Feb. 25, 1930. L. M. KING 1,748,134

CONDUIT CONSTRUCTION

Filed March 8, 1928 2 Sheets-Sheet 1

Fig. 1

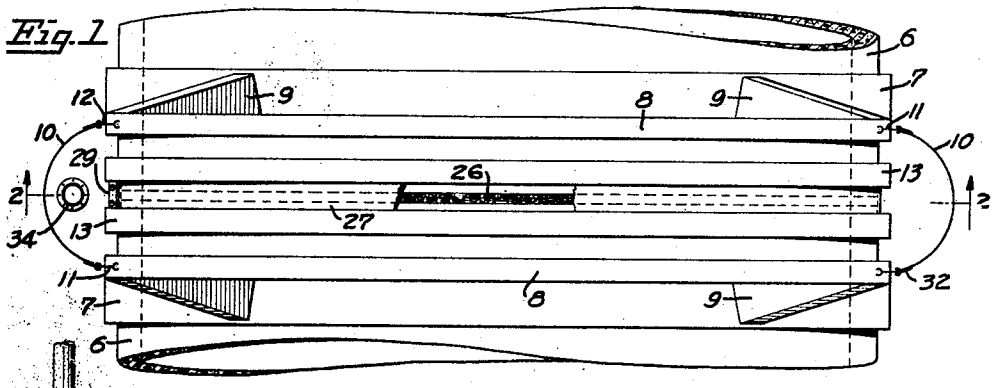
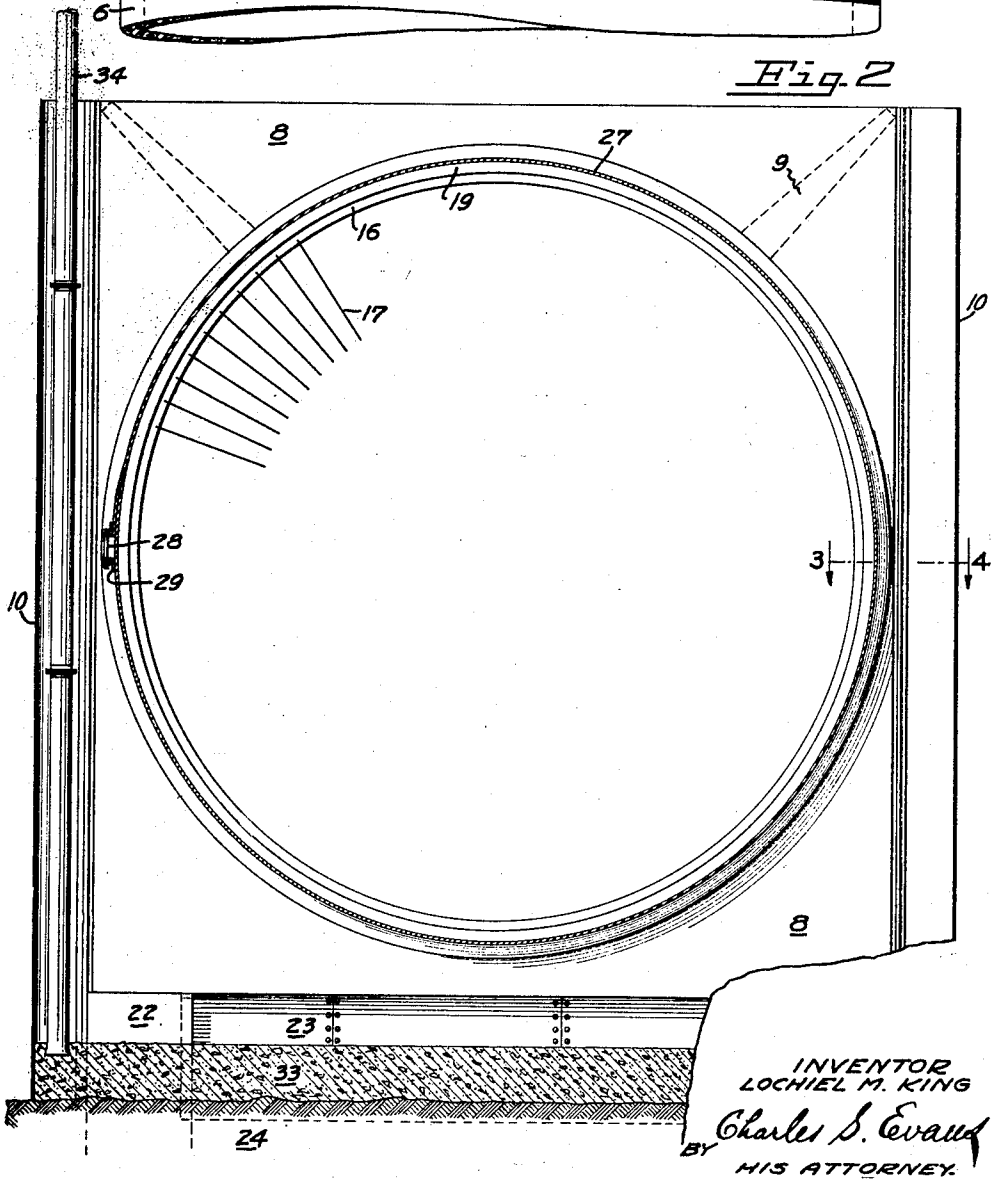


Fig. 2



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Fig. 3

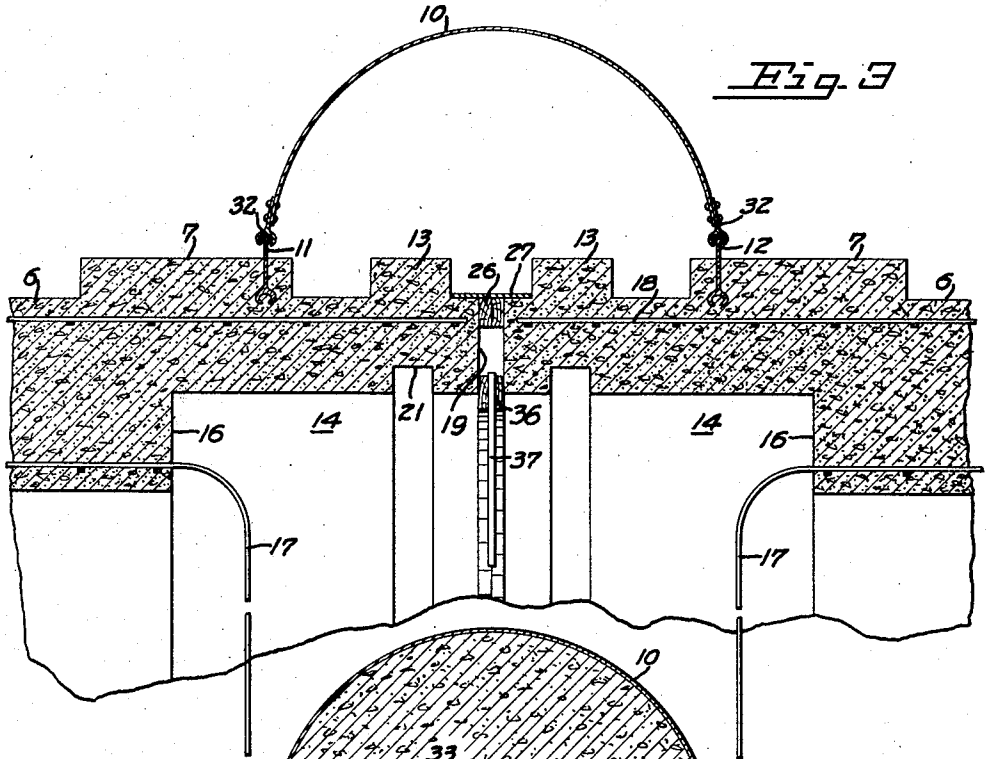
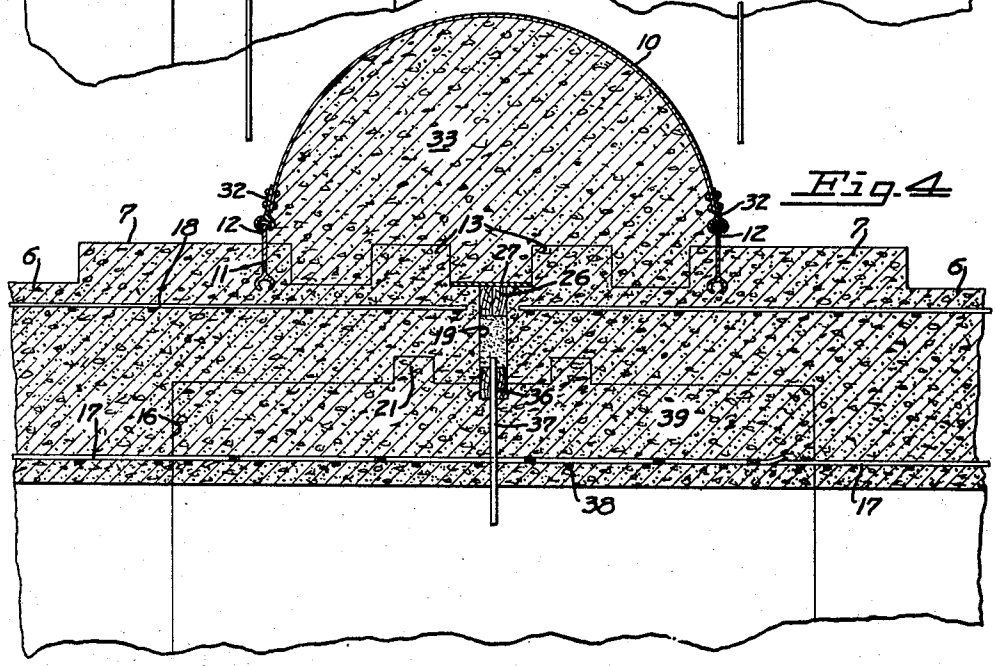


Fig. 4



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1,748,134

UNITED STATES PATENT OFFICE

LOCHIEL M. KING, OF ALAMEDA, CALIFORNIA

CONDUIT CONSTRUCTION

Application filed March 8, 1928. Serial No. 259,934.

My invention relates to the construction of reenforced concrete conduits, and particularly to under-water tubes for vehicular and railway traffic, but it is also applicable to aqueducts, sewers and other conduits. Its broad purpose is to provide a practical construction using pre-cast reenforced concrete sections.

An object of my invention is to provide a conduit of uniform strength.

Another object of my invention is to provide a joint for conduit sections which may easily be formed under water.

Still another object of my invention is to provide a substantially tight conduit joint.

A further object of my invention is to provide a conduit construction which is low in cost in comparison with other types.

My invention possesses other objects and valuable features, some of which will be set forth in the following description of my invention which is illustrated in the drawings forming part of the specification. It is to be understood that I do not limit myself to the showing made by the said description and drawings, as I may adopt varying forms of my invention within the scope of the claims.

For illustration I will describe my invention as embodied in subway construction of which there are two types in general use. The older of these involves the use of a shield, forced forward by jacks and backed by compressed air, behind which the workers operate. As the shield advances cast iron rings are bolted in place, and the inside is then covered with a layer of concrete. The operation is expensive and hazardous.

The other method comprises digging a trench for the subway, laying a riveted steel tube in the trench and then pouring concrete into the trench to cover the tube and form a permanent monolithic structure. While this construction offers certain advantages over the first method, the amount of concrete used is enormous, and the cost is high.

In the construction of subways, as in any major engineering problem, cost is inevitably the determining factor. The saving which would be effected were it possible to use a uniform tube of reenforced concrete of the proper section to withstand the stresses is obvious, and accordingly it has been often proposed to pre-cast a tube of the proper dimensions in sections, lay them like steel tubes in a trench, and back-fill over the completed subways. This has not been done, because no joint which has hitherto been proposed for joining such sections was at once watertight, adequate to withstand the stresses which would be set up in it, and easy enough of construction to be practical. To provide a joint which meets these requirements is to reduce by as much as 30 to 40 per cent the cost of an engineering operation in which the expenditures run into millions of dollars, and such a joint is provided by my invention.

Referring to the drawings:

Fig. 1 is a plan view of the abutting ends of two conduit sections embodying my invention. The joint is shown as it appears before pouring the outer seal.

Fig. 2 is a cross sectional view of the joint; the plane of section being indicated by the line 2—2 of Fig. 1. The tremie pipe for pouring the outer seal is shown at the left of the figure and the beginning of the outer seal appears at the bottom of the figure.

Figs. 3 and 4 are sectional views on a larger scale, taken on the line 3—3 of Fig. 2 and showing the joint respectively partly completed and finished.

Broadly considered my invention comprises conduit sections formed with encircling, preferably quadrilateral flanges spaced slightly from their ends; and provided with counterbores into which extend longitudinal reenforcing bars embedded in the walls of the sections. These sections are placed in position on grade piers with the ends abutting, and an outer seal is poured about the joint, and an inner seal poured into the counterbores. Preferably both counterbore and outer surface of each section are provided with key ways or grooves with which the seals key or interlock. Preferably also a caulking space is left between the abutting ends of the sections into which a grouting is forced under pressure, so as to fill all space and secure a tight joint.

In more detailed terms the preferred em-

bodiment of my invention is constructed as follows:

Tube sections 6 of reinforced concrete are cast having a collar 7, spaced a convenient distance from each end. The collar bears a straight sided flange 8, preferably rectangular and provided with buttresses 9 for strengthening the corners. Means are provided for attaching a form or diaphragm 10 to the vertical edges of the flanges. A convenient attaching means is a length of steel sheet piling 11 embedded in the flange with the tongue edge 12 projecting. Between the flange and the end of the section a flange collar 13 encircles the tube, so as to form an annular keyway around the end of the section.

Within the ends of the section are counterbores 14 extending back into the tube. The exact length of the counterbores is not important, but they may conveniently terminate in the annular faces 16 about as far from the end of the section as the collar 7. The longitudinal reenforcing bars 17 extend through the face 16 and into the counterbore.

The sectons are also provided with outer reinforcing bars 18 which end a short distance from the end faces 19 of the tube sections. Annular grooves 21 are formed within the counterbores of each section preferably under the collar 13, in order to avoid too great a reduction of cross-section of the tube.

A trench is excavated to receive the subway, and grade piers 22 are set for the tube to rest upon. A pair of piers is provided to receive each flange and between the piers of each pair is placed a diaphragm 23, which may be built of riveted plates, and which extends from the grade level down to and slightly into the sub-grade 24.

Bulkheads are fixed in the ends of the tube sections, which are floated into position and then sunk into place on the grade piers. In doing this the faces 19 are brought into as close approximation as practical, but a crack will be left between the faces which may be several inches in width. Where this is the case it is caulked with wooden chocks 26 and a gasket or belt 27 is then passed around the joint, and drawn tight by bolts 28 bearing against angles 29 secured to the belt.

The material of the belt may be rubber or canvas belting, or it may be a steel band. In the case of the closing joint, formed where the last section is placed, it may be advisable to allow several feet between the ends of the sections to facilitate their handling. In this case the belt would be a steel ring, and the chocks 26 would be omitted.

The steel forms 10, preferably semi-cylindrical, with interlocks 32 to engage the sheet piling 11 are next slid into place to close the space between the flanges. The forms extend to or silghtly below the subgrade, and the space between the flanges thus becomes a compartment, closed except at the top, into which a concrete seal 33 is poured by means of a tremie pipe 34. Any slight leakage due to failure of the forms to close exactly may be blocked by the use of sand bags.

Pouring the seal entirely from one side is advantageous in that the concrete rises simultaneously from both sides and the formation of voids is minimized. The cross-section of the compartment is ample to allow this to be done, but it is not essential that it should be, and with proper precautions the pouring may be done from either or both sides as the exigencies of the work demand. Pouring continues until the seal is level with the tops of the flanges. It will be noted that the seal, when set, surrounds and is firmly keyed to the sections.

The outer seal being completed, the inside of the joint is next formed. Caulking 36 is driven into the crack between the faces 19, and pipes 37 are passed through the caulking and left projecting into the bore of the tube to be used later.

The reinforcing bars 17 were either bent back out of the way as shown in Fig. 3 or cut off within the counterbore, so as not to interfere when the sections were being placed. They are now straightened or extensions are welded on so that the reinforcing bars of each section extend substantially the entire length of the adjoning counterbores. Circumferential reinforcing 38 is placed, and temporary forms are applied within which the inner seal 39 is formed. The longitudinal reinforcement within the seal is thus the combined reinforcement of the two adjacent sections, stressed in pure tension, overlapping, and anchored by and into the seal from both directions. The lower part of the seal is first poured; then the upper part is forced in under pressure. Like the outer seal, the inner seal is keyed to the tube sections, the grooves 21 serving this purpose.

The final stage in the formation of the joint is forcing a grouting, preferably of neat cement, through the tubes 37, and into the space between the faces 19 of the section ends. This is done under heavy pressure, and the grouting enters any interstices which may have been left in the formation of the seals, and practically eliminates leakage at the joint. Such leakage is slight in any event, as the bond between the seals and the tube sections is long and the leakage path tortuous. One of the advantages of the curved plate form 10 is its ability to adjust itself to variations in the spacing of the anchor flanges 11.

A stress analysis of a joint so formed shows it to have a strength at least as great as the body of the tube. There are, of course, many minor modifications of struc-

ture which may be made without impairing the strength. For example, box forms may be used instead of diaphragms to confine the outer seal between the grade piers, the forms between the flanges may be bolted in place instead of slipped over sheet piling, and methods of caulking may be varied at will.

The joint described, however is adequate, and low in cost; and is applicable to structures designed for a variety of uses. There is a wide field for its use in outfall sewer construction in particular. Neither is its use limited to underwater construction, although by the use of tremie concrete it gives the greatest durability obtainable in structures of this class.

I claim—

1. A conduit comprising abutted sections, each section having an integral flange disposed thereabout, and a concrete seal surrounding the ends of the sections between the flanges.

2. A conduit comprising abutted sections, each section having a collar and an integral flange disposed thereabout, and a concrete seal surrounding the ends of the sections between the flanges and interlocking with the collars.

3. A conduit comprising abutted sections, each section having a flange disposed thereabout, a retaining form connecting the flanges, and a concrete seal surrounding the ends of the sections and filling the chamber between the flanges and the form.

4. A conduit comprising abutted sections, each section having a quadrilateral flange disposed thereabout, anchor flanges arranged in the edges of the section flanges, a retaining form secured between the anchor flanges, and a concrete seal surrounding the ends of the sections and filling the chamber between the flanges and the form.

5. A conduit comprising abutted sections, each section having a quadrilateral flange disposed thereabout, sheet piling embedded in the section flanges, a curved metal form secured between the piling, and a concrete seal surrounding the ends of the sections and filling the chamber between the flanges and the form.

6. A conduit comprising abutted sections, each section having a collar and a quadrilateral flange disposed thereabout, a curved metal form connecting the flanges, and a concrete seal surrounding the ends of the sections between the form and the flanges and interlocked with the collars.

7. A conduit comprising abutted sections, each section having a flange disposed thereabout, a form connected to said flanges, a band encircling the juncture of said sections, and a concrete seal disposed in the space between the flanges and form and band.

8. A conduit comprising abutted sections, each section having a quadrilateral flange disposed thereabout, forms connecting the flanges on opposite vertical edges thereof, means for closing the space between the lower edges of the flanges, and a concrete seal surrounding the ends of the sections in the space between the flanges and forms and closing means.

9. A conduit comprising abutted sections, each section having a flange disposed thereabout, a form connected to said flanges, a concrete seal surrounding the ends of the sections between the flanges and form, and means for interlocking the seal with the section ends.

10. A conduit comprising abutted sections, each section having an integral flange disposed thereabout, a concrete seal surrounding the ends of the sections between the flanges and means for interlocking the seal with the section ends.

11. A conduit comprising abutted sections the end of each section having a flange on the outside and a counterbore on the inside, a concrete ring surrounding the abutting ends of the sections between the flanges and a concrete ring filling the counterbores.

12. A conduit comprising abutted sections, the end of each section having a flange on the outside and a counterbore on the inside, a concrete ring surrounding the abutting ends of the sections between the flanges, a concrete ring filling the counterbores, and means for interlocking the concrete rings with the section ends.

13. A conduit comprising abutted sections, the end of each section having a flange on the outside and a counterbore on the inside, a concrete ring surrounding the abutting ends of the sections between the flanges, a concrete ring filling the counterbores, means for interlocking the concrete rings with the section ends, and reenforcing bars extending from each section into the counterbore filling ring.

14. A conduit comprising abutted sections, each section having a counterbore on the inside, a concrete ring surrounding the abutting ends of the sections, and a concrete ring filling the counterbores.

15. A conduit comprising abutted sections, each section having a counterbore on the inside, a concrete ring surrounding the abutting ends of the sections, a concrete ring filling the counterbores, and means for interlocking the concrete rings with the section ends.

In testimony whereof, I have hereunto set my hand.

LOCHIEL M. KING.