Feb. 2, 1943. E. L. WESTWOOD 2,309,685

CULVERT

Filed Jan. 27, 1941 2 Sheets-Sheet 1

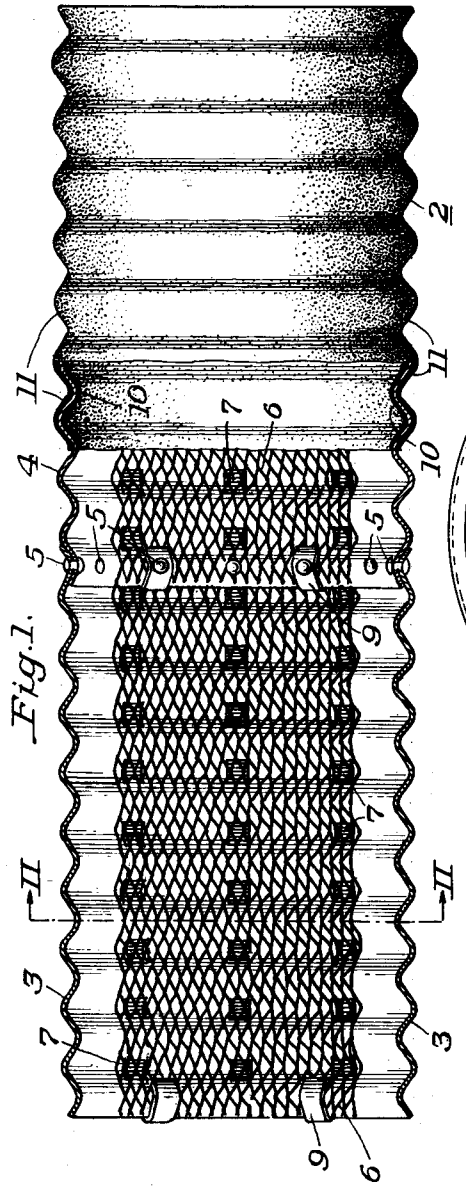


Fig. 1.

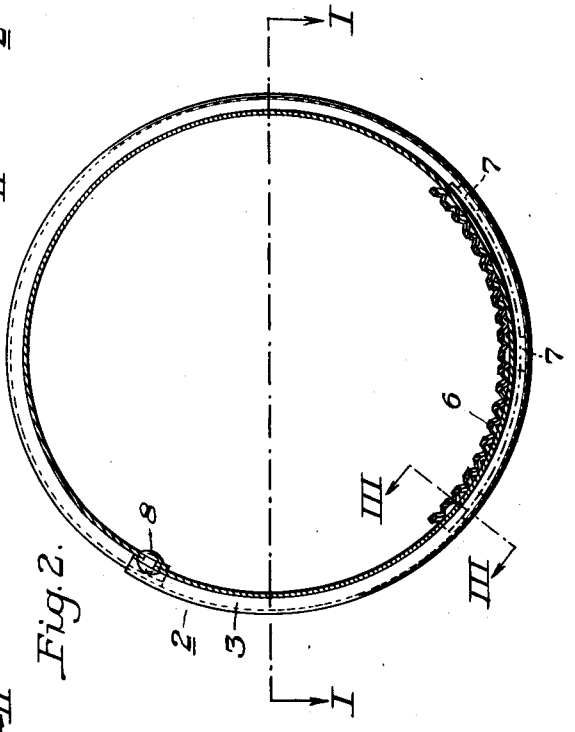


Fig. 2.

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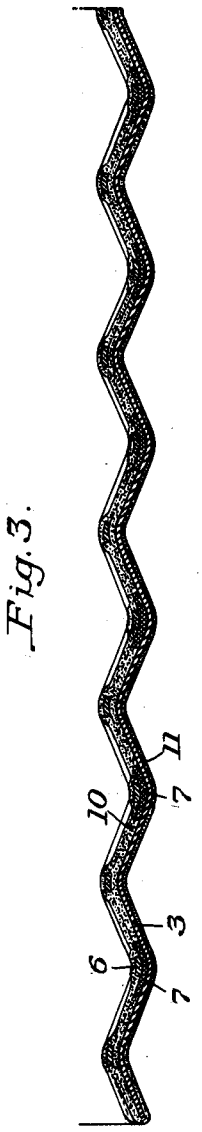


Fig. 3.



Fig. 4.

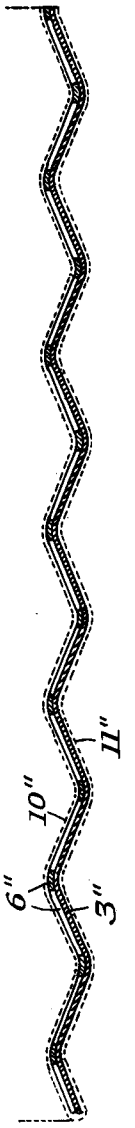


Fig. 5.

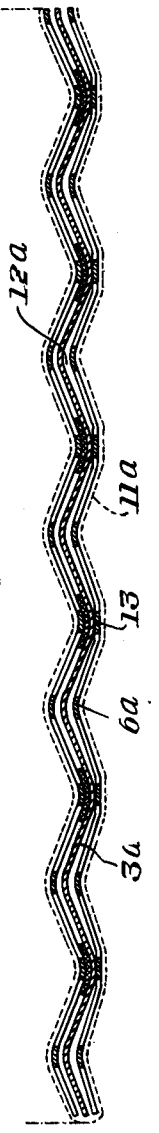


Fig. 6.

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2,309,685

UNITED STATES PATENT OFFICE

2,309,685

CULVERT

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Application January 27, 1941, Serial No. 376,065

9 Claims. (Cl. 138—70)

This invention relates to culvert and like pipe and particularly to pipe which is subjected to abrasion and corrosion in use. The invention relates more particularly to lined culvert pipe and still more particularly to corrugated metal pipe lined internally and externally or both. In certain of its more specific aspects the invention relates to an improved pipe having a novel and particularly useful abrasion resistant lining.

Lined culvert pipe is well known in the art. In its most common form such pipe is made of corrugated sheet metal with the corrugations extending circumferentially of the pipe. For years it has been customary to coat or line corrugated metal culvert pipe with bituminous material such as tar or asphaltic material to protect the metal against both corrosion and wear due to abrasion. Such lining has been applied both interiorly and exteriorly. However, such lining, particularly when applied internally, has not been found to most satisfactorily withstand abrasion. Efforts have been made to improve the abrasion resistance of corrugated metal pipe lined with bituminous material, such efforts including filling up the corrugations at the bottom of the pipe interiorly thereof with bituminous material to provide a smooth floor within the pipe, but all of such efforts have fallen short of the goal of a thoroughly abrasion resistant lined culvert pipe. The pipe having the corrugations at the bottom of the pipe filled up with bituminous material is not fully satisfactory because it is found that through wear and abrasion large chunks of bituminous material will be torn loose, exposing the inner surface of the metal pipe which then becomes subject to rapid corrosion. Another attempt to solve the problem involves the lining of a corrugated metal pipe with an iron shield and a felt pad bridging the corrugations, but such pipe does not have advantages commensurate with its greatly increased cost of manufacture.

I have made what I believe to be the first practical solution to the problem of providing lined abrasion and corrosion resistant pipe. I utilize metal pipe lined with plastic material, such, for example, as inert adhesive plastic material (I at present prefer to use bituminous material such as tar or asphalt), but I also apply to the pipe internally or externally or both a lining of preformed sheet material preferably metal of a particular kind which is inexpensive and easy to apply and highly effective in resisting abrasion and maintaining the integrity of the plastic lining. In its preferred form when adapted for use as culvert pipe my pipe comprises corrugated metal pipe which is preferably lined both internally and externally with bituminous material. In addition to the bituminous material, however, I preferably provide at at least the lower portion of the pipe internally thereof an additional lining of preformed sheet material which is preferably foraminous and at least partially embedded in the bituminous lining material. I find that metal and particularly expanded metal is particularly advantageous as the lining material. It assists in bonding the bituminous lining material to the pipe and also offers superior abrasion resistance. I find that the bituminous material forming the inner facing or surface of the pipe exhibits a markedly reduced tendency to spall or crack away when my additional metallic lining is employed. Moreover, after my pipe has been in use for a considerable time and the inner portion of the bituminous material has worn away the metallic lining material then offers direct resistance to abrasion internally of the pipe while bituminous material still remains to protect the inner surface of the pipe proper against both corrosion and abrasion. I also find that superior results are obtained by at least partially slightly spacing the metallic lining from the inner pipe surface, as this seems to provide for a more firm bond between the metallic lining and the bituminous lining.

Other details, objects and advantages of the invention will become apparent as the following description of certain present preferred embodiments thereof proceeds.

In the accompanying drawings I have shown certain present preferred embodiments of the invention, in which—

Figure 1 is a top plan view partly in central horizontal cross section taken on the line I—I of Figure 2 through a culvert pipe.

Figure 2 is a vertical transverse cross-sectional view taken on the line II—II of Figure 1 but to enlarged scale;

Figure 3 is a longitudinal cross-sectional view taken on the line III—III of Figure 2 but extending through only a portion of the length of one of the pipe sections;

Figure 4 is a somewhat diagrammatic longitudinal cross-sectional view showing a modified structure;

Figure 5 is a view similar to Figure 4 showing a further modified structure; and

Figure 6 is a view similar to Figure 4 showing a still further modified structure.

Referring now more particularly to the draw-

ings, there is shown in Figure 1 a culvert pipe 2 comprising two sections 3 and 4 connected together by rivets 5. The sections 3 and 4 are preferably alike and any convenient number of such sections may be joined together to make a culvert pipe of desired length. Each section comprises corrugated metal, as iron, bent into pipe form and having a bituminous coating. The coating may be internal only or both internal and external or it may cover only the lower portion of the inside of the pipe whether or not applied to the outside. At the lower portion of the interior of the pipe there is provided a metallic lining portion 6 which in the form shown is made of expanded metal. For convenience the entire section 3 is shown with the metallic lining portion applied but without any bituminous coating, as is also the left-hand portion of the section 4. An intermediate portion of the section 4 is shown in cross section with bituminous coating material applied both internally and externally and the right-hand portion of section 4 is shown in plan with the bituminous coating material applied.

The metallic lining portion 6 is preferably corrugated so as at least partially to interfit with the corrugated metal forming the body of the culvert pipe. In the structure shown in Figures 1, 2 and 3 the lining portion 6 is provided with corrugations of the same depth and width as the corrugations of the metal forming the pipe body. Spacers 7 are provided at intervals and lie between the pipe body and the lining portion 6 whereby to space the lining portion from the corrugated metal of the pipe body. The spacers may be of felt or any other suitable material.

The lining portion 6 is preferably at least partially embedded in bituminous material applied internally of the pipe. Preferably the lining portion is first applied and a predetermined number of sections are connected together, after which the pipe comprising said connected sections is dipped in bituminous material to apply the bituminous coating. While I prefer to coat the entire inside and outside surface of the pipe this is not in all cases essential and only the lower portion of the inside of the pipe may be coated.

The lining portion 6 preferably covers approximately one fourth of the internal circumference of the pipe. It is positioned so that when the pipe is laid the lining portion will be at the bottom as shown in Figures 1 and 2. Bituminous material is applied to the portion of the pipe covered by the lining portion 6 so that said lining portion becomes largely embedded in the bituminous material. Since the lining portion 6 is spaced from the corrugated metal of the pipe body the bituminous material, which is preferably applied hot and in comparatively fluid condition, can pass through the spaces in the lining portion 6 and lie between the lining portion and the metal of the pipe body as well as within the openings in the lining portion and on top of the lining portion. The composite lining of bituminous material and foraminous metal provides an especially strong and durable culvert pipe. The lining portion 6 assists in maintaining the bituminous lining material in place and prevents portions of it from breaking off. When the innermost bituminous material lying atop the lining portion 6 has been worn away the metallic lining material serves to protect the metal of the pipe body from abrasion. At the same time the bituminous material lying between the lining portion 6 and the corrugated metal of the pipe body and within the openings in the lining portion 6 protects the metal of the pipe body both from corrosion and from wear.

Each of the sections 3 and 4 is formed out of corrugated sheet metal which is curved and riveted longitudinally by rivets 8. Preferably one section is thus riveted, the spacers 7 applied therein and the lining portion 6 applied over the spacers. The lining portion 6 is held in place by metal clips 9 each of which embraces one end of the corrugated metal pipe and the lining portion 6. Then the next section is applied to the first section by applying the spacers and the lining portion 6 in the former and bending the same up about the end of the first section and riveting the two sections together circumferentially by rivets 5 as shown in Figure 1. In doing this riveting rivets are passed through the clips 9 as shown. I preferably space the rivets about six inches apart circumferentially of the pipe in making a circumferential joint between two adjacent sections. After the desired number of sections have thus been formed up and riveted together with the lining portion 6 in place the pipe thus made is coated to the extent desired with bituminous material. As above pointed out, the coating may be applied only internally over the lining portion 6 or it may be applied to the entire interior of the pipe or it may be applied to the entire interior and exterior of the pipe as is preferred. Likewise, although I prefer to employ the lining portion 6 only at the lower portion of the pipe, such portion may be applied over the entire interior of the pipe or any portion thereof as desired. The bituminous internal coating is designated by reference numeral 10 and the bituminous external coating by reference numeral 11.

Figure 4 shows more or less diagrammatically a modified structure employing corrugated metal 3' and a corrugated lining portion 6' of expanded metal without any spacers corresponding to the spacers 7. The corrugations on the lining portion 6' are of the same width as but of greater depth than the corrugations of the metal 3' so that the corrugations of the portions 3' and 6' interfit as shown in Figure 4 and at the same time provide spaces 12 therebetween by reason of the difference in the height of the respective corrugations. The lining portion 6' is otherwise applied similarly to the lining portion 6 of the structure of Figures 1, 2 and 3 and the bituminous coating material is applied as above explained. The lower dotted line 11' in Figure 4 indicates approximately the surface of the outer bituminous coating and the upper dotted line 10' indicates approximately the surface of the inner bituminous lining.

Figure 5 shows a structure which is to all intents and purposes identical with the structure of Figure 3, but with the spacers 7 omitted. In Figure 5 the corrugated metal pipe body is shown at 3'', the expanded metal lining portion at 6'', the surface of the inner bituminous lining at 10'' and the surface of the outer bituminous lining at 11''. I find that the structure of Figures 3 and 4, in which there is space between at least portions of the metallic lining and the corrugated metal pipe body are somewhat more durable than the structure of Figure 5, but the latter is satisfactory for many uses and is a great improvement over the lined corrugated culvert pipe heretofore available.

Figure 6 shows a further modified structure in which the corrugated metal pipe body is shown at 3a, the pipe being lined and reinforced both

internally and externally. As in the case of Figures 3 and 4 the inner face of the pipe is at the top of Figure 6 and the outer face of the pipe is at the bottom of the figure. The inner face of the pipe shown in Figure 6 is identical with the inner face of the pipe shown in Figure 3. However, the outer face of the pipe shown in Figure 6 is different from the outer faces of the pipes shown in any of the other figures in that it is both reinforced and lined. I provide an outer expanded metal lining portion 6*a* which is corrugated with corrugations of the same width as the corrugations of the pipe body 3*a* but of less depth than the corrugations of the pipe body. Moreover, where the lining portion 6*a* contacts the crests of the corrugations of the pipe body 3*a* as at 13 the expanded metal is flattened out for a short distance as shown in Figure 6. This provides the finished culvert pipe with substantially cylindrical projecting portions at intervals therealong. The surface of the outer bituminous lining in Figure 6 is shown at 11*a*. This lining fills the openings in the expanded metal 6*a* and also the spaces 12*a* between the pipe body and the expanded metal.

The longitudinal joints in adjacent pipe sections are preferably staggered at alternate sides of the upper portion of the pipe. This breaks the longitudinal joint and keeps such joint at the upper portion of the pipe where it is ordinarily above the level of liquid flowing in the pipe. While I prefer to use expanded metal as the preformed sheet material for reinforcing and protecting the pipe, I may use metal in other forms, as, for example, woven or welded wire or other open metallic fabric or I may use material other than metal, such, for example, as molded material such as Bakelite. The pipe sections are, as above indicated, preferably riveted together, but they may be otherwise connected together, as, for example, by welding or by the use of connecting bands or other connecting means. Similarly the preformed sheet material may be connected with the pipe otherwise than by riveting.

While I have shown and described certain present preferred embodiments of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

I claim:

1. Corrugated pipe having a lining comprising preformed corrugated sheet material, spaced apart individual spacers spacing the material of the lining from the metal of the pipe and plastic material at least partially covering the material of the lining.

2. Corrugated pipe lined with preformed corrugated sheet material having corrugations of substantially the same width as but different depth than the corrugations of the pipe and plastic material in which the material of the lining is at least partially embedded.

3. Corrugated pipe comprising sections riveted together end to end, the pipe having preformed foraminous sheet material lining, holding means for holding the lining to the pipe during manufacture, at least some of the rivets which hold the sections together passing through said holding means, and plastic material applied to the sheet material.

4. Corrugated pipe having a lining comprising preformed corrugated foraminous sheet material, spaced apart individual spacers spacing the material of the lining from the metal of the pipe and plastic material disposed between the lining and the pipe and also disposed within the openings in the lining.

5. Conduit comprising an outer corrugated metal pipe, an inner corrugated metal lining, the pipe and lining being fastened together with the corrugations thereof interfitting, and plastic material in which the lining is at least partially embedded.

6. Conduit comprising an outer corrugated metal pipe, an inner lining of expanded metal, said lining being also corrugated, the pipe and lining being fastened together with the corrugations thereof interfitting, and plastic material in which the lining is at least partially embedded.

7. Corrugated pipe lined with preformed corrugated foraminous sheet material having corrugations of substantially the same width as but different depth than the corrugations of the pipe and plastic material disposed between the lining and the pipe and also disposed within the openings in the lining.

8. Conduit comprising an outer corrugated metal pipe, an inner expanded metal lining spaced from the inner crests of the corrugations of the pipe, fastening means holding the lining to the pipe and a single mass of plastic material both filling the interstices in the expanded metal and extending within the corrugations of the pipe.

9. Corrugated pipe lined with preformed corrugated expanded metal having corrugations of substantially the same width as but different depth than the corrugations of the pipe and plastic material in which the expanded metal lining is at least partially embedded.

EDWARD L. WESTWOOD.