(No Model.) 3 Sheets—Sheet 1.

J. T. HOUGH.

ROOF FOR VAULTS AND OTHER STRUCTURES.

No. 396,040. Patented Jan. 8, 1889.

FIG. 1.

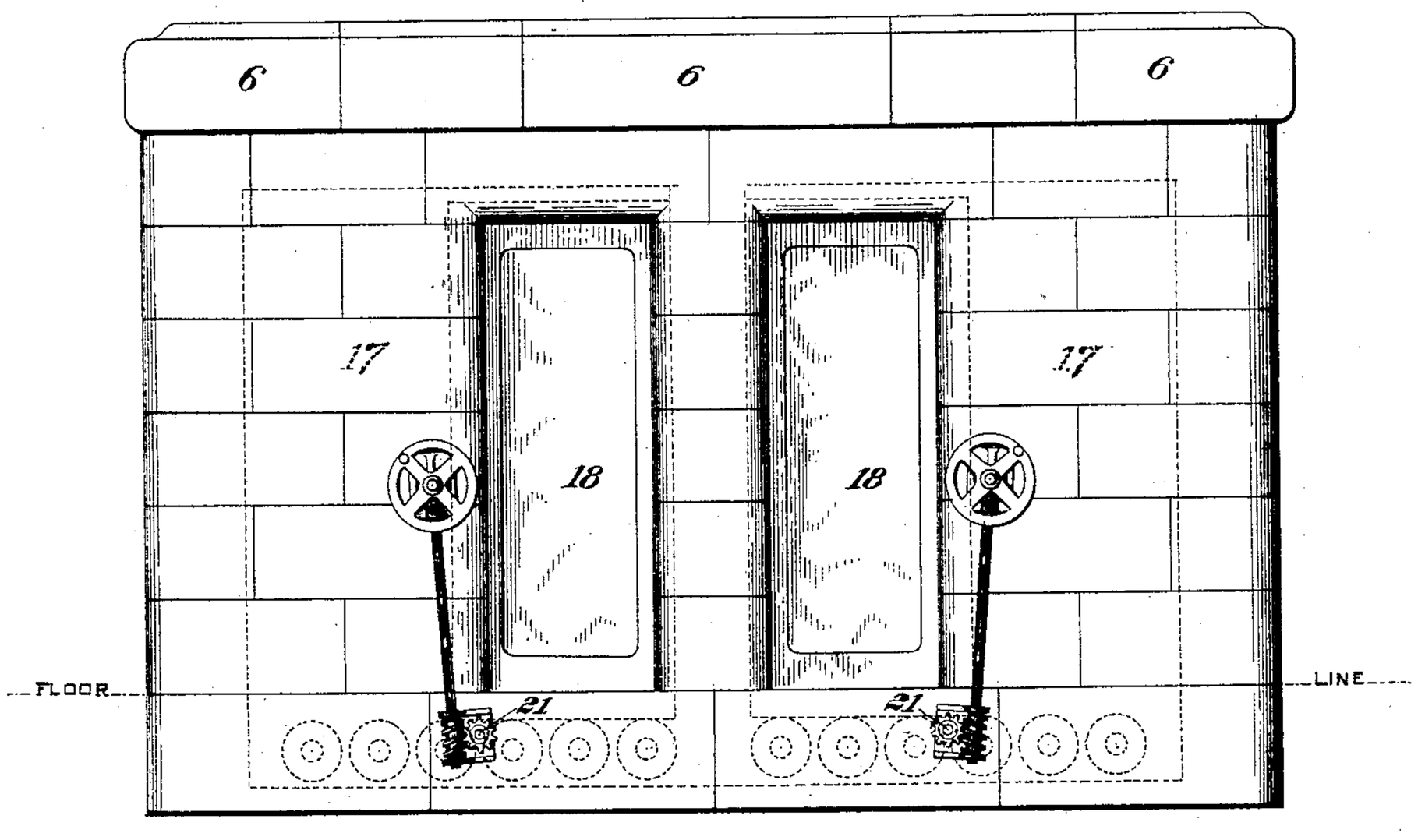
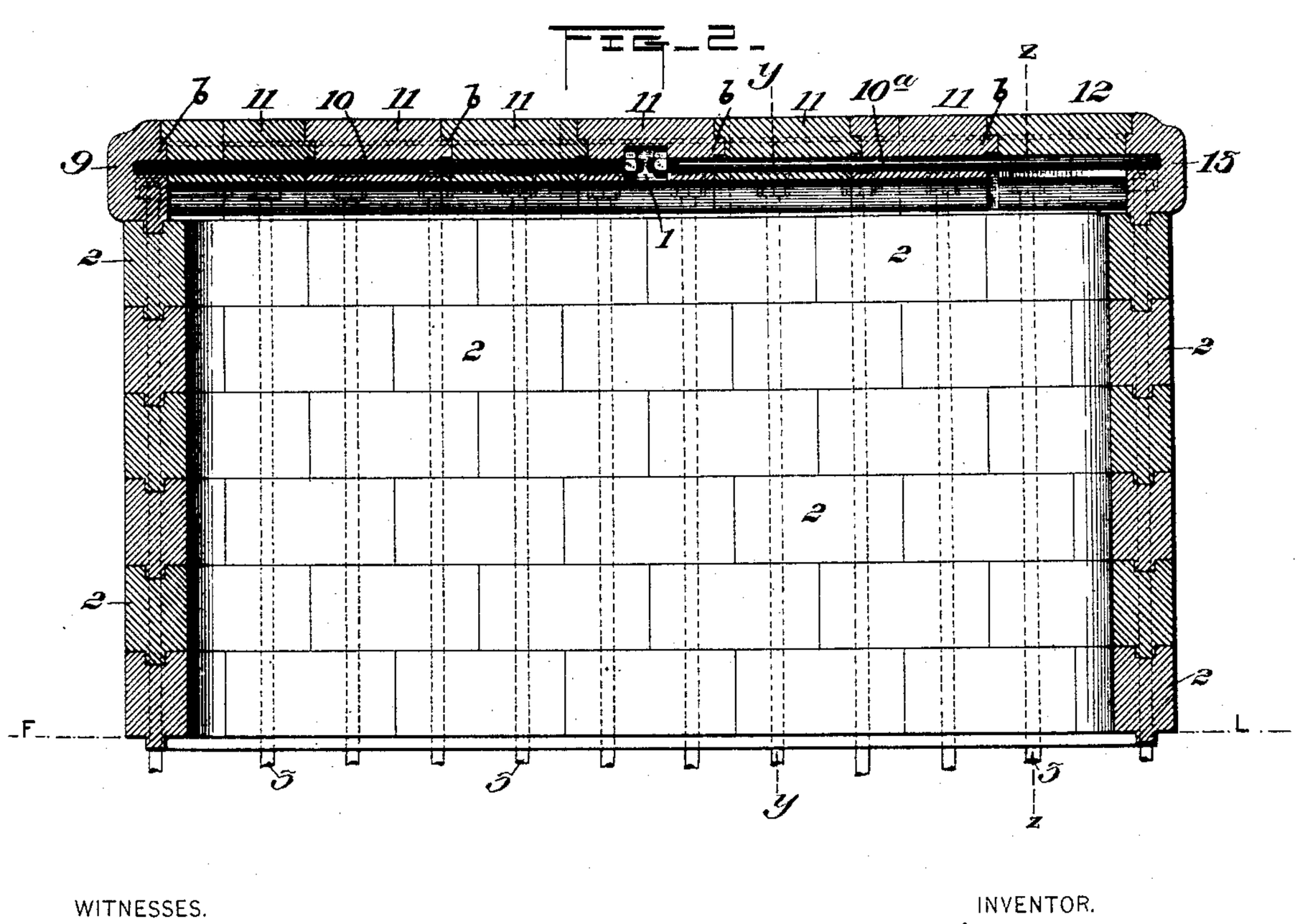


FIG. 2.



WITNESSES.

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(No Model.) 3 Sheets—Sheet 2.

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FIG. 4.

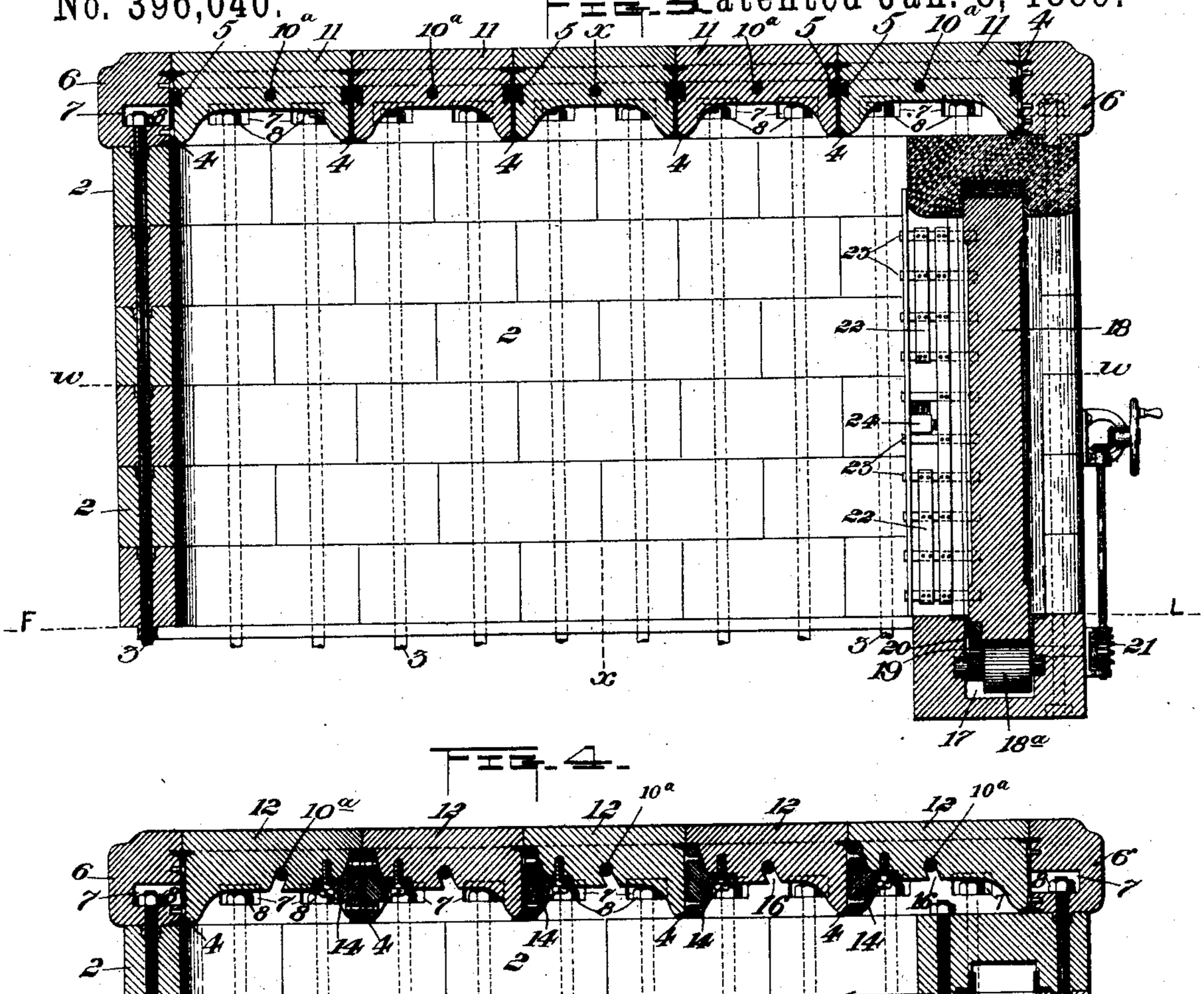
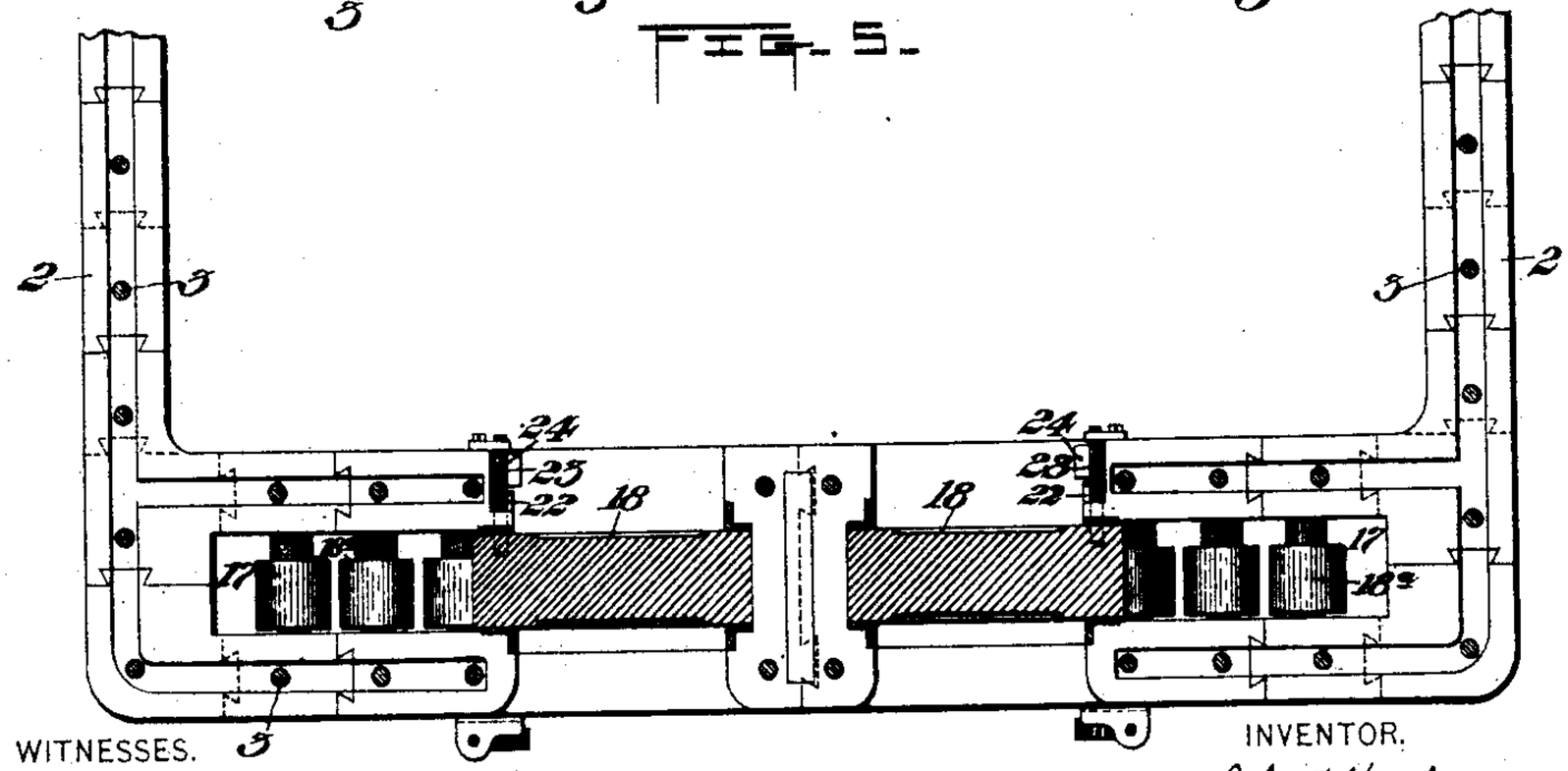


FIG. 5.



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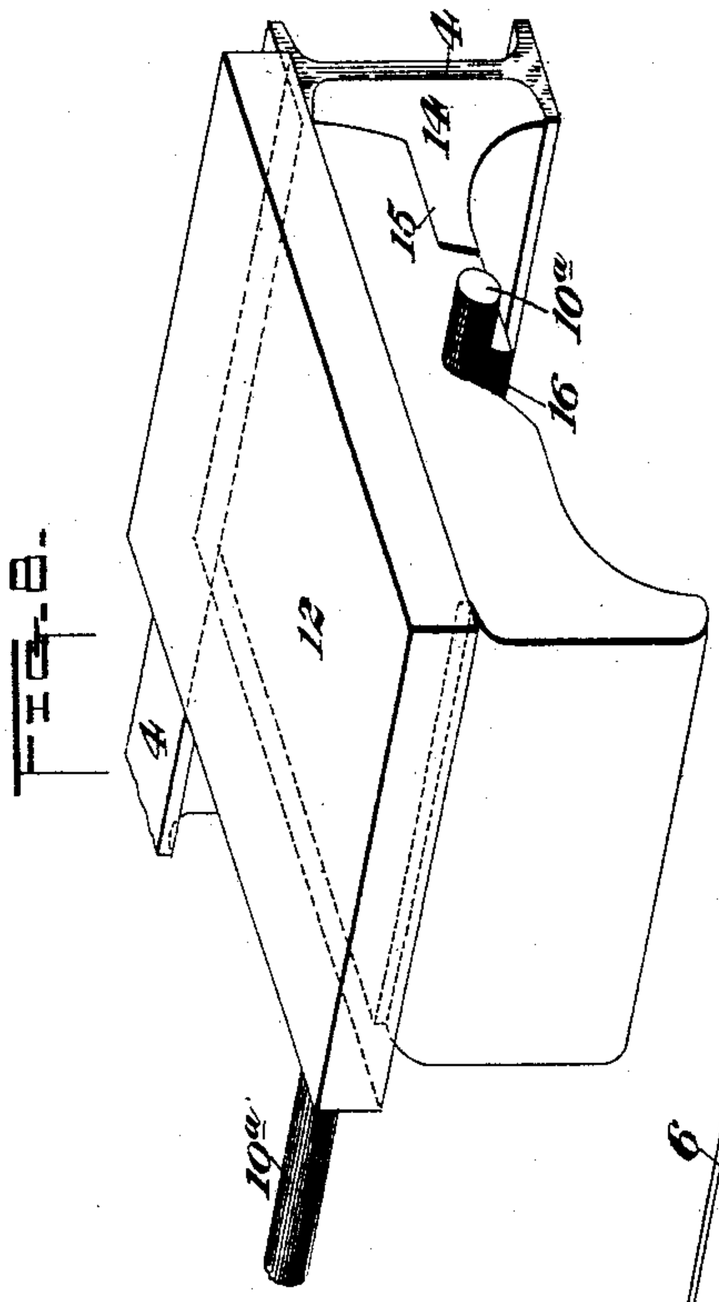
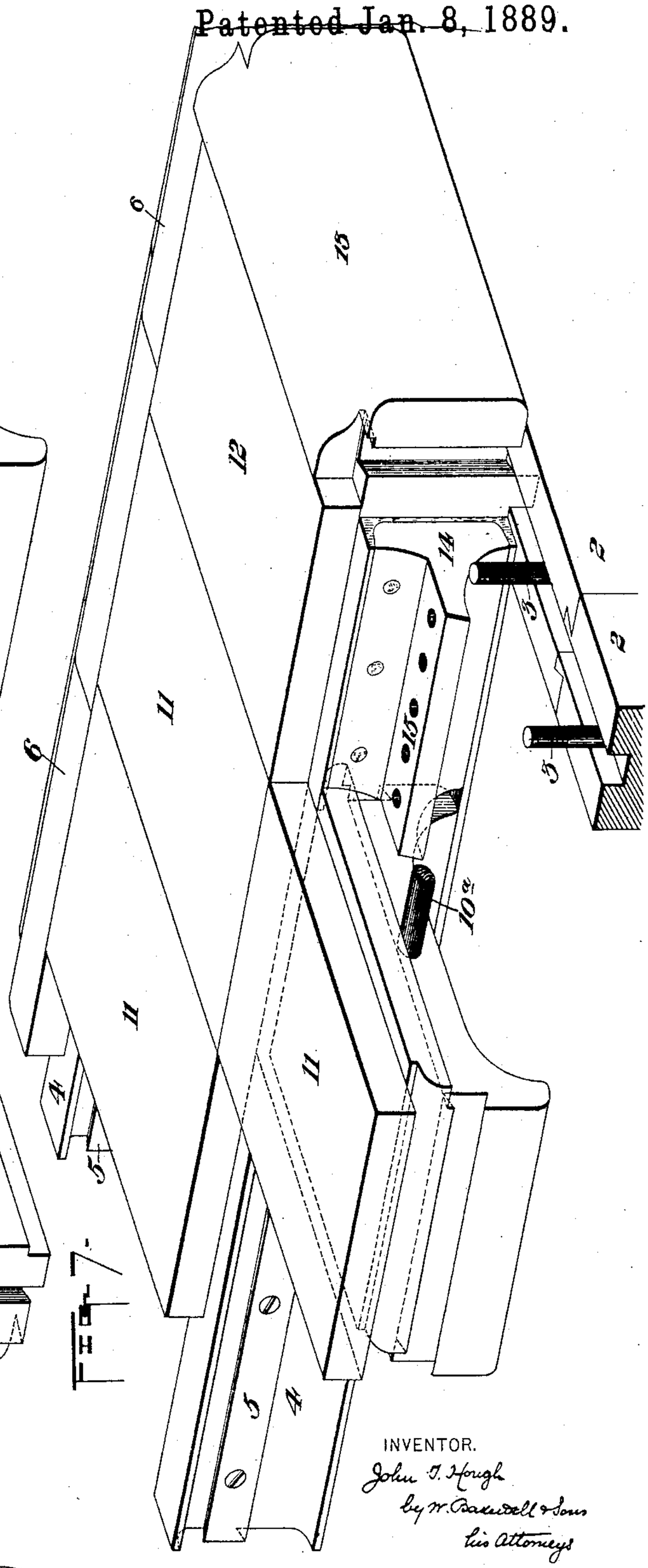
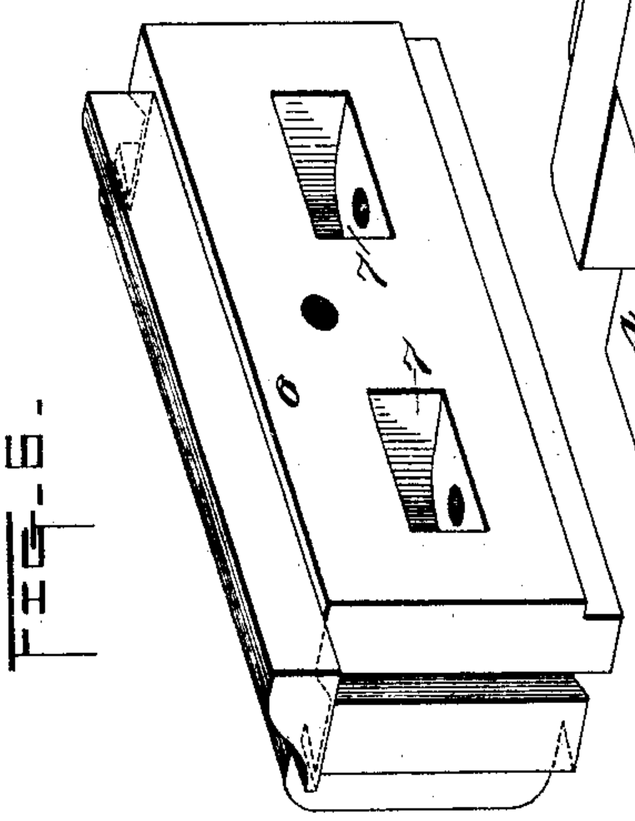
ROOF FOR VAULTS AND OTHER STRUCTURES.

No. 396,040. Patented Jan. 8, 1889.







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UNITED STATES PATENT OFFICE.

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ROOF FOR VAULTS AND OTHER STRUCTURES.

SPECIFICATION forming part of Letters Patent No. 396,040, dated January 8, 1889.

Application filed April 19, 1888. Serial No. 271,224. (No model.)

To all whom it may concern:

Be it known that I, JOHN T. HOUGH, of Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Roofs for Vaults and other Structures; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a front view of a vault constructed with my improved roof. Fig. 2 is a vertical cross-section thereof on the line *x x* of Fig. 3, showing the construction of the roof. Fig. 3 is a vertical longitudinal section thereof on the line *y y* of Fig. 2. Fig. 4 is a vertical longitudinal section on the line *z z* of Fig. 2, showing the blocks by which the other blocks of the roof structure are keyed in place. Fig. 5 is a horizontal section on the line *w w* of Fig. 3. The figures on the third sheet of the drawings show enlarged detail views of parts. Fig. 6 is a perspective view of one of the top blocks of the side walls. Fig. 7 is a perspective view of a part of the roof, showing its connection with the walls; and Fig. 8 is a perspective view of one of the key-blocks of the roof.

Like symbols of reference indicate like parts in each.

My invention relates to an improvement in roofs for vaults and other structures. I have shown it in connection with a vault of the kind which was patented to me together with John A. Harper by United States Letters Patent No. 294,626, dated March 4, 1884; but I do not intend to limit it thereto, since it may be used on vaults otherwise constructed, or on other sorts of buildings, such as fortifications, parts of vessels, or other structures where great strength is desired. It may also be used in the construction of floors for like purposes. I therefore propose to claim it independently of its connection with that form of vault.

Referring now to the drawings, I show the vertical walls of the vault composed of series of cast-iron blocks 2, provided with tongues and grooves and bound together by tie-rods 3. After the side walls have been built in this way the frame-work of the roof is composed of **I**-beams or girders 4, arranged parallel to each other and at regular distances apart, their ends resting on the side walls. On the sides of these **I**-beams are dovetailed key-strips 5, which extend from one end of each **I**-beam nearly, but not quite, to the other end thereof. Before the outer **I**-beams of the series are laid in place the top blocks 6 of the front and back walls of the vault are set. These blocks are connected with the blocks below by tongues and grooves and have holes through which the vertical tie-rods 3 enter, and in the bodies of the blocks are cavities 7, which extend through the inner sides of the block. The upper ends of the tie-rods 3 extend into these cavities. Nuts 8 are fitted on the ends of the rods, and by screwing them up the blocks of the walls are drawn tightly together.

In the joint between the blocks 6 and the blocks 2 immediately below is left a small recess for the reception of the lower flange of the **I**-beam, and in the side of the block 6 is made another small recess for the reception of the upper flange of the **I**-beam. The **I**-beams are set in place in these recesses, as shown in Fig. 3, after the blocks 6 have been laid and clamped in place by tightening up the nuts 8. The outer **I**-beams have no dovetailed key-strips on the sides next the outer top blocks 6; but they are secured to these blocks by screws 26, which pass through the webs of the beam and enter the blocks, the heads of these screws being countersunk in the web of the beam. The walls at the front and back having thus been completed, the top blocks 9 of one of the side walls are set in place, and horizontal tie-rods 10 are screwed into sockets in the sides of these blocks and project horizontally therefrom to the center of the vault. The next step in constructing the roof is to set the blocks 11, which form the body of the roof. These have at the sides mortised grooves which are adapted to fit the key-strips 5 on the **I**-beams and recesses to fit the upper flanges of the **I**-beams, and through the body of each there is a hole

through which the tie-rod 10 is passed. In setting these blocks they are placed between the I-beams at one end, so that the key-strip may properly fit in their mortises, and then they are pushed along between the I-beams and over the tie-rods 10 until their proper position is reached, Figs. 2 and 3. The middle block of each row is preferably provided with a central cavity, 1, open at the bottom, Fig. 2, and the horizontal tie-rods are preferably divided in the middle into two parts, 10 and 10^a, the inner ends fitting in this cavity and being provided with nuts by which the blocks may be drawn together. The adjacent blocks of each row are further connected with each other by tongues and grooves *b* at their ends, as shown in Fig. 2, which close the joints and prevent the insertion of wedges between the blocks. After all the blocks of the roof have been thus laid except the row of blocks nearest the side wall, which blocks are numbered 12 in the drawings, I set in place the top blocks 13 of this side wall and screw up the nuts 8 on the ends of the vertical tie-rods in the cavities of these blocks. The ends of the parts 10^a of the horizontal tie-rods are then screwed into these blocks. Now to complete the roof the next step is the setting of the key-blocks 12. For this purpose I bolt to the sides of the I-beams in the cavities provided for these blocks seat-pieces 14, which are cast blocks having a vertical flange adapted to fit against and to be bolted to the web of the I-beam between the flanges and a horizontal flange or seat, 15, which projects horizontally from the web of the I-beam. These castings are not bolted to both sides of each I-beam, but are arranged, as shown in Fig. 4, so that each of the spaces between the I-beams shall have one of the castings. The shape of the key-blocks 12 is shown in Figs. 4, 7, and 8.

At one side each key-block is formed so as to seat on the casting 14, and at the other side it is recessed to fit the flanges and the web of the I-beam. To fit them in place, this last-mentioned side is fitted against the I-beam and the block is then dropped to its seat on the casting 14, and is there secured by bolts which pass up through the horizontal seat 15 of the block 14 into the body of the key-block 12. The tie-rods do not pass through holes in the bodies of these key-blocks 12, but they simply fit in open recesses 16, which permit the blocks to be dropped into place. Unlike the other blocks of the roof these blocks 12 are not connected with the blocks at their ends by tongues and grooves, but have simply overlapping flanges, as shown in Figs. 2 and 7. When the parts of the roof are thus put together and connected, they form a most substantial and secure structure, which is proof against the usual tools and explosives employed by burglars. The principal feature of the structure is the use of the flanged beams which support the blocks of the roof and hold them together. The flanges of the I-beams prevent lifting of the blocks of the roof, and the dovetailed key-strips prevent their lateral displacement. The tie-rods passing through the blocks and binding them together, so as to prevent them from being wedged apart lengthwise for the insertion of an explosive charge, also add great security to the structure. I prefer to make the blocks of cast-iron, and when they are molded and set in place accurately the joints between the blocks are so tight that there is no room sufficient to permit the insertion of the end of a wedge substantial enough to have any effect on the blocks. I do not, however, limit the claims to any particular material of which the parts of the structure may be made.

It is obvious that my invention is applicable not only to the construction of roofs for vaults, but in the construction of floors as well.

I claim—

1. In a roof or floor, the combination, with beams arranged side by side and having key-strips on the opposing sides thereof, of blocks interposed between the beams and secured to the key-strips, the said blocks having lateral recesses to receive the flanges of the beams, substantially as and for the purposes described.

2. In a roof or floor, the combination, with beams arranged side by side and having dovetailed key-strips on the opposing faces thereof, of blocks interposed between the beams and having lateral grooves or mortises corresponding in shape to the said key-strips, whereby the blocks are fitted on the strips, substantially as and for the purposes described.

3. In a roof or floor, the combination, with flanged beams arranged side by side, of blocks interposed between them and supported by the flanges, and tie-rods extending through the blocks lengthwise of the beams and connecting the blocks, substantially as set forth and described.

4. In a roof or floor, the combination, with flanged beams arranged side by side, of blocks interposed between them and supported by the flanges, and blocks 14, secured to the sides of the flanged beam and having seats to which the key-blocks of the roof structure are secured, substantially as set forth and described.

5. In a roof or floor, the combination, with flanged beams arranged side by side, of blocks interposed between them and supported thereby, the outer beams of the series being arranged with the flanges beneath the upper blocks of the walls and with the webs of the beam in contact with the sides of the blocks, substantially as set forth and described.

6. In a roof or floor, the combination, with flanged beams arranged side by side, of blocks interposed between them and supported by the flanges, and tie-rods connecting the blocks, said tie-rods being divided, and intermediate blocks of the series having cavities within which the tie-rods project, so as to afford means for tightening them, substantially as set forth and described.

7. In a roof or floor, the combination, with flanged beams arranged side by side, of blocks interposed between them, fitting against the sides or webs of the beams, and laterally recessed for the reception of the flanges of the beams on both sides of the blocks, and connected with each other by tongues and grooves at their meeting ends, said blocks extending above the flanges on the outer sides of the beams, overlapping the same, and meeting over the said flanges, substantially as and for the purposes described.

8. In a roof or floor, the combination, with beams arranged side by side and having dove-tailed key-strips on the opposing faces thereof, of blocks interposed between the beams and having lateral grooves or mortises corresponding in shape to the said key-strips, whereby the blocks are fitted on the strips, said blocks having also interlocking tongues and grooves at the ends, substantially as and for the purposes described.

9. In a roof or floor, the combination, with flanged beams arranged side by side, of blocks interposed between them and supported by the flanges, supporting-blocks 14 at the sides of the flanged beams and having seats to which the key-blocks of the roof structure are secured, and tie-rods which extend lengthwise of the beams and pass through open slots in the key-blocks and through holes in the other blocks of the series, substantially as and for the purposes described.

10. In a roof or floor, the combination, with flanged beams arranged side by side, of a series of blocks interposed between them and keyed laterally thereto by longitudinal keys, and a block at the end of the series which is bolted in place on the inner side and is not keyed to the beams, substantially as and for the purposes described.

In testimony whereof I have hereunto set my hand this 27th day of March, A. D. 1888.

JOHN T. HOUGH.

Witnesses:
I. P. CULLEN,
P. M. COLVILLE.