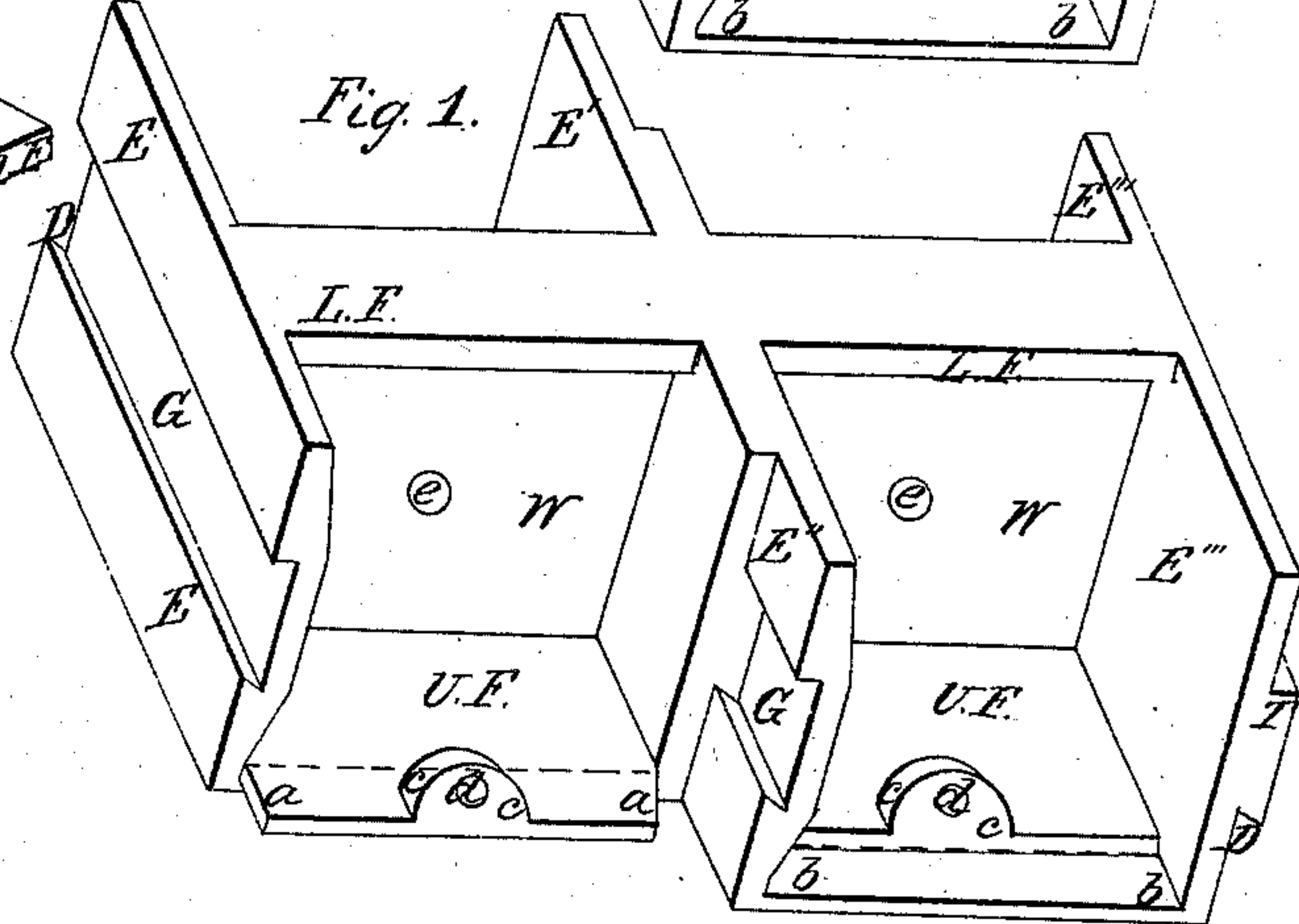
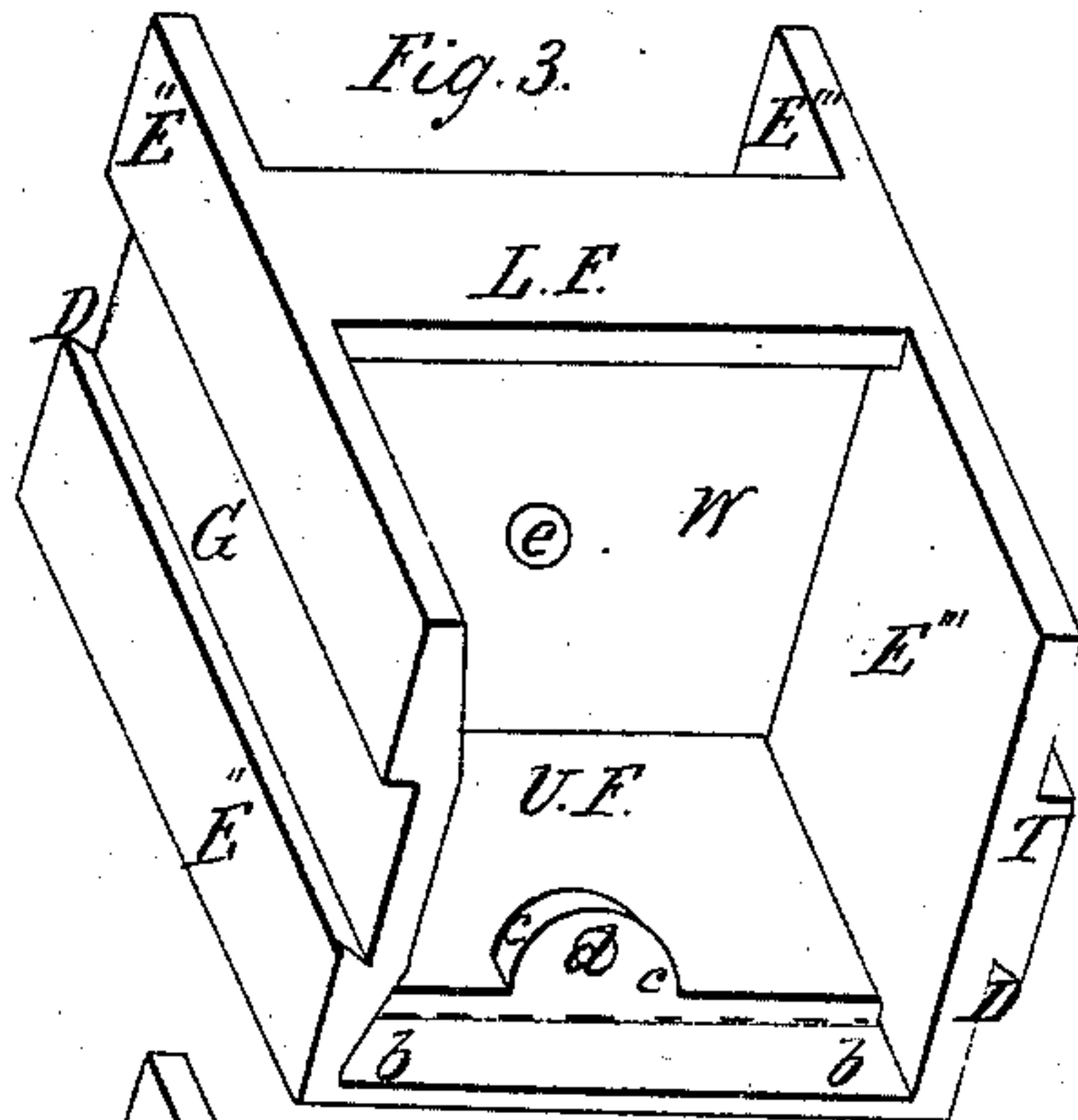
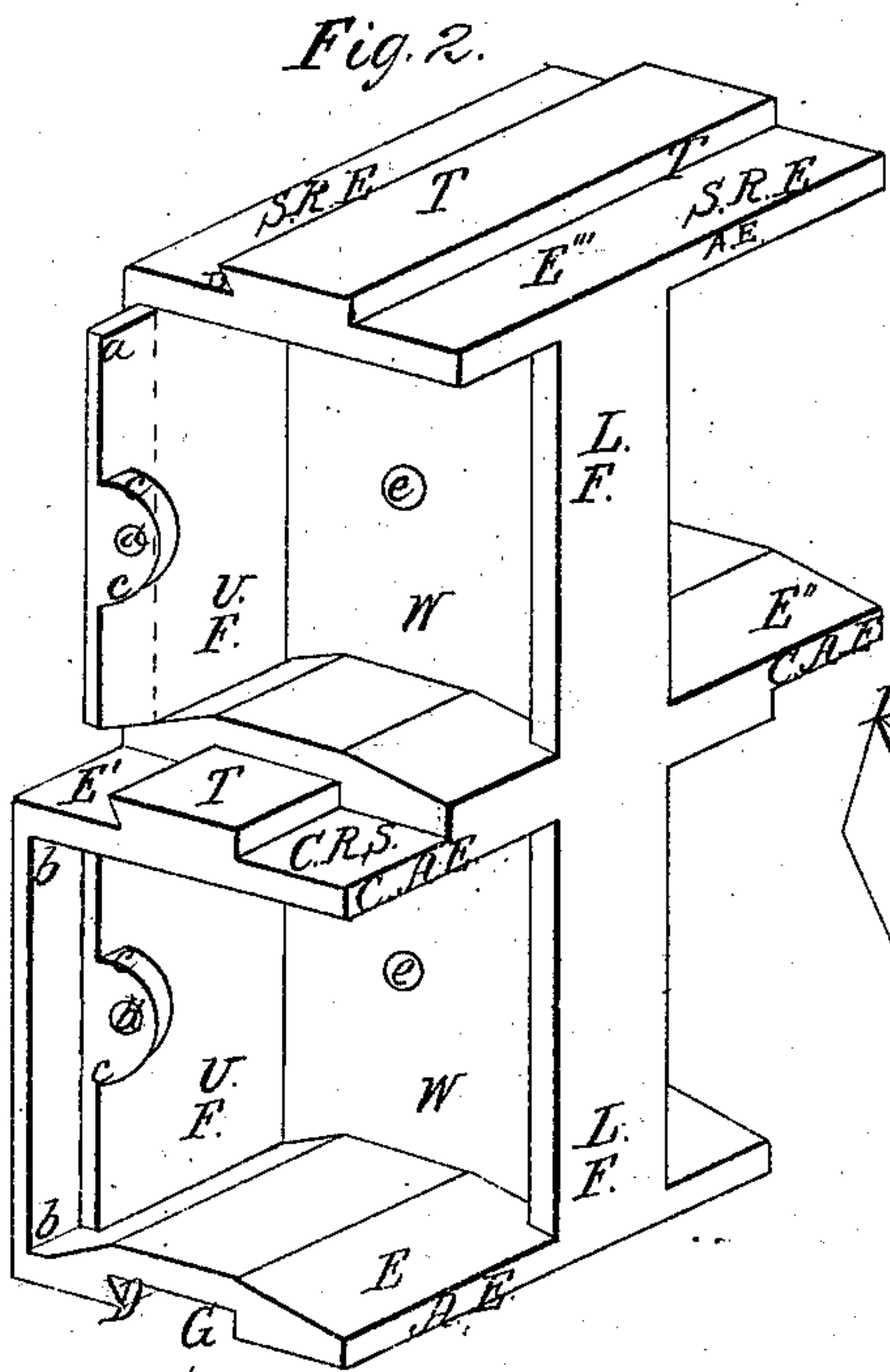
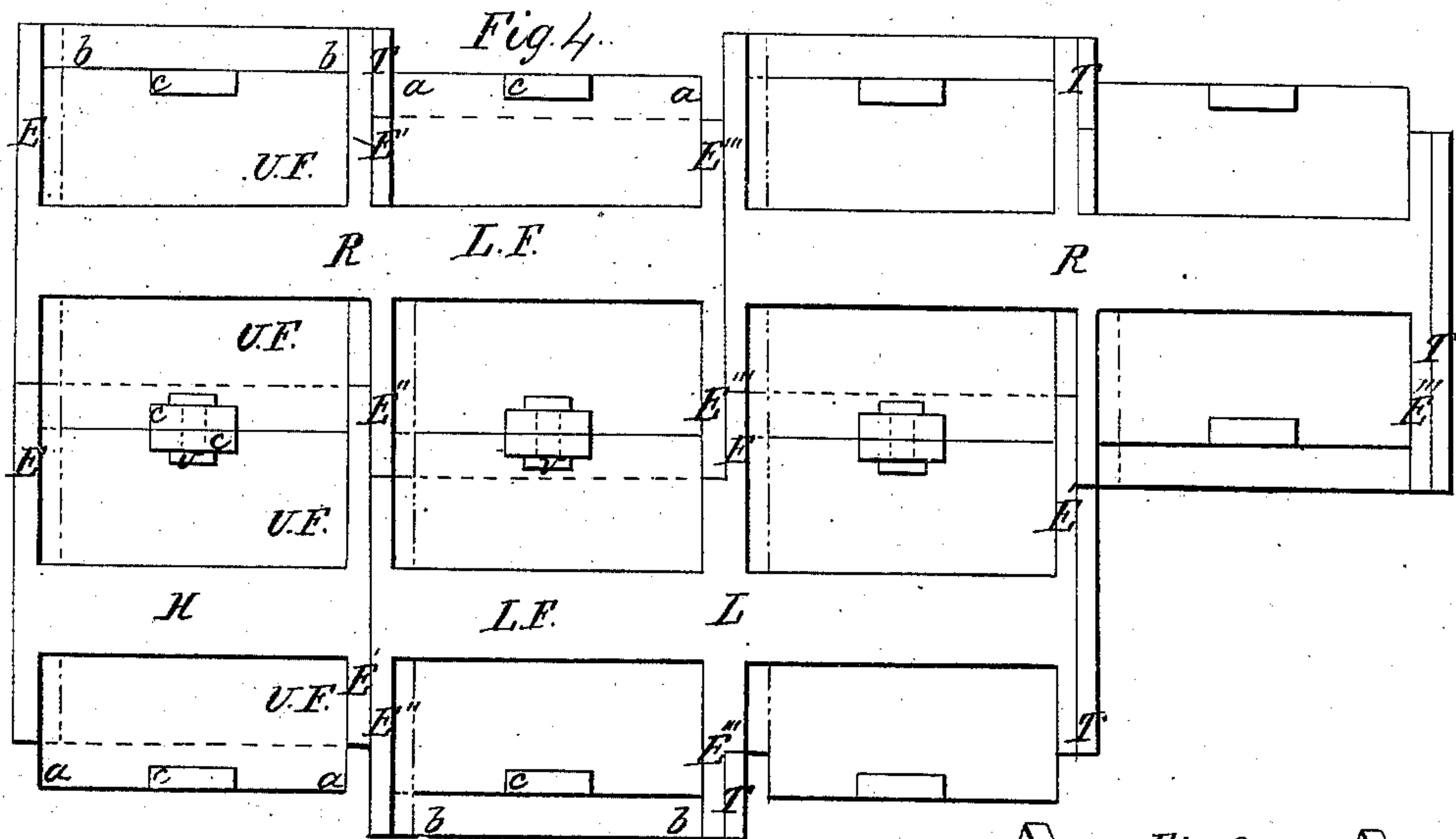


*G. T. Lape.*

*Constructing Tunnels.*

*N<sup>o</sup> 81,797.*

*Patented Sept. 1, 1868.*



*Witnesses;*  
*Peter Van Antwerp*  
*Thomas Van Antwerp*

*Inventor;*  
*G. T. Lape*



# United States Patent Office.

GEORGE T. LAPE, OF SUMMIT, NEW YORK.

Letters Patent No. 81,797, dated September 1, 1868.

## IMPROVED CONSTRUCTION OF ARCHES, TUNNELS, &c.

The Schedule referred to in these Letters Patent and making part of the same.

### TO ALL WHOM IT MAY CONCERN:

Be it known that I, GEORGE T. LAPE, of Summit, in the county of Schoharie, and State of New York, have invented a new and useful Improvement in the Construction of Arches for Bridges, Tunnels, &c.; and I do hereby declare that the following is a full, clear, and exact description thereof, enabling others skilled in the art to construct and use the same, reference being had to the annexed drawings, forming a part of this specification, in which drawings—

Figure 1 shows a perspective view of the grooved ends, the lower and right-hand sides of a voussoir.

Figure 2, a perspective view of the tongued ends, the lower and left-hand sides thereof.

Figure 3, (corresponding with the right-hand half of fig. 1,) a perspective view of the grooved end, lower, and right-hand sides of a half-lengthened voussoir.

Figure 4, a development or view of the under side of a structure, composed of several voussoirs, combined together, showing the breaking of joints throughout, by introducing at the ends half-lengthened voussoirs, and then side by side, right and left-handed voussoirs alternately.

The principal object of my invention is to provide a means of constructing arches of iron or other suitable material, in the process of tunnelling, building sewers, bridges, culverts, &c., by a series of sectional pieces or voussoirs, and consists in forming and combining these in the manner hereinafter described.

This invention differs from my improvement for which a patent was allowed to me by the United States on the 28th day of October, 1867—

First, in providing means for combining the sections or voussoirs horizontally in tunnelling, sewerage, &c., by the use of horizontal dove-tailed tongues and grooves.

Second, in casting the sections or voussoirs with rebates of the side edges at the top plates, so that one will lap over the other at the joints, when placed side by side.

Third, in providing means of securing the sections or voussoirs together laterally by the use of screw-bolts.

Having ascertained the conformation of the desired arched structure, such as tunnels, sewers, &c., I provide a suitable pattern (or patterns, if necessary) of a section or voussoir, (or voussoirs thereof,) and cast such numbers of sections or voussoirs as will, when combined, form said arched structure, the length, breadth, and shape of the sections being varied according to convenience or circumstances.

In each section or voussoir of an arch, the radial end plates and upper plate or flange extend, on diagonally opposite sides of the rib or web, further on one side than on the other, in order to form laps along the rebated sides, and also to break joints at the ends of the voussoirs.

These sections or voussoirs are combined together by horizontal dove-tailed tongues T and grooves G, on their radial abutting ends, and transversely by screw-bolts passing through holes c c in the rib or web W, or through flanges e e on the upper plates.

Figs. 1 and 2 represent a voussoir, cast in one piece, a transverse section of which resembles the capital letter T.

The upper plate U F takes the curve of the extrados of the arch, longitudinally, and extends diagonally further on one side of the web W than on the other. The lower plate or flange L F takes the curve of the intrados of the arch, and extends on both sides of the web equally.

The rib or web W, at right angles to the top and bottom, lies in the same vertical plane. The radial end plates E E' E'' E''' abut against each other in an arch, and become fastened together by the horizontal dove-tailed tongues and grooves T and G. The parts a a and b b of the upper plate (outside the blue lines) are respectively the lower and upper side rebates, each extending longitudinally along the half side edges of a voussoir, so that each half part thereof has a top rebate on one side of the web, and a bottom rebate on the other, in order to lap and cover the joints (at the sides) when the voussoirs are placed side by side throughout their entire length or only their half lengths.

Fig. 3 represents a half-lengthened voussoir, and corresponds to the right-hand half of the voussoir repre-



sented in fig. 1, while the left-hand part thereof (also a half-lengthened voussoir) is the counterpart of fig. 3, and the two halves, according as their ends E' E'', or E E''', are included in the same central radial plate, form the right and left-handed voussoir, as seen in R and L, of fig. 4, in consequence of which and the half-lengthened voussoir, I am enabled to break joints and construct a complete arched structure.

In constructing arches, the proper walls or abutments having been erected, a skewback is secured to the wall or abutment on each side, with a tongue or groove to receive the adjacent sections or voussoirs, and the structure proceeds by shoving the tongue of one in the groove of the other, until the required number are placed into position.

In constructing sewers, there will necessarily be a change in the form of the sections or voussoirs.

As the bottom of the sewer requires a smooth, clear surface, the sections or voussoirs forming that part of it should be cast without the webs or ribs on the side which is to form the interior of the bottom, but the rib or web, the principal function of which, in all cases, is to add strength by economizing material, may be cast on the outside. And in cases where the sewer is to perform the functions of drainage, as well as a conduit, the bottom plate may be cast with perforations. The sections or voussoirs being in readiness for the sewers, the lower one is placed and secured in position, and the others connected in the same manner as above provided for arching.

In forming arches or sewers of any considerable length, or when the ends are firmly supported, or the pressure upon the structure is sufficient to keep the sections or voussoirs from moving laterally, after they are in position, the provisions for bolting together may be dispensed with.

Having thus described my invention, and the means of applying it, what I claim as new, and desire to secure by Letters Patent, is—

1. The construction of sections or voussoirs, with horizontal dove-tailed tongues and grooves along their abutting ends, substantially as and for the purpose specified.
2. In combination with said dove-tailed tongues and grooves, constructing said voussoirs or sections with rebates along their abutting sides, so that they will lap over each other at their joints or points of contact.
3. The construction of sewers, aqueducts, and arches for bridges, culverts, tunnels, &c., by combining and abutting or securing to each other a series of sections or voussoirs, substantially as and for the purposes herein set forth.

This specification signed, this 28th day of March, 1868.

GEO. T. LAPE.

Witnesses:

PETER VAN ANTWERP,  
THOMAS VAN ANTWERP.