Mar. 6, 1923.

P. KIRCHER.

REENFORCED CONCRETE PIPE.

FILED JULY 14, 1921.

1,447,421.

3 SHEETS—SHEET 1.

Fig. 1

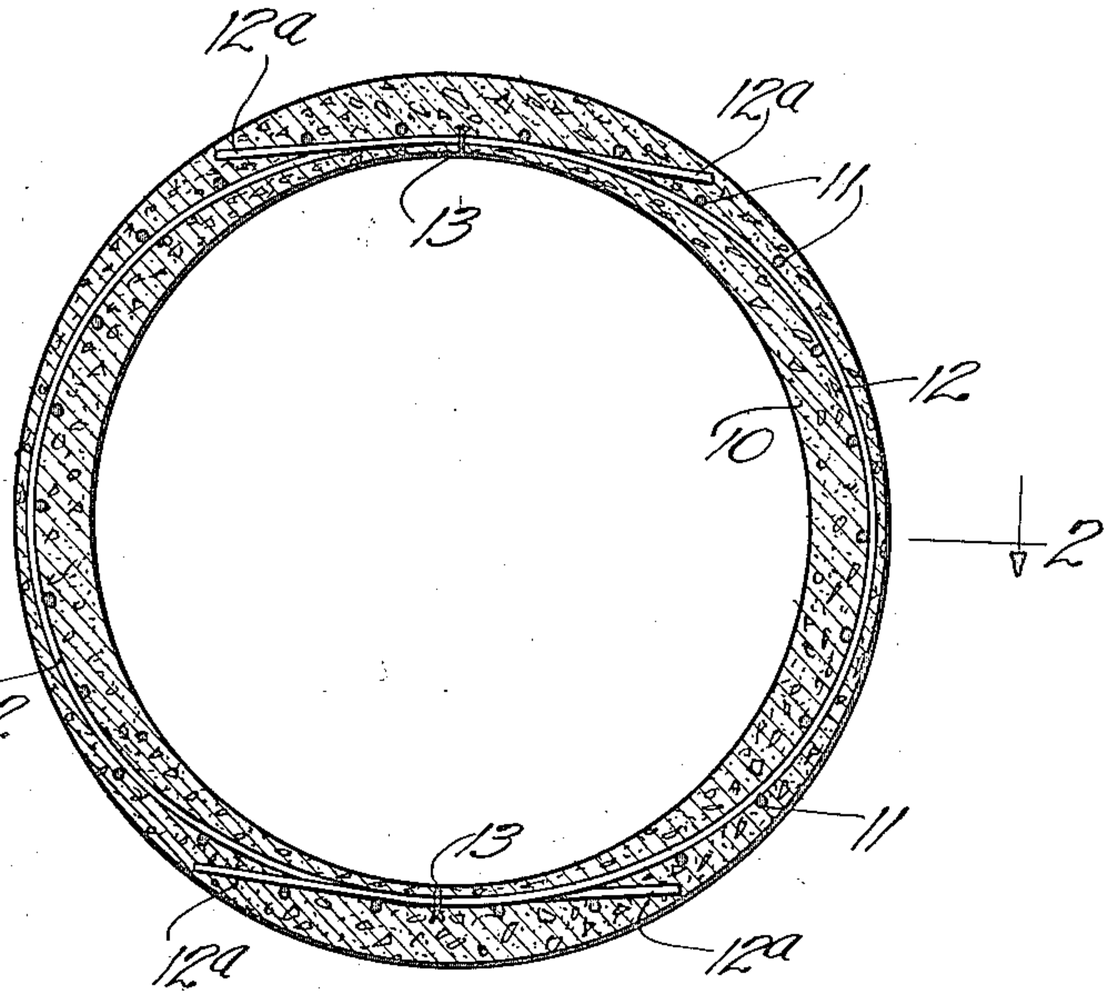


Fig. 2

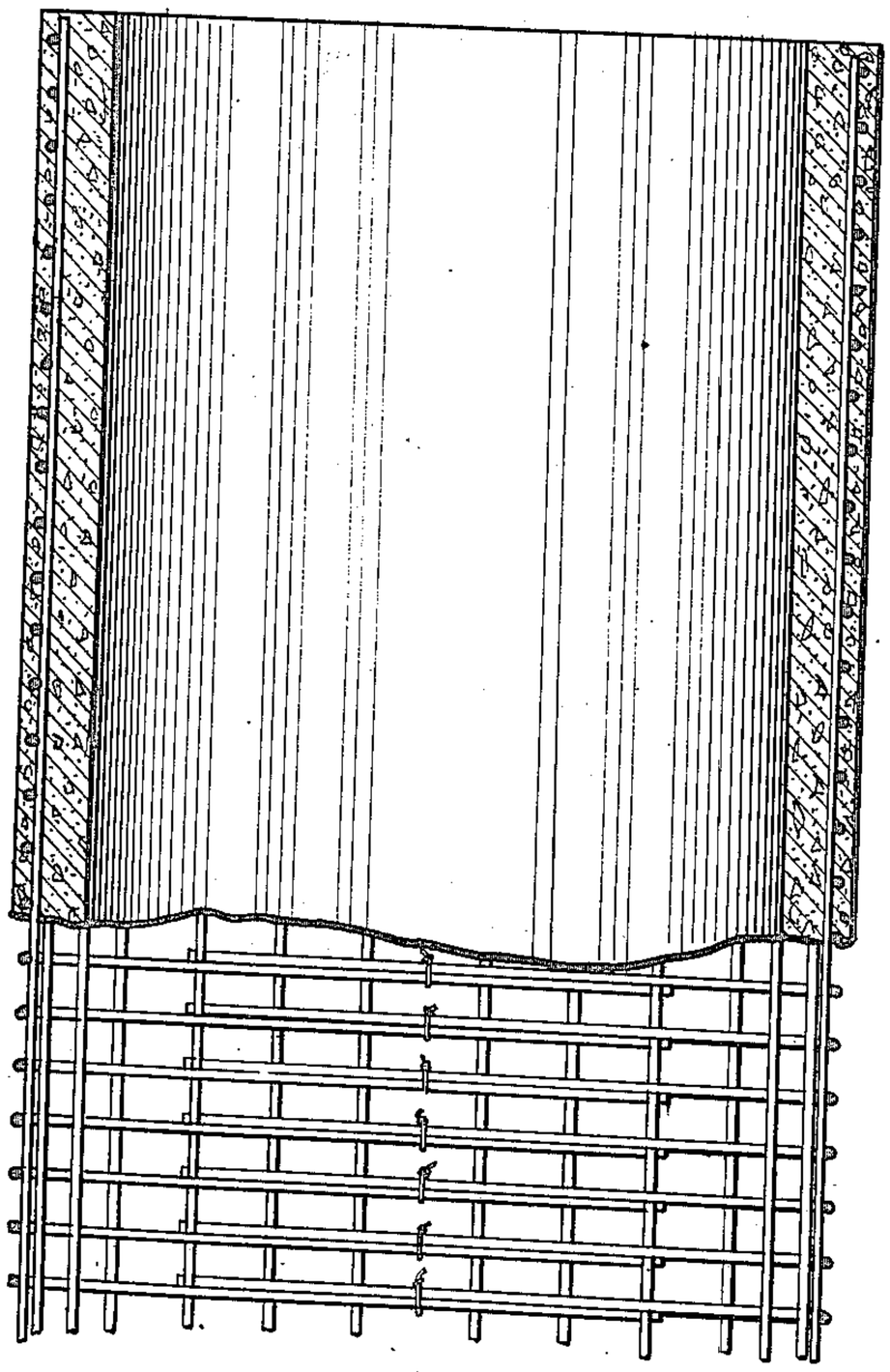
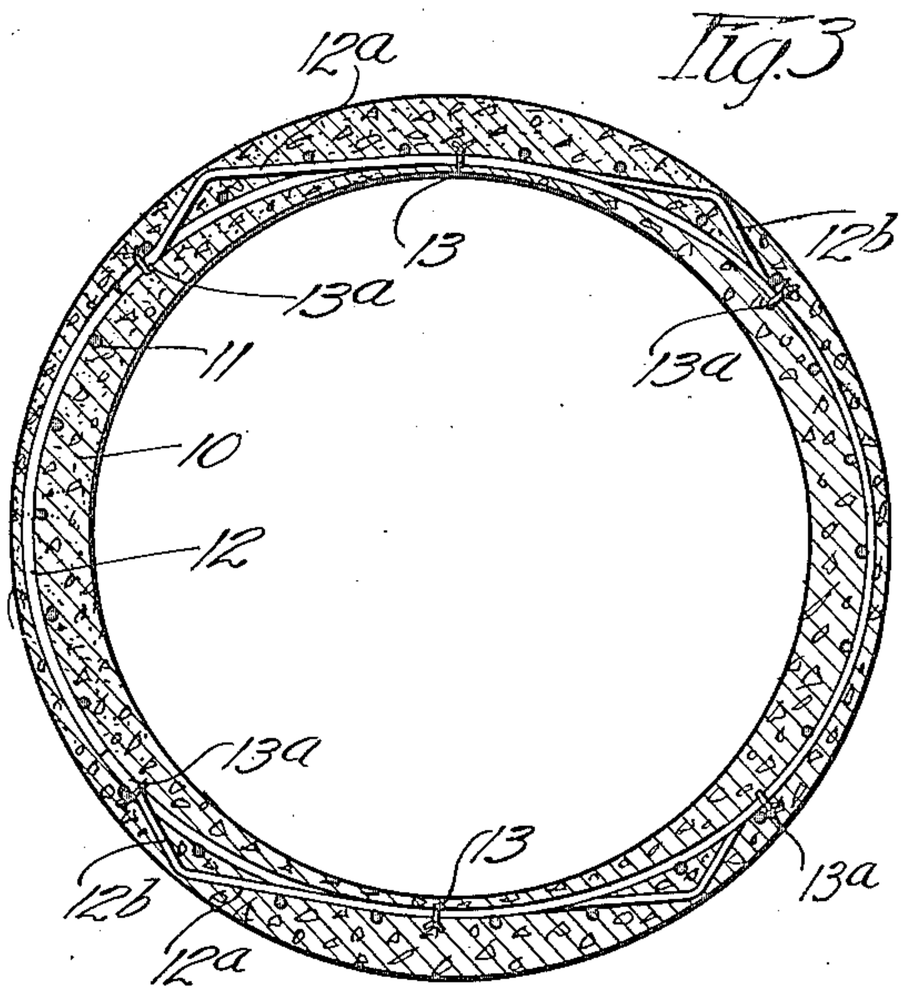


Fig. 3



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3 SHEETS—SHEET 2.

Fig 4

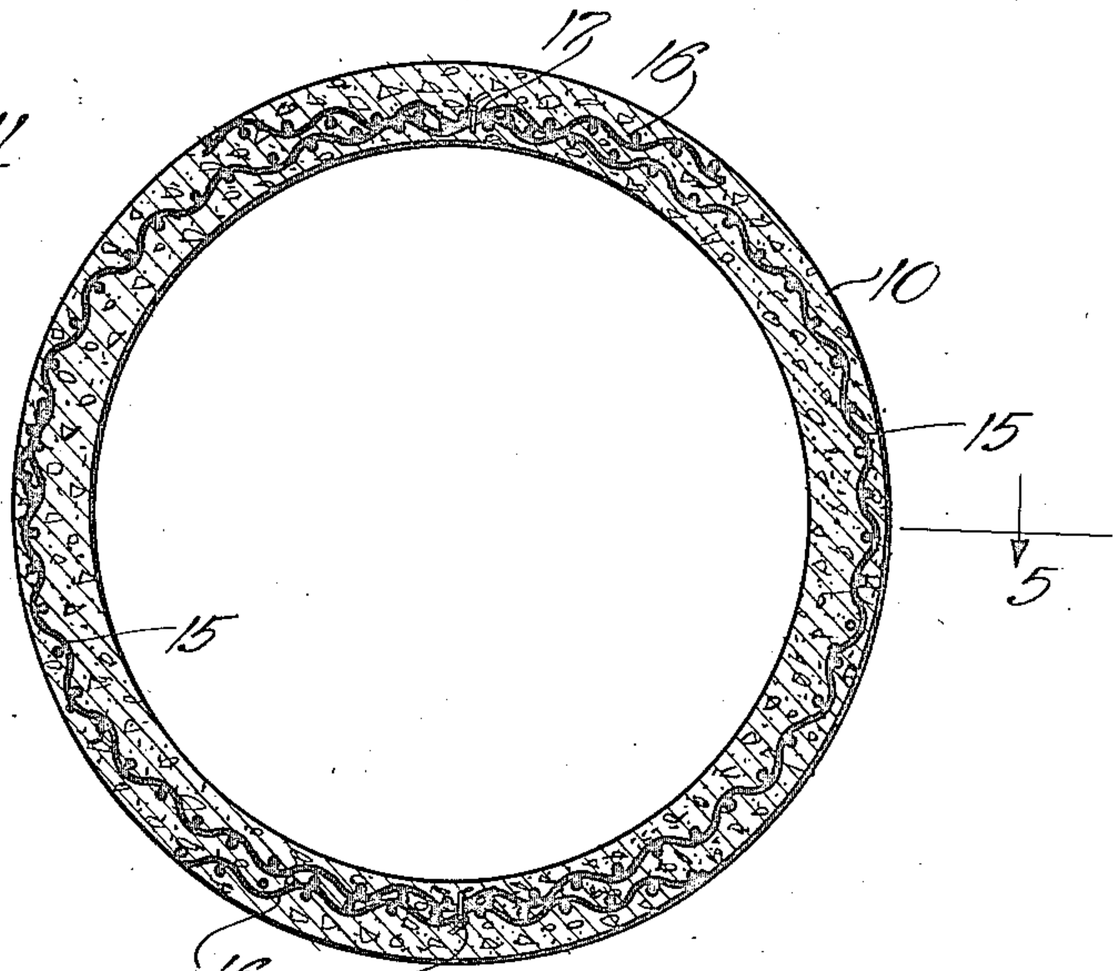
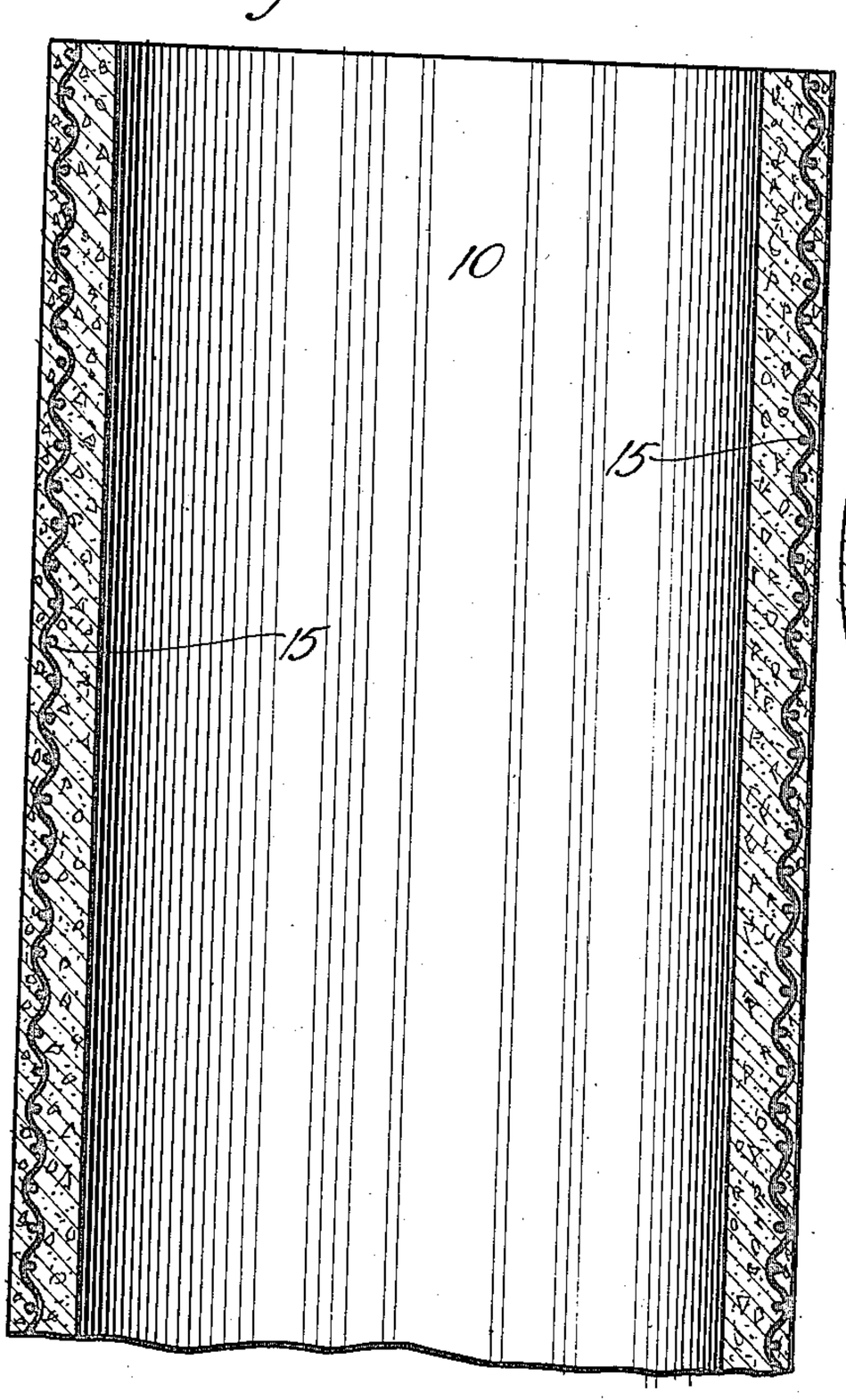


Fig 5



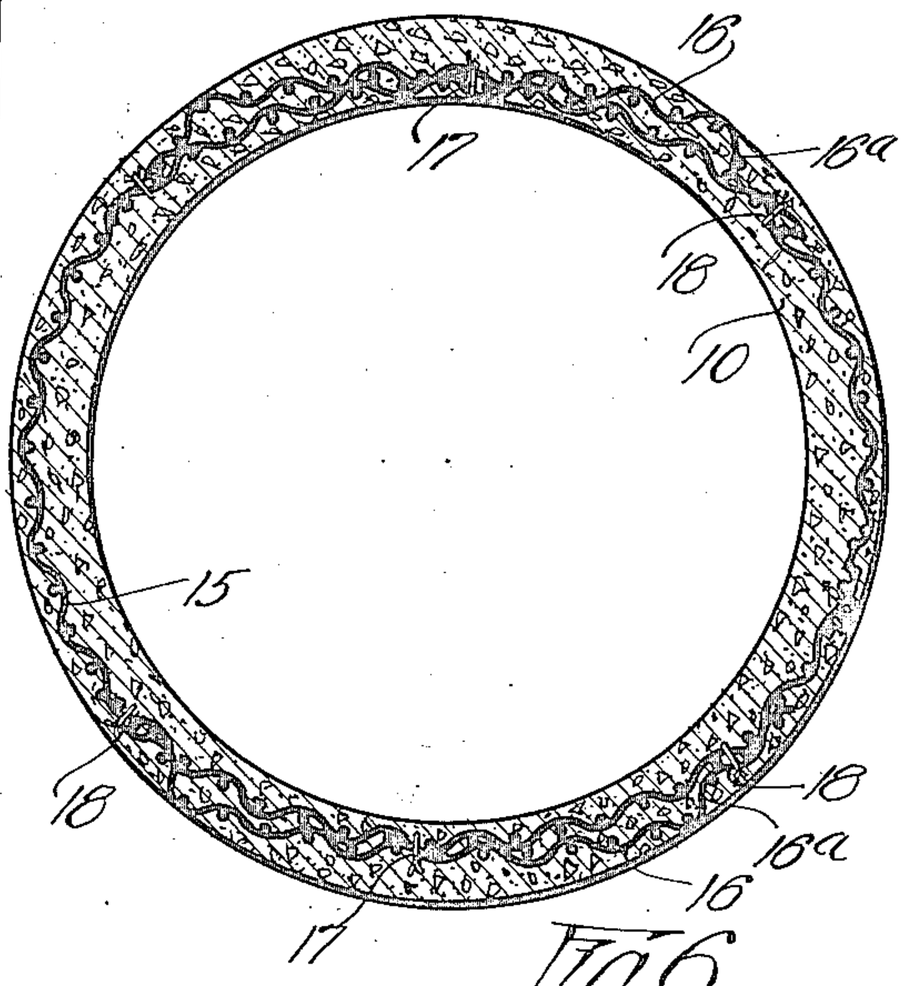


Fig 6

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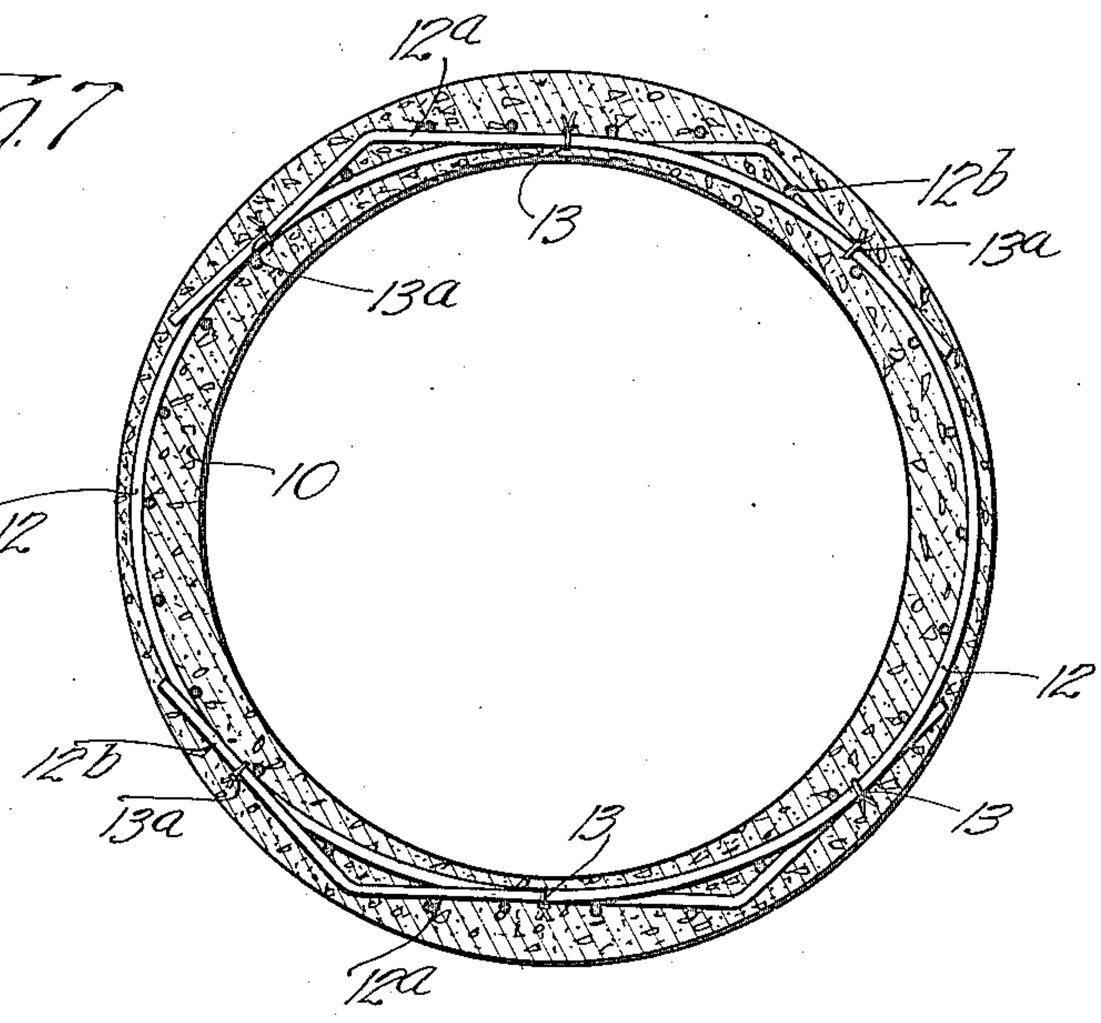
3 SHEETS—SHEET 3.

Fig. 7



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Patented Mar. 6, 1923. 1,447,421

UNITED STATES PATENT OFFICE.

PAUL KIRCHER, OF CHICAGO, ILLINOIS, ASSIGNOR TO MASSEY CONCRETE PRODUCTS CORPORATION, OF CHICAGO, ILLINOIS, A CORPORATION OF VIRGINIA.

REENFORCED-CONCRETE PIPE.

Application filed July 14, 1921. Serial No. 484,556.

To all whom it may concern:

Be it known that I, PAUL KIRCHER, a citizen of the United States, and resident of Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Reenforced-Concrete Pipe, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a reenforced concrete pipe, and particularly to concrete pipe suitable for use in railway culverts and for other purposes which require that the pipe be capable of resisting heavy forces transmitted thereto in lines substantially at right angles to the longitudinal axis of the pipe.

It is the object of my invention to provide a pipe which comprises a minimum of concrete and reenforcing material in its construction, but which is nevertheless capable of resisting such severe strains as may be imposed thereon in use.

Heretofore, the most successful styles of railway culvert pipe have been constructed in accordance with the teachings of United States Patent No. 709,794, granted to Walter C. Parmley, on September 23, 1902. My present invention enables me to retain all of the advantages of the Parmley construction, and in addition affords other important advantages never to my knowledge heretofore attained in a concrete pipe of the type to which my invention relates.

A detail description of my invention will best be understood when read in connection with the accompanying drawings in which—

Figure 1 is a transverse vertical section of a reenforced concrete pipe embodying my invention;

Figure 2 is a horizontal, longitudinal section taken on line 2—2 of Figure 1, certain portions of the concrete being broken away more clearly to reveal the nature of its reenforcement;

Figure 3 is a view similar to Figure 1, but illustrating a slightly modified embodiment of my invention;

Figure 4 is a view similar to Figure 1, but illustrating a modification of my invention wherein wire netting is used as the reenforcing material;

Figure 5 is a horizontal longitudinal section taken on the line 5—5 of Figure 4;

Figure 6 is a view similar to Figure 4, but illustrating a further modification of my invention, and

Figure 7 is a view similar to Figure 3, but illustrating a further modification of my invention.

Similar characters of reference refer to corresponding parts throughout the several views.

Referring first to Figures 1 and 2, at 10 I have illustrated a concrete pipe of circular transverse cross section. Imbedded in the pipe is a reenforcing cage which consists of a plurality of longitudinal bars 11—11, and a plurality of spaced pairs of transversely disposed bars 12—12. The bars 12—12 are substantially U-shaped, and it will be noted that the said bars 12—12 of each pair lie in immediate proximity one to the other, and are reversely disposed. The bars 12—12 of each pair are preferably tied together by twisted wires or other attachment means indicated at 13—13. In practice, the longitudinal and transverse bars will also be wired or be otherwise secured together at their crossing points. The tying together of the transverse bars and the longitudinal bars is resorted to merely in order to form a reenforcement cage which may be inserted in the pipe mold as a unit. After the cage has been imbedded in the concrete the tie wires have served their purpose.

It will be noted that the cage comprising the bars 11—11 and 12—12 is substantially elliptical in transverse cross-section, the major axis of the elliptical cage co-inciding with the horizontal plane passing diametrically through the pipe, and the minor axis of the elliptical cage coinciding with the vertical plane passing diametrically through the pipe. By virtue of the arrangement described, the ellipse circumscribing portions of each pair of bars 12—12 pass through regions of tension both in intrados and in extrados in accordance with the teachings of the Parmley patent aforesaid. The pipe illustrated is intended to withstand downwardly directed forces exerted thereon. When such forces are exerted on the pipe, regions of tension exist at and near the

inner surface of the pipe at top and bottom, and regions of compression exist at and near the outer surface of the pipe at top and bottom. Under the same conditions, regions of tension exist at and near the outer surface of the pipe at the sides thereof, and regions of compression exist at and near the inner surface of the pipe at the sides thereof.

I now call particular attention to the location and function of the end portions 12^a of each pair of U-shaped bars 12—12. The bar ends 12^a lie outside of and project away from the boundary of the ellipses circumscribed by the U-shaped bars of which they form parts. The points at which the U-shaped bars 12—12 of each pair cross, both at top and bottom, are located in regions of tension in intrados, but the bar ends 12^a project outwardly and away from such points and preferably extend into regions of compression in extrados. It is desirable, of course, that the pipe wall be made as thin as possible. Furthermore, in following the teachings of the Parmley patent, it is necessary that the bars 12—12 lie extremely close to the inner surface of the pipe at top and bottom. Downwardly directed pressure exerted upon the pipe tends to flatten the ellipses circumscribed by the several pairs of U-shaped bars 12—12. Thus, there is a decided tendency for the bars 12—12 to pull out of the concrete at the regions of tension in intrados. However, the several ends 12^a—12^a of the U-shaped bars are disposed so that in each case there is a very considerable thickness of concrete between the bar end and the inner surface of the pipe. The anchoring of the bar ends in portions of the concrete removed from the regions of internal tension minimizes the possibility of the bars being pulled out of the concrete at the regions of internal tension when the pipe is forced to sustain a heavy load.

The arrangement illustrated in Figure 3 differs from the arrangement shown in the preceding figures in that the bar extremities 12^a—12^a of the several pairs of transversely disposed U-shaped bars 12—12 are provided with offset portions or hooks 12^b—12^b. The hooks 12^b—12^b formed upon the ends of each U-shaped bar 12 terminate alongside of and are tied or secured to its associated bar 12 at points remote from the ends of the latter. The wires whereby the hook ends of each bar are tied to its associated bar are indicated at 13^a—13^a. It will thus be seen that in the arrangement of Figure 3, the bars 12—12 of each pair are tied directly together at six points instead of only at two points, as is the case in the arrangement shown in Figures 1 and 2. The arrangement of Figure 3 enables me to construct a much more rigid cage than is possible when the arrangement shown in Figures 1 and 2 is employed. Furthermore, the hook portions 12^b—12^b to a very considerable extent resist the sheering strains which, when the pipe is under load, exist in the concrete in the regions where the hooks 12^b—12^b are disposed.

It is sometimes desirable particularly in constructing small diameter pipe to employ wire screen as the means for reinforcing concrete against tensile strains. In Figures 4 and 5, I have illustrated an embodiment of my invention wherein wire screen is used as the reinforcing material. In these figures, reference character 10 indicates a concrete pipe of circular transverse cross-section, and numeral 15 indicates a wire screen cage of elliptical cross-section. Cage 15 extends continuously through regions of tension, both in intrados and in extrados in accordance with the teachings of the Parmley patent, hereinbefore mentioned. In order to prevent the possibility of the cage 15 being torn out of the concrete at the internal regions of tension, I provide a pair of wire netting strips 16—16, which are co-extensive with the cage 15, and are tangentially disposed relative thereto. Strips 16—16 contact with cage 15 along lines immediately above and below the longitudinal axis of the pipe, and are preferably tied (wired) or otherwise secured to the cage by attachment means indicated at 17—17. The lateral edges of the strips 16—16 extend from the internal regions of tension into regions of compression and serve the same functions as do the bar ends 12^a—12^a of the arrangement shown in Figures 1 and 2.

In Figure 6 I have illustrated a modification of the arrangement shown in Figures 4 and 5. In Figure 6, the lateral edges of the strip 16—16 are offset or turned toward the cage 15 and are tied or otherwise secured thereto by attachment devices indicated at 18. The offset lateral edges 18^a—18^a of the strips 16—16 correspond in location and function with the bar end hooks 12^b—12^b of the arrangement illustrated in Figure 3.

In the arrangement of Figure 7, the bar extremities 12^b of each bar 12 are disposed in lines tangential to the ellipse circumscribing portion of its associated bar. In some classes of work, this arrangement is preferable to that shown in Figure 3, wherein the portions 12^b of each bar are "hooked in" toward the ellipse circumscribing portion of the adjacent bar.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A reenforced pipe comprising a pipe body of initially plastic material, and a reenforcing cage embedded in the pipe body and lying adjacent to the outer surface of the pipe at substantially diametrically opposite points, and adjacent to the inner surface of the pipe at points between said opposite

points, and tension members associated with those portions of the cage which lie adjacent to the inner surface of said pipe and extending outwardly therefrom toward the outer surface of said pipe.

2. An article of manufacture comprising a pipe body of initially plastic material, and a reenforcing cage embedded in the pipe body and lying adjacent to the outer surface of the pipe at substantially diametrically opposite points and adjacent to the inner surface of the pipe at points intermediate said opposite points, and tension members associated with those portions of the cage which lie adjacent to the inner surface of the pipe and extending outwardly from the cage to points adjacent to the outer surface of the pipe body.

3. An article of manufacture comprising a pipe body of initially plastic material, and a reenforcing cage embedded therein, said reenforcing cage lying adjacent to the outer surface of the pipe at substantially diametrically opposite points and adjacent to the inner surface of the pipe at points substantially midway between said opposite points, and tension members associated with those portions of the cage which lie adjacent to the inner surface of said pipe, said tension members being disposed substantially tangential to the cage and extending outwardly therefrom toward the outer surface of the pipe body.

4. As an article of manufacture, a pipe body of initially plastic material reenforced by a plurality of pairs of tension members embedded therein, the tension members of each pair being substantially U-shaped and disposed side by side in reverse arrangement, and in immediate proximity one to the other, each of the U-shaped members of each pair having its middle portion positioned adjacent to the outer surface of said pipe and portions adjacent to the ends thereof positioned adjacent to the inner surface of said pipe, the ends of each of said U-shaped members extending outside of the other members of the pair.

5. As an article of manufacture, an initially plastic pipe body reenforced by a plurality of U-shaped tension members embedded therein, some of said U-shaped tension members being disposed reversely to other tension members, and each of said U-shaped members having a portion thereof adjacent to the outer surface of said pipe and two portions adjacent to the inner surface of said pipe, the ends of said U-shaped tension members extending beyond the portions adjacent the inner surface of the pipe outwardly toward the outer surface of the pipe in lines substantially tangential to the inner cylindrical surface of the pipe body.

6. As an article of manufacture, an initially plastic pipe body reenforced by a plurality of U-shaped tension members embedded therein, said tension members being disposed side by side in transverse vertical planes, each tension member being reversely arranged with respect to its contiguous tension members, each of said tension members having a portion adjacent to the outer surface of said pipe, and two portions adjacent to the inner surface of said pipe, the ends of said U-shaped tension members extending outwardly from the portions adjacent to the inner surface of said pipe toward the outer surface of the pipe body.

7. A reenforced concrete pipe comprising a circular pipe body of initially plastic material having embedded therein a plurality of pairs of U-shaped metal bars disposed in planes at right angles to the longitudinal axis of the pipe, the bars of each pair circumscribing an elipse, each bar having a portion thereof adjacent to the outer surface of the pipe and two portions adjacent to the inner surface of the pipe.

8. A reenforced concrete pipe comprising a circular pipe body of initially plastic material having embedded therein a plurality of pairs of U-shaped metal bars disposed in planes at substantially right angles to the longitudinal axis of the pipe, the bars of each pair being reversely arranged and disposed immediately adjacent one to the other, and having their ends crossing at substantially diametrically opposite points located near the inner surface of the pipe body, the middle portion of each of said bars lying adjacent to the outer surface of the pipe body.

9. A reenforced concrete pipe comprising a substantially circular pipe body of initially plastic material having embedded therein a plurality of pairs of U-shaped metal bars disposed in planes transverse to the longitudinal axis of the pipe, the bars of each pair being reversely arranged and disposed immediately adjacent one to the other, and having their ends crossing at points adjacent to the inner surface of the pipe body, each U-shaped bar passing through a region of tension adjacent to the outer surface of said pipe, and through two regions of tension adjacent to the inner surface of said pipe, the ends of each U-shaped bar being provided with offset ends which terminate at points adjacent to the other bar of the pair.

10. A reenforced concrete pipe comprising a circular pipe body of initially plastic material having embedded therein a substantially elliptical reenforced cage, said cage having portions adjacent to the outer surface of the pipe at substantially diametrically opposite points, and adjacent to the inner surface of the pipe at points substantially midway between said opposite points,

and tension members associated with said cage and extending outward from those portions of the cage which lie adjacent to the inner surface of the pipe, said tension members lying in planes substantially tangential to the cage.

11. A reenforced concrete pipe comprising a substantially circular pipe body of initially plastic material having embedded therein an elliptical reenforcing cage, said cage passing adjacent to the outer surface of said pipe at substantially diametrically opposite points and adjacent to the inner surface of said pipe at points substantially midway between said opposite points, and tension members associated with said cage and extending outwardly from those portions of the cage which lie adjacent to the inner surface of said pipe, said tension members lying in lines substantially tangential to the cage, the outwardly extending portions of said tension members terminating near the outer surface of the cage.

In witness whereof, I hereunto subscribe my name this 29th day of June, 1921.

PAUL KIRCHER.

Witnesses:
ALBIN C. AHLBERG,
EMILE J. BOURGEOIS.