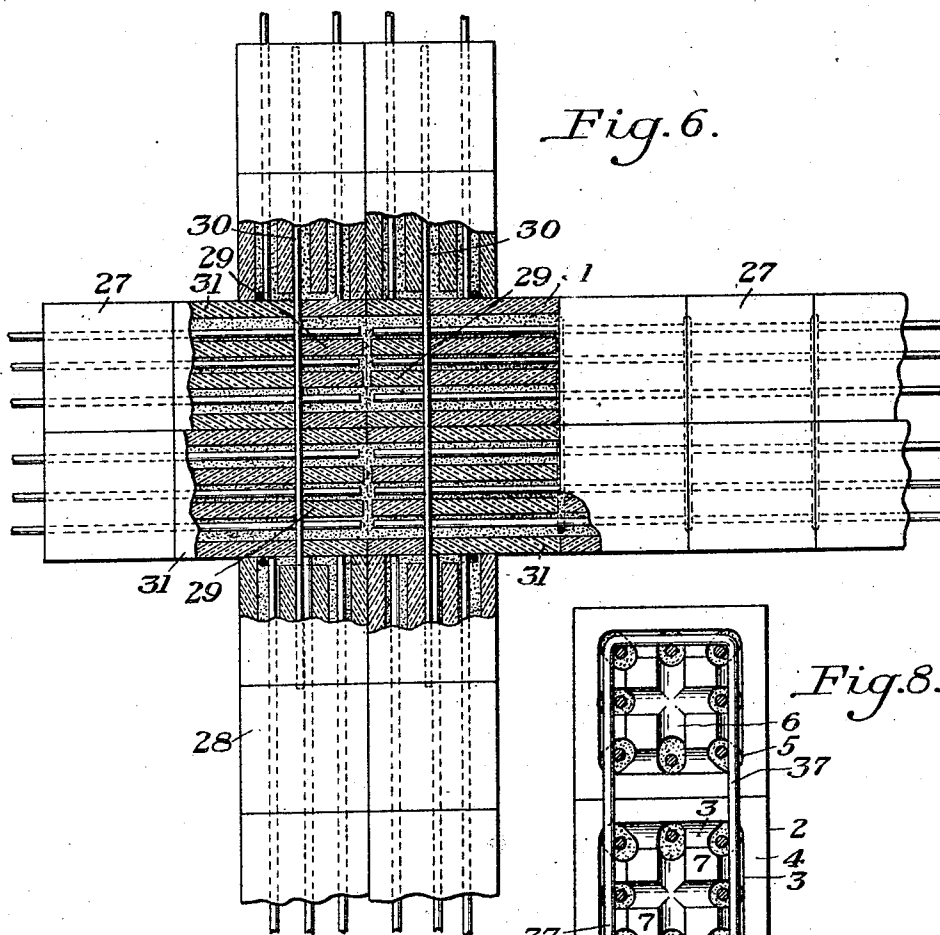
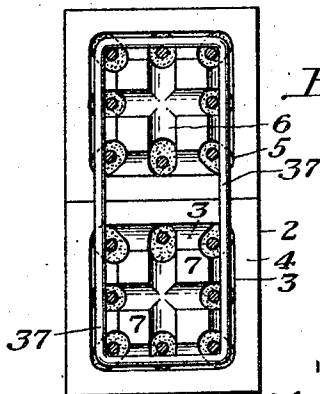


Fig. 8.



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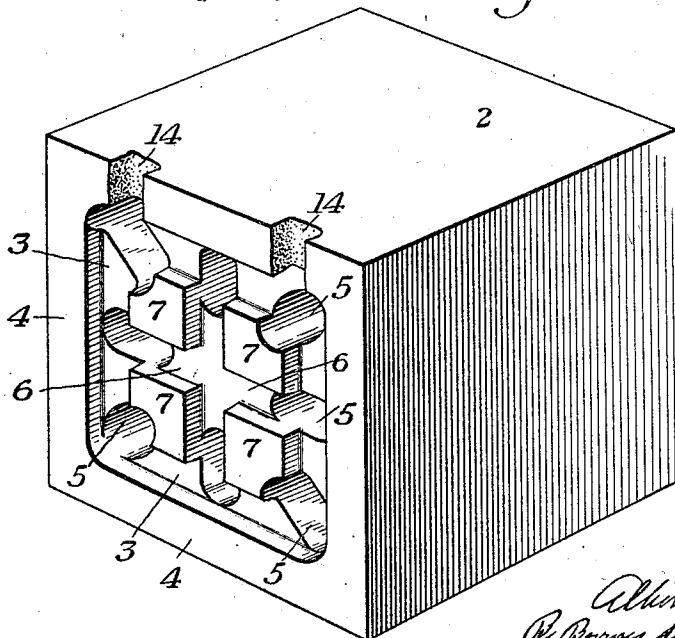
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CONCRETE BUILDING CONSTRUCTION

Filed Oct. 20, 1923

5 Sheets-Sheet 4



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CONCRETE BUILDING CONSTRUCTION

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Fig. 9.

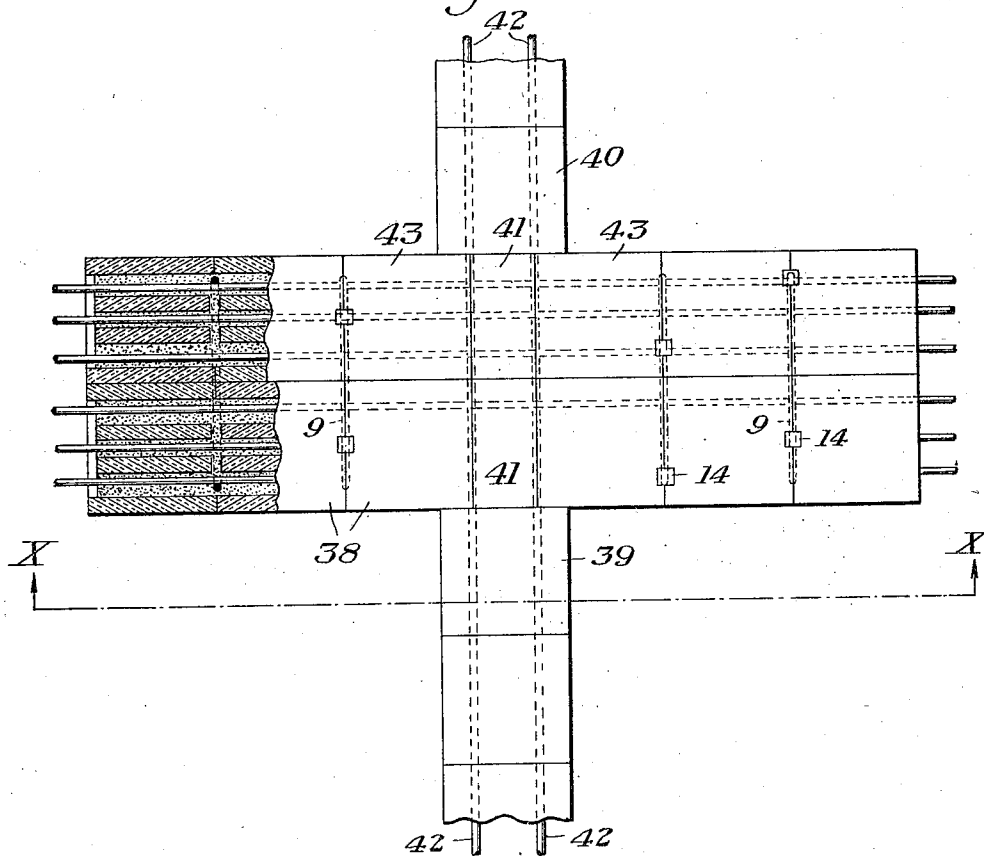
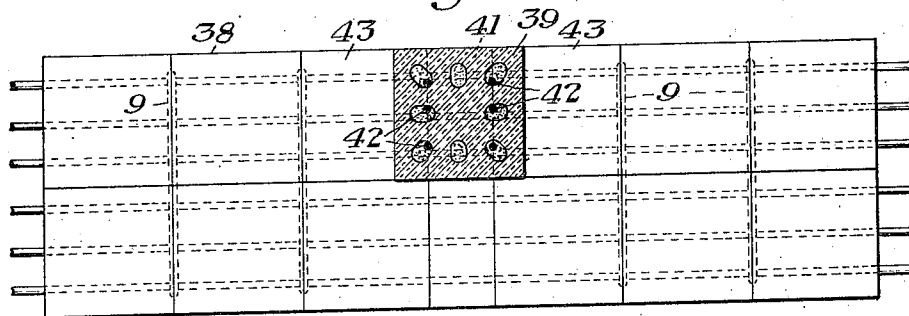


Fig. 10.



INVENTOR

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UNITED STATES PATENT OFFICE.

ALBERT HENDERSON, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO HENDERSON CORPORATION, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

CONCRETE BUILDING CONSTRUCTION.

Application filed October 20, 1923. Serial No. 669,694.

To all whom it may concern:

Be it known that I, ALBERT HENDERSON, a citizen of the United States, residing at Pittsburgh, county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Concrete Building Constructions, of which the following is a full, clear, and exact description.

The present invention relates broadly to concrete building construction, and more particularly to the construction of concrete columns, girders and beams.

In my prior Patent No. 1,445,945, granted February 20, 1923, there is disclosed a system of concrete building construction in which columns, girders and beams are built up of concrete blocks arranged end to end in series and having reinforcing tie rods extending through the series of blocks, the blocks being preformed with longitudinal passages therein to receive the rods, and the latter being embedded in cement or grout poured into such passages after the blocks are assembled in series, and the tie rods inserted through the aligned passages therein. In the system disclosed in this patent, however, special blocks are required at the intersections of columns and girders and of girders and beams, having tie rod receiving passages extending therethrough at right angles to each other to receive the tie rods of both the column and girder or of the girder and beam.

By the present invention, I have provided a system of construction which does not require these special blocks at the intersections of columns and girders and of girders and beams, in that the reinforcing tie rods of a column, for example, at the intersection of the column with a girder, are extended between meeting end faces of certain of the blocks of the girder, or vice versa, the tie rods of the girder are extended between meeting end faces of certain of the blocks of the column. The same thing is true at the intersection of a girder or beam. I am, therefore, enabled to utilize throughout the construction blocks having tie rod receiving passages extending in one direction there-through only. This not only simplifies the problem of manufacture of the blocks at the central plant, but also the erection problem. My present invention comprehends, however, in certain instances, the use at the intersections of columns and girders and of girders

and beams of blocks of shorter length, preferably half length, than the blocks used throughout the body of the columns, girders and beams. These shorter blocks are of the same dimensions in cross section as the other blocks, and have the tie rod receiving passages extending in one direction there-through only. They may be formed at the central plant or provided at the point of erection, in case of necessity, by cutting a full length block to the shorter length required.

In the accompanying drawings, there are shown, for purposes of illustration only, certain embodiments of the present invention, it being understood that the drawings do not define the limits of the invention, as changes may be made in the construction therein disclosed without departing from the spirit of the invention or scope of my broader claims.

In the drawings:

Figure 1 is a view, partly in elevation and partly in section, the section being taken on the line I—I of Figure 2, of a column and girder construction in accordance with one embodiment of my invention, the column being continuous and the girders abutting at their ends against opposite side faces of the column;

Figure 2 is a plan view, partly in section, of the structure shown in Figure 1, the section being taken on the line II—II of Figure 1;

Figure 3 is a view, similar to Figure 1, of a modified form of column and girder construction, the section being taken on the line III—III of Figure 4, this view also showing in section a beam connected to the girder;

Figure 4 is a plan view, partly in section, of the construction shown in Figure 3, the section being taken on the line IV—IV of Figure 3;

Figure 5 is a sectional view taken on the line V—V of Figure 4;

Figure 6 is a view, partly in elevation and partly in section, of still another form of column and girder construction embodying my invention;

Figure 7 is a plan view of a column having a girder abutting against each face thereof and illustrating different methods of connecting the girders to the column;

Figure 8 is a sectional view through the

joint of a girder having a depth of two blocks, illustrating the manner of tying the superposed blocks together;

Figure 9 is a plan view, partly in section, of a girder and beam construction;

Figure 10 is a view, partly in elevation and partly in section, of the structure shown in Figure 9, the section being taken on the line X—X of Figure 9, and

Figure 11 is a perspective view illustrating the type of block preferably employed in the construction.

In constructing columns, girders and beams, I prefer to employ a molded concrete block of the general type disclosed in my prior Patent No. 1,446,796, granted February 27, 1923. This type of block is also illustrated in Figure 11. Referring to this figure, the block, which is designated by the reference character 2, is of rectangular shape, both in transverse and longitudinal section. In each end face of the block there is provided a groove 3 which is spaced inwardly from the sides of the block to leave a marginal seating face 4. This block is provided with a suitable number of passages 5 extending longitudinally there-through and opening at their ends in the grooves 3 in the end faces of the block. These longitudinal passages are formed to receive metal tie rods, as will be hereinafter explained. I have shown the block as being provided with eight such passages, but it will be obvious that the number of passages may be increased or decreased, as desired. Where eight passages are provided, four of the same will preferably be located adjacent the corners of the block, and the other four opposite the middle points of the sides of the block. The end faces of the block may be provided with additional cross grooves 6 connecting these intermediate passages. The through passages in the block leave the same with a solid central core, and the marginal and cross grooves 3 and 6 in the end faces of the block leave projecting lugs 7, the end faces of which are preferably flush with the marginal seating faces 4, so as to provide additional seating surfaces at the ends of the block.

Referring to Figures 1 and 2, the column 8 shown therein is formed by arranging blocks 2 side by side to form a column having a depth and width equal to the width of two blocks, and the blocks are superposed in end to end relationship one upon the other to build the column up to the desired height. It will be apparent that where the column has a section of four blocks as shown, there will be four vertical series of blocks forming the column. The blocks in each vertical series will have the tie rod receiving passages 5 thereof in alignment. At every joint in the column, a reinforcing

tie rod or frame 9 will preferably be inserted in the grooves 3 in the end faces of the blocks, in order to tie the four vertical series of blocks together at the joints.

After a column has been built up to the desired height, shores are erected and girders 10 formed by aligning series of blocks on the shores and placing these series of blocks side by side and one upon the other to form girders of the desired section. In Figures 1 and 2 I have shown the girders as having a section consisting of four blocks arranged side by side. At the joints reinforcing frames 9 may be placed as in the column construction, and for the same purpose, that is, to tie together the series of blocks forming the girders. At the intersection of the column with the girders, blocks 11 of shorter length than the blocks 2 may be employed. The blocks 2 will preferably be made of a size so as to have a weight to be conveniently handled by a workman. A block in the form of a twelve inch cube is a convenient size and will weigh approximately 125 pounds, more or less. Where eight through holes are formed, the distance between the corner holes will be approximately six inches for a twelve inch block. This enables me to employ at the intersection of the column with the girders a block 11 of half the length of the blocks 2. After the girders have been formed as described, reinforcing tie rods 12 may be inserted through the aligned passages 5 in the lower portion of the bottom series of blocks of the girders. These rods will extend across the top of the column, and will be located in the grooves 3 in the end faces of the blocks 13 at the top of the column. It will be obvious that it will be necessary to chip out the blocks, as at 14 in Figure 11, in order to accommodate these tie rods. It will also be necessary to chip out the blocks in order to accommodate the reinforcing frames 9. After the tie rods 12 have been inserted, half blocks 11 may be placed on top of the blocks 13 at the top of the column, and then other reinforcing rods 15 inserted through the aligned passages in the upper portion of the lower series of aligned blocks of the girders.

A second course of half blocks may then be placed upon the first course and tie rods 16 inserted through the aligned passages in the lower portion of the upper series of blocks of the girders. Then another course of half blocks may be superposed on the second course and tie rods 17 inserted through the aligned passages in the upper portion of the upper series of blocks of the girders. After this has been done, cement or grout may be poured through chipped out openings 18 in the upper faces of the girders at the joints to fill the longitudi-

nal passages and embed the reinforcing rods and to fill the grooves in the meeting end faces of the blocks and embed the reinforcing frames 9 therein. After this cement or grout has set, the blocks constituting the girders will be united into a monolithic structure.

After the girders have been constructed as described, the column may be continued on up to any desired height, and then reinforcing rods 19 may be dropped into the aligned passages in the series of blocks, and then cement or grout poured into these passages to fill the same and also to grooves in the meeting end faces of the blocks and embed the tie rods and reinforcing frames. After this cement or grout has set, the blocks constituting the column will also have become united into a monolithic structure.

While I have described the column as having a section equal to four blocks, and the girders also as having a section equal to four blocks, it will be understood that the column and girders may have a section of one block or of a plurality of blocks, depending upon the load to be supported thereby. It will be seen that this method of uniting columns and girders does not require any special blocks at the intersection of the column and girders, except blocks of reduced length. The purpose of using half blocks is merely to permit additional reinforcing tie rods 15 and 17 to be used in the girders. If these tie rods were omitted, full length blocks could be employed at the intersection. This method of construction also obviates the necessity for employing special bracket blocks at the intersection between the column and girders. I have found by actual test that when a girder and column are connected in the manner illustrated in Figures 1 and 2, and the tie rods embedded in rich cement or grout in the manner shown, these tie rods will develop their full strength in shear, and that the cement or grout forms such a strong bond between the rods and the blocks that the rods will shear without showing any relative longitudinal movement between the rods and the blocks. This method of construction also obviates any necessity for field concrete work at the intersections of the girders and columns, thereby reducing the cost of construction by eliminating the forms required for such work.

If desired, the girders shown in Figure 1 could be formed on the ground and hoisted into position by a crane or the like. In this case, however, the reinforcing tie rods 12, 15, 16 and 17 would not extend continuously through the column, but these tie rods in each girder would terminate at a point x over the center of the column. Each girder would be formed into a monolithic structure on the ground and half blocks 11 inserted between the projecting ends of the tie rods.

Then these girders would be lifted into position and the erection of the column completed in the manner previously described. This modified form of construction would obviously eliminate the expense of erecting the shores for supporting the girders while being constructed.

In Figures 3 and 4 there is illustrated a modification in which a column 20 is first built up to the desired height and then a girder 21 is constructed to extend continuously over the top of the column, and thereafter the construction of the column continued above the girder. In other words, in the form of construction shown in Figures 1 and 2, the column extends continuously through the girder, whereas in the construction shown in Figures 3 and 4 the girder extends continuously through the column. The method of constructing the column and girder, as shown in Figures 3 and 4, is substantially the same as the method of constructing the girder and column shown in Figures 1 and 2, except that in Figures 3 and 4 full length blocks are employed at the intersection of the girder and column, instead of half blocks.

In Figures 3 and 4 I have also shown a beam 22 intersecting and connected to the girder. This beam, as shown, is constructed of a single series of aligned blocks having the reinforcing tie rods extending longitudinally therethrough, so that the cross sectional area of the beam is equal to the cross sectional area of a single block. Obviously, however, the beam might be constructed so as to have a cross sectional area equal to the cross sectional area of a plurality of blocks. The beam extends continuously through the two upper courses of the girder 21, and is supported upon the lower courses of said girder. By reference to Figure 5 it will be seen that reinforcing tie rods 23 of the two upper courses of blocks in the girder 21 extend between meeting end faces of blocks 24, 25 and 26 of the beam. Figure 5 also illustrates clearly the manner of tying together the four blocks, of which the cross section of the girder is composed, by means of a reinforcing frame 9 positioned in the grooves 3 in the end faces of the blocks. It will be noted that the blocks are chipped out at 14, as previously explained, to accommodate such frame.

In Figure 6 there is illustrated a further modification of column and girder construction. For constructing the column and girder shown in Figures 3 and 4, it is necessary to erect shores for supporting the girder while being erected. The girders 27, shown in Figure 6, may be formed into a monolithic structure on the ground and then hoisted into position and connected to the column 28. It will be noted that each girder terminates in half blocks 29, and that rein-

forcing rods 30 are positioned between the meeting end faces of these half blocks and the adjacent full length blocks 31 in the girders. These reinforcing rods 30 project
 5 above and below the upper and lower faces of the girders, so that when the girders are hoisted into position, the lower projecting ends of these rods may be inserted in certain of the vertical tie rod receiving pas-
 10 sages in the column 28, whereby the girders are effectively tied to the column. In continuing the construction of the column above the girders, the upper projecting ends of the rods 30 will extend into certain of the tie rod
 15 receiving passages in the lower portion of the column above the girders, thereby effectively tying the column above the girders to the girders.

Figure 7 shows a column 32 whose section
 20 is composed of four blocks and which has four girders 33, 34, 35 and 36 connected thereto and abutting against the four sides of the column. The girders 33 and 34 are shown as having a width equal to the width
 25 of two blocks, the same as the width of the column. The girders 35 and 36, on the other hand, have a width equal to the width of one block only. It will be noted that girder 35 abuts against a side of the column
 30 so as to have one longitudinal face of the girder flush with a side of the column, whereas girder 36 abuts against a side of the column so as to be positioned centrally of such side. This illustrates the flexibility of
 35 my method of construction.

Figure 8 shows a section through a girder having a width equal to the width of a single block and a depth equal to the depth
 40 of two blocks, the section being taken at a joint in the girder to illustrate the method of tying the upper and lower courses of the girder together by means of reinforcing frames 37 similar to the reinforcing frames
 9 previously described.

Figures 9 and 10 illustrate a modified method of girder and beam construction. In Figure 4 I have shown the beam as being continuous through the upper courses of the
 50 girder. In the construction shown in Figures 9 and 10, the upper courses of the girder 38 are continuous, and the beams 39 and 40 abut at their ends against the opposite side faces of the girder. Half blocks
 55 41 may be employed in the upper courses of the girder at the intersection between the girder and the beams, and the reinforcing rods 42 of the beams may extend between the meeting end faces of these half blocks
 41 and the adjacent full length blocks 43.

While my invention is particularly concerned with the use of concrete as the material from which the blocks will be formed at the central plant, it will be understood
 60 that the invention is not limited to the use of this particular material, as the blocks

may be formed of other suitable materials.

The advantages of my improved system of construction will be apparent. By constructing columns, girders and beams from pre-
 70 formed blocks and extending the reinforcing tie rods of a girder, for example, between meeting end faces of certain of the blocks of a column at the intersection between the girder and column. I am enabled
 75 to utilize blocks of the same structure throughout the construction. Field concrete work and the expensive forms therefor are entirely eliminated, and the amount of skilled labor required at the point of
 80 erection is reduced to a minimum. No special bracket blocks are required at the intersections between columns and girders and girders and beams, and unit blocks may
 85 be employed of a weight to be conveniently handled by a workman. Any desired section of column or of girder or of beam may be obtained, as my method of construction enables the columns, girders and beams to
 90 be constructed in courses, and these courses tied together at the joints and united into a monolithic structure.

I claim:

1. Building construction, comprising two members extending at an angle to and intersecting each other and each comprising
 95 blocks arranged end to end in series, one of said members having reinforcing means extending longitudinally of and tying together its series of blocks, said reinforcing means extending between meeting end faces
 100 of certain of the series of blocks of the other of said members, substantially as described.

2. Building construction, comprising two members extending at an angle to and intersecting each other and each comprising
 105 blocks arranged end to end in series, one of said members having reinforcing means extending longitudinally of and tying together its series of blocks, said reinforcing means extending between meeting end faces
 110 of certain of the series of blocks of the other of said members, said meeting end faces being grooved to receive said reinforcing means, substantially as described.

3. Building construction, comprising two members extending at an angle to and intersecting each other, one of said members comprising concrete blocks arranged in series
 120 end to end and united into a monolithic mass, the other of said members comprising concrete blocks arranged end to end in series and united into a monolithic mass and having reinforcing means extending there-
 125 through and completely surrounded by the material of said blocks, said reinforcing means extending between meeting end faces of certain of the series of blocks of the first member, substantially as described.

4. Building construction, comprising two 130

members extending at an angle to and intersecting each other and each comprising blocks arranged end to end in series, each of said members having reinforcing means extending longitudinally through its series of blocks, the said reinforcing means of one of said members extending between meeting end faces of certain of the series of blocks of the other of said members, substantially as described.

5. Building construction, comprising two members extending at an angle to and intersecting each other and each comprising blocks arranged end to end in series, the said series of blocks of one of said members having grooves in their end faces spaced inwardly from the sides of the blocks, grouting filling said grooves and uniting said blocks into a monolithic mass, and reinforcing means extending longitudinally through said blocks and between meeting end faces of certain of the series of blocks of the other of said members, substantially as described.

6. Building construction, comprising two members extending at an angle to and intersecting each other and each comprising blocks arranged end to end in series, one of said members abutting at one end against a side of the other of said members and having reinforcing means extending longitudinally through its series of blocks and between meeting end faces of certain of the series of blocks of the other of said members, substantially as described.

7. Building construction, comprising a member having blocks arranged end to end in series, two aligned members having their adjacent ends in abutting relationship with opposite sides of the first mentioned member and each comprising blocks arranged end to end in series, and reinforcing means extending longitudinally through the series of blocks of said aligned members and between meeting end faces of certain of the series of blocks of said first mentioned member, substantially as described.

8. Building construction, comprising two members extending at an angle to and intersecting each other and each comprising blocks arranged end to end in series, one of said members abutting at one end against a side of the other of said members and having reinforcing means extending longitudinally through and tying together its series of blocks, said reinforcing means extending between meeting end faces of certain of the series of blocks of the other of said members and constituting substantially the sole means for taking the shear at the joint between said members, substantially as described.

9. Building construction, comprising two connected members extending at an angle to and intersecting each other, each of said members comprising blocks arranged end to end in series and tied together by reinforcing means extending longitudinally there-through, all of said blocks of said members being of the same form and having the passages for receiving the reinforcing means extending in one direction therethrough only, substantially as described.

10. Building construction, comprising two members extending at an angle to and intersecting each other, one of said members comprising blocks arranged end to end in series and the other of said members comprising a plurality of courses of blocks placed side by side, the blocks in each course being arranged end to end in series and tied together by reinforcing means extending longitudinally therethrough, and reinforcing means tying said courses together at the joints between the meeting end faces of the blocks, at least a portion of the longitudinally extending reinforcing means of one of said members extending between meeting end faces of certain of the blocks of the other of said members for tying said members together, substantially as described.

In testimony whereof I have hereunto set my hand.

ALBERT HENDERSON.