

W. C. FLANNERY.
 PROCESS OF CONSTRUCTING SEWERS, AQUEDUCTS, &c.
 APPLICATION FILED MAR. 12, 1912.

1,063,672.

Patented June 3, 1913.

3 SHEETS-SHEET 1.

Fig. 1.

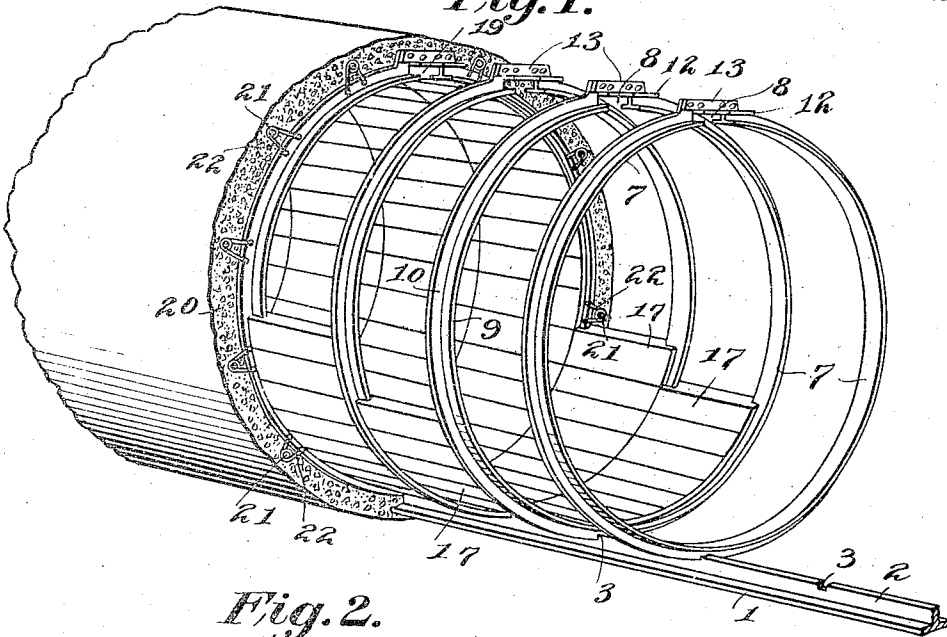


Fig. 2.

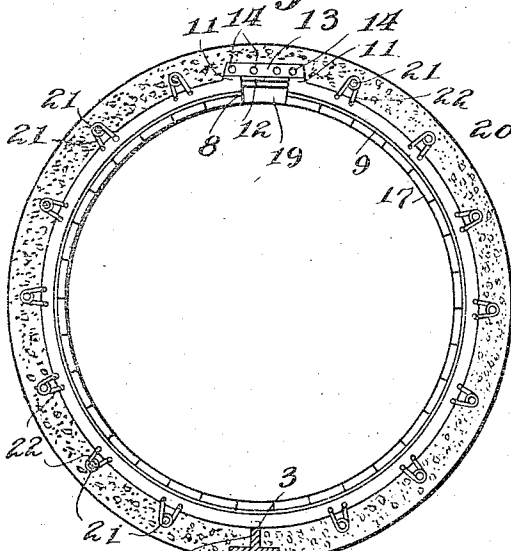


Fig. 8.

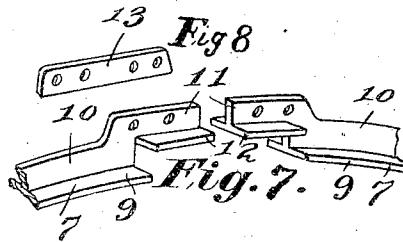


Fig. 7.

Fig. 9.

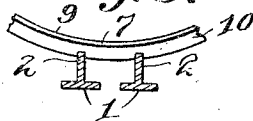
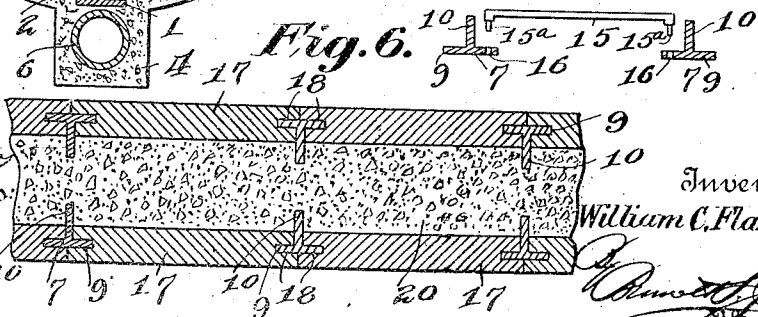


Fig. 13.

Fig. 6.



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3 SHEETS—SHEET 2.

Fig. 3.

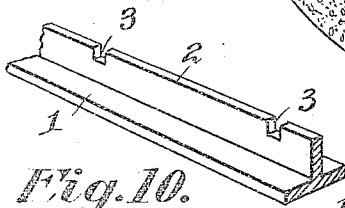
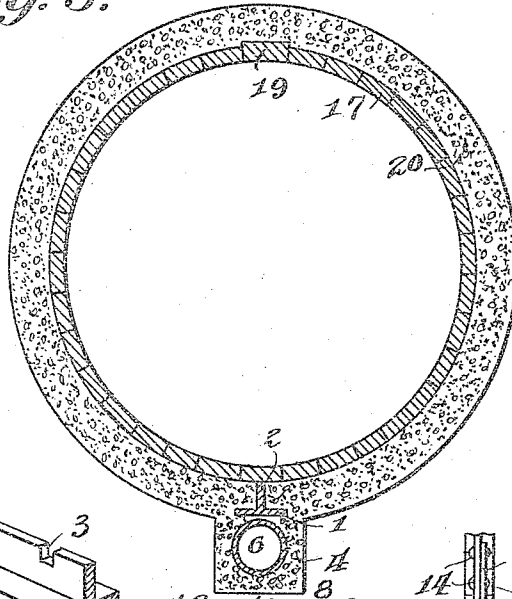


Fig. 10.

Fig. 12.

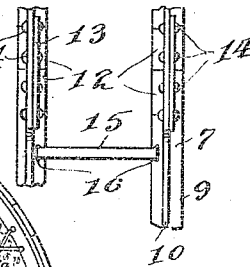


Fig. 4.

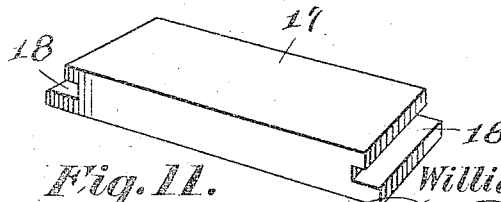
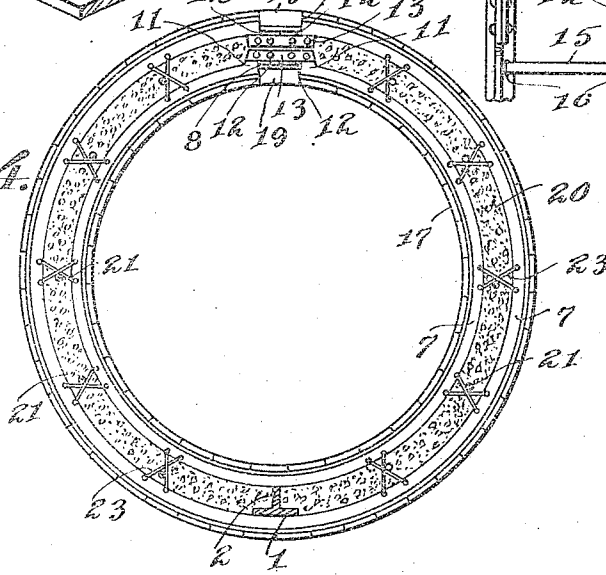


Fig. 11.

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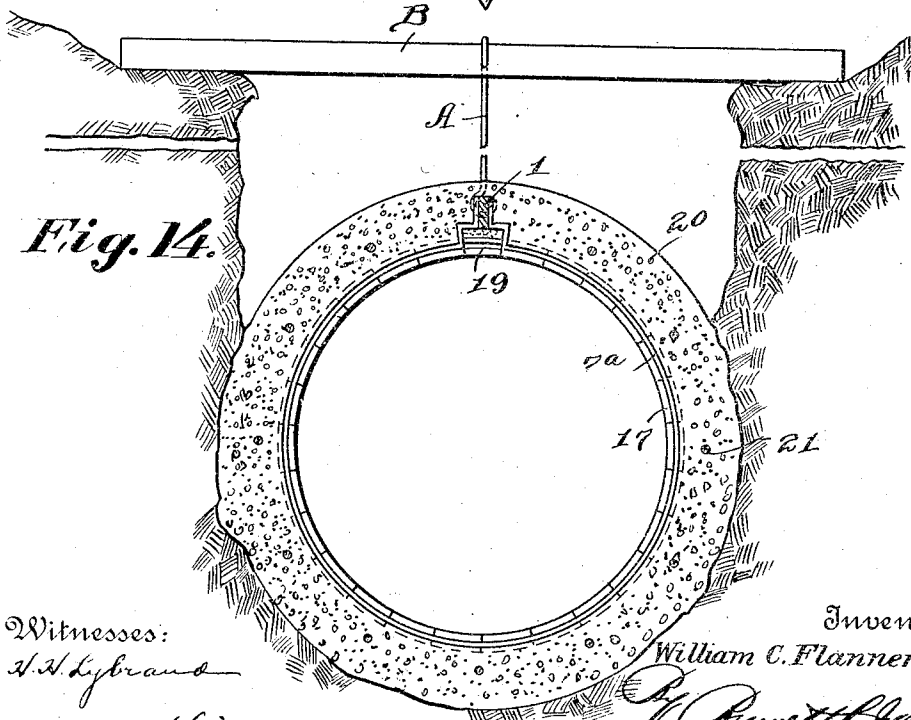
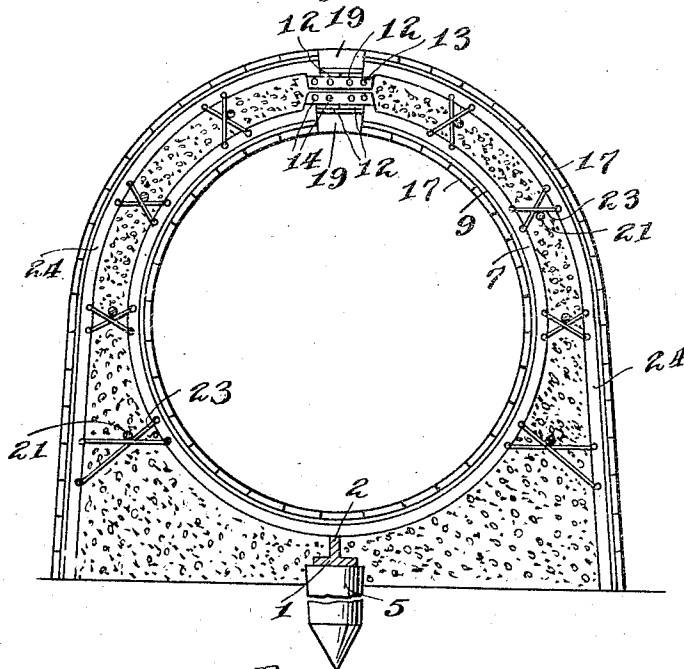
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3 SHEETS—SHEET 3.

Fig. 5.



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UNITED STATES PATENT OFFICE.

WILLIAM C. FLANNERY, OF WASHINGTON, DISTRICT OF COLUMBIA.

PROCESS OF CONSTRUCTING SEWERS, AQUEDUCTS, &c.

1,063,672.

Specification of Letters Patent.

Patented June 3, 1913.

Original application filed July 19, 1911, Serial No. 639,454. Divided and this application filed March 12, 1912. Serial No. 683,317.

To all whom it may concern:

Be it known that I, WILLIAM C. FLANNERY, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Processes of Constructing Sewers, Aqueducts, &c., of which the following is a specification.

My invention relates to a novel process of building or constructing concrete sewers, aqueducts, etc., and particularly concrete sewers or the like of that type provided with an acid-proof lining, whereby the concrete is protected from the disintegrating action of acids and other destructive constituents of the sewage, although the invention is not limited in this direction, as the process may be employed with manifold advantages in conduit or sewer construction generally.

The present application constitutes in general a division of my prior application No. 639,454, filed July 19, 1911.

In the construction of ordinary concrete sewers as heretofore practised, a trench of the required depth and width is first dug, after which a concrete base or invert is formed at the bottom of the trench. When this base or invert has thoroughly set and hardened, which usually requires about two days' time, forms for the side walls are set up and properly tied and braced, and the concrete is then filled in and tamped down about the same up to the spring line of the arch. After these walls have set and hardened, which usually consumes about two days' further time, molds and centers are placed in position and properly braced and the final filling of concrete laid thereon to form the arch or crown of the sewer. When this arch has set and hardened, after another interval of two days' time, the molds and braces are removed, the interior of the sewer so constructed, if to be made acid-proof, lined with vitrified brick, and the trench filled with dirt up to the earth line. The construction of sewers of this character as above carried out is, therefore, comparatively expensive on account of the loss of time involved during the setting of the fillings of concrete, the large number of forms and amount of false-work material which must be made and carried, the amount of labor necessary in placing in position and removing the forms, and the cost of the final work of laying the vitrified brick.

The object of my invention is to provide a construction and method of building operation whereby the cost of building such sewers may be materially reduced; whereby a strong, durable and acid-proof sewer may be built at the expenditure of less time, labor and building material; and whereby the use of false-work construction is avoided, as well as the labor and expense of setting up and removing forms, braces and centers, or of laying a brick lining when the structure is to be rendered acid-proof.

In the accompanying drawings I have shown certain means for carrying my invention into practical effect, without, however, intending to limit the invention to the structural features which, for the purposes of exemplification, I have set forth.

In said drawings: Figure 1 is a perspective view of a section of a concrete sewer constructed in accordance with my invention, showing a portion of the sewer completed and the remainder in the course of erection. Fig. 2 is a vertical transverse section through the completed sewer, taken in the plane of one of the frame rings, hoops or ribs, and showing one form of base which may be employed. Fig. 3 is a vertical transverse section similar to Fig. 2, taken on a plane between adjacent frame rings, hoops or ribs. Fig. 4 is a view similar to Fig. 2 of a modified construction of sewer made up of inner and outer circular frames and an intermediate body or wall of concrete. Fig. 5 is a similar view of a type of double-framed sewer particularly adapted for soft earth beds or foundations, showing also a mode of utilizing piles. Fig. 6 is a horizontal transverse section through a portion of the type of sewer shown in Fig. 4 or Fig. 5. Fig. 7 is a perspective view of the meeting ends of one of the frame rings, hoops or ribs, showing one form of construction thereof which may be employed to receive the key-bricks or tiles and to secure a rigid coupling connection. Fig. 8 is a perspective view of one of the coupling or joint plates used in conjunction therewith. Fig. 9 is a detail transverse section showing the use of a plurality of rails in forming a keel piece. Fig. 10 is a fragmentary perspective view of the keel piece. Fig. 11 is a perspective view of one of the tiles. Fig. 12 is a fragmentary top plan view of two adjacent frame rings, hoops or ribs, showing the manner of holding

the same in position during the course of building the sewer. Fig. 13 is a sectional elevation of parts shown in Fig. 12. Fig. 14 is a cross-sectional view showing a different arrangement of the keel or girder.

In the construction of a tunnel embodying the general characteristics of my invention, I provide a shell formed of a metallic skeleton framework and a body of tiles filling the open spaces thereof and arranged to form the inner face or lining of the sewer, which shell is embedded in an outer body or wall of concrete binding the parts of the shell firmly together. The skeleton framework is made up of ring sections between which the tiles are arranged and on which said tiles are supported in position, and the said ring sections are preferably mounted upon a longitudinal gaging or spacing and supporting keel or girder, whereby they are mutually sustained and properly spaced with relation to each other. The parts of the set-up framework so formed may be suitably braced and reinforced, and, if desired, inner and outer shells may be employed and the general construction and arrangement of parts may be modified in many respects, other than hereinafter stated, to meet different conditions, as circumstances require.

Referring to the drawings, 1 designates the keel or girder, which is arranged longitudinally at the bottom or top of the trench, and which may consist of a single rail, as shown in Figs. 1 to 5, inclusive, or of two or more parallel rails, as shown in Fig. 9. Metal keel rails of T-form are preferably employed, and the vertical web 2 of each bottom keel rail is provided with notches or seat recesses 3 at regular and desired intervals apart. In the use of a plurality of rails, the notches in the rails are arranged in transverse alinement with each other. The keel rail or rails are embedded in the concrete invert and their body portions may rest upon or be disposed immediately above a concrete base 4, as shown in Figs. 2 and 3, or upon piles 5 anchored at their upper ends in the invert, as shown in Fig. 5, said bases or piles being employed to give a firmer foundation support when or wherever a solid earth foundation is not afforded. The base 4 may inclose a conduit 6 for drainage purposes, when occasion requires.

The rings, hoops or ribs 7 of which the skeleton framework is formed consist in the form shown in Figs. 1 to 13, inclusive, of split metallic T-rails bent into form. These rings are arranged at regular intervals apart upon and transversely of the keel with their slots or open spaces 8 disposed at their highest point. As shown, the body portion of each rail faces inwardly and provides laterally extending flanges or webs 9, while the central web or flange 10 thereof projects outwardly, the said flanges 10 of the

rings being seated in the notches 2 of the keel. For the purpose of enabling the ends of each ring to be coupled, and the key-bricks or tiles hereinafter described to be fitted and held in position, the extremities of such ends may be transversely split and offset upwardly to form elevated coupling portions 11 and retaining plates 12, leaving the ends of the body portions relatively arranged to flare the spaces or openings 8. The coupling portions 11 are perforated for cooperation with one or more joint or coupling plates 13, through which coupling portions and plates, pins, bolts, or rivets 14 are passed to hold the ring against expansion or contraction while the concrete is being filled in, and to impart greater stability of construction to the completed shell and sewer as a whole. Any other suitable mode of coupling the ends of the split rings may, however, be employed. In order to hold the rings erect in the process of construction until the concrete is built up sufficiently to sustain the same, temporary gage and stay bars 15 (one or more) may be arranged to connect the upper portions of adjacent rings, said bars having pins or projections 15^a to engage openings 16 in the webs 9. In addition to these temporary gage and stay bars, any other temporary braces may be employed, as circumstances or conditions may require.

The spaces between the rings of the skeleton frame are filled and closed by rows of tiles 17 of vitrified clay, glass, porcelain or other suitable acid-proof material, or tiles of any suitable type having acid-proof inner faces. The tiles of each row are strung upon the rings, said tiles having grooved end edges 18 to slidably engage and interlock with the flanges or webs 9 of adjacent rings. As shown, the outer walls of the grooves in the tiles abut against the webs 10 and are relatively shorter than the inner walls thereof, which abut and lap over the inner surfaces of the body portions of the rings, whereby the interior of the framework is completely covered and protected from atmospheric influences and the action of acids and other destructive constituents of the sewage. The tiles are fitted in position by disposing them between the crown portions of adjacent rings with their grooved ends inserted in the openings 8 of said rings and in alinement with the ends of the webs 9, and then sliding them onto the ends of the webs alternately at opposite sides of the openings 8, after which a tapered key-brick or tile 19 of ordinary or any preferred form is slid laterally into position between the ends of the rings and beneath the retaining plates 12 to close the openings 8. The tiles of successive rows may be arranged to break-joint or not, and mortar or other binding and sealing means may be employed to close any

crevices which may exist between the inner walls of the grooves of adjacent tiles when it is desired to make the joints absolutely tight and fasten the inwardly projecting portions of the tiles firmly together.

The shell constructed as above described is inclosed and surrounded by an outer wall 20 of concrete in which the framework and tiles are both embedded and which binds the framework and tiles solidly together, forming a monolithic or practically homogeneous structure of great strength and durability and capable of resisting all earth vibrations and strains to which it may be subjected. For the purpose of securing additional strength and stability longitudinal reinforcing rods 21 may be embedded in the concrete and connected with the rings by anchor ties 22, preferably consisting of looped wires engaging the rods and perforations in the webs 10 of the rings. When desired plain rings or bands 7^a may be employed, as shown in Fig. 14, and, as also shown in this view, the keel or girder 1 may be arranged above instead of below the plane of the frame, in which event said keel or girder may be supported at intervals by hangers A depending from bars B extended across the top of the trench, and the ends of the rings or band are suitably secured to the keel or girder. After the structure is built up to a sufficient degree to be self-supporting, or at any time prior to the filling in of the crown portion of the concrete, the hangers A are removed, as will be readily understood. In some cases the tiles may be assembled without directly fastening the same to the framework and cemented or locked together by the concrete filled about the conduit formed thereby. The inner faces of the tiles will then form the acid-proof lining.

As above stated, the general structure may be modified to suit special conditions. For instance, to reduce the cost of construction where a full-tiled sewer is not needed, the tiles may terminate at the spring line of the arch or at any level between the same and the crown of the arch, in which event the top of the shell may be filled and closed by cement or concrete. Also, when desired, inner and outer counterpart circular shells of the construction described may be employed, as shown in Fig. 4, which are reversed as to position to arrange the tiles of the outer shell upon the outer surface of said shell. In this case the body or wall of concrete lies between the shells and binds the component parts of both shells together. Crossed wire stays or ties 23 are provided in this construction for coöperation with the rods to connect and reinforce both shells, said ties being fastened to the adjacent webs 10 of both shells and bearing against the rods. Where soft foundation ground is en-

countered, and a broad solid concrete base or invert is used to provide a solid bed or support for the sewer, as shown in Fig. 5, the frame elements of the outer shell, in a double-shelled type of sewer, may be in the form of arched T-rails 24 split and constructed at the crown like the frame rings, and on which the tiles may be strung in the manner before described. These and other modifications, and variations required by special conditions, are held to fall within the spirit and scope of my invention.

In the construction of a simple type of sewer embodying my invention, the keel or girder is first laid at the base or top of the trench, the frame rings or elements set up and braced and the tiles slipped or fastened into position. After a sufficient number of tiles to close the bottom of the skeleton frame are inserted, the concrete to form the base or invert is filled in and packed. The operation of applying the tiles is meanwhile continued, and, as the tiles are inserted upwardly at the sides, the concrete is filled in and tamped, whereby the operation of building up the sides of the concrete wall is made continuous with the closing of the sides of the shell by the tiles. When the tiles have been filled up to the sides of the openings 8, the key-bricks or blocks, if used, are inserted and the concrete to form the arch or crown of the outer wall filled in and tamped, after which the trench is filled with earth up to the ground line in the usual manner. This operation is the same in building all forms of sewers embodying the general features of my invention, except where it is first necessary to prepare a special foundation by driving piles or forming concrete bases, the parts of the two shells in the double-shell construction disclosed being simultaneously assembled in the erection of the sewer. The reinforcing stays and ties are, of course, placed in position as the concrete wall is built up, but it will be seen that as the shell or shells and concrete wall are simultaneously in course of construction no loss of time is experienced, as in ordinary sewer construction, as a result of the necessity of separately building portions of the concrete wall and allowing time for the same to set and harden. Moreover, as the shell constitutes, in a unitary structure, the frame and lining of the sewer, as well as a form about which the concrete wall is built, the necessity of constructing, carrying, erecting and removing forms, centers, interior braces, jacks and other similar false-work is avoided, as well as the ordinary final work of laying a brick lining. By my construction and process of building, the cost of erecting sewers of the character described is materially reduced, and at the same time a simpler, stronger, more durable and otherwise superior type of sewer is provided

Having thus described the invention, what I claim as new is:—

1. The herein described method of building a sewer, aqueduct or like horizontal conduit, which consists in erecting a permanent skeleton framework of the prescribed cross-sectional contour along the established course, setting up and supporting by means of the framework a body of tiling, so as to close the openings in said framework, form a permanent lining for the completed structure, and produce a resultant rigid self-sustaining shell, and surrounding and embedding said shell in an outer wall of concrete.
2. The herein described method of building a sewer, aqueduct or like horizontal conduit, which consists in erecting a permanent skeleton framework of the prescribed cross-sectional contour along the established course, setting up and supporting by means of the framework a body of tiling, so as to close the openings in said framework, form a permanent lining for the completed structure, and produce a resultant rigid self-sustaining shell through which the outer surface of the tiling composing said lining is exposed, and then surrounding and embedding both the framework and tiling in an inclosing wall of concrete.
3. The herein described method of building a sewer, aqueduct or like horizontal conduit, which consists in erecting a permanent skeleton framework of longitudinally spaced vertically supported rigid rings or bands along the established course, setting up and supporting by means of the framework a body of tiling, so as to close the openings in said framework, form a permanent lining for the completed structure, and produce a resultant rigid self-sustaining shell, through which the outer surface of the tiling composing said lining is exposed, and then surrounding and embedding both the framework and tiling in an inclosing wall of concrete.
4. The herein described method of building a sewer, aqueduct or like horizontal conduit, which consists in extending a longitudinal frame element along the established course, supporting at determined intervals along said frame element relatively transverse, rigid vertical rings or bands, constituting therewith a framework of the prescribed cross-sectional contour, setting up

and supporting by means of the framework a body of tiling, so as to close the openings in said framework, form a permanent lining for the completed structure, and produce a resultant rigid self-sustaining shell, through which the outer surface of the tiling composing said lining is exposed, and then surrounding and embedding both the framework and tiling in an inclosing wall of concrete.

5. The herein described method of building a sewer, aqueduct or like horizontal conduit, which consists in extending a longitudinal girder along the base line of the prescribed course, supporting at determined intervals along said girder relatively transverse, rigid vertical rings or bands, constituting therewith a framework of the prescribed cross-sectional contour, setting up and supporting by means of the framework a body of tiling, so as to close the openings in said framework, form a permanent lining for the completed structure, and produce a resultant rigid self-sustaining shell, through which the outer surface of the tiling composing said lining is exposed, and then surrounding and embedding both the framework and tiling in an inclosing wall of concrete.

6. The herein described method of building a sewer, aqueduct or like horizontal conduit, which consists in forming a trench, erecting a permanent skeleton framework of the prescribed cross-sectional contour within and along the line of the trench and supported in spaced relation to the bottom and sides thereof, setting up and supporting by means of the framework a body of tiling, so as to close the openings in said framework, form a permanent lining for the completed structure, and produce a resultant rigid self-sustaining shell, through which the surface of the tiling composing said lining is exposed, surrounding and embedding both the framework and tiling in an inclosing wall of concrete, and covering the conduit and closing the trench with a filling material.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM C. FLANNERY.

Witnesses:

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C. C. HINES.