Aug. 8, 1944. G. E. SHAFER 2,355,336

REINFORCED WOODEN CULVERT AND THE LIKE

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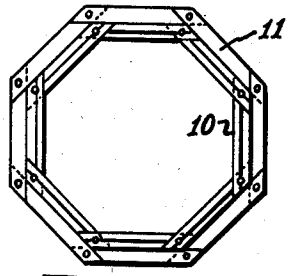


FIG. 1.

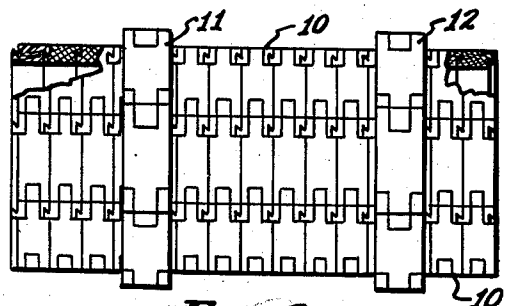


FIG. 2.

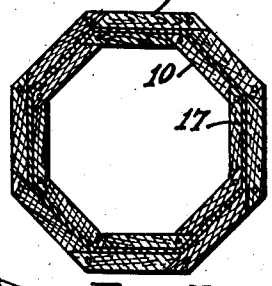
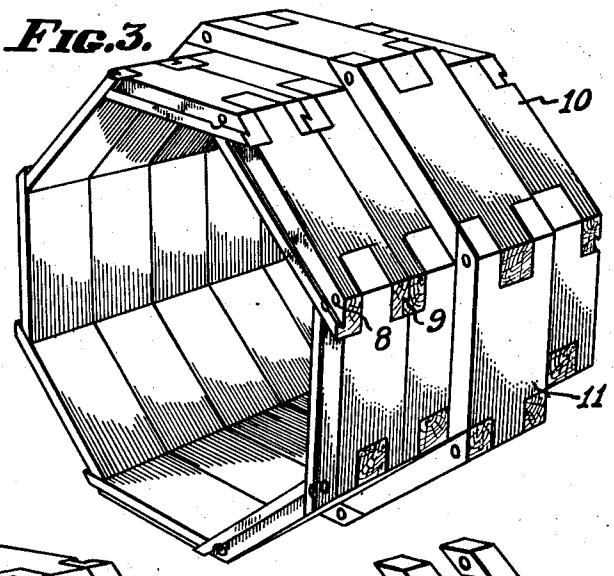


FIG. 7.

FIG. 3.



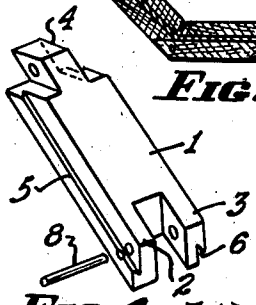


FIG. 4.

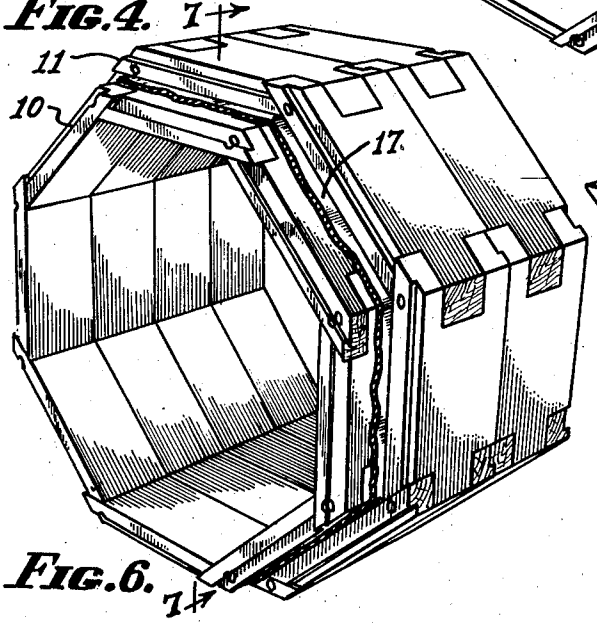


FIG. 6.

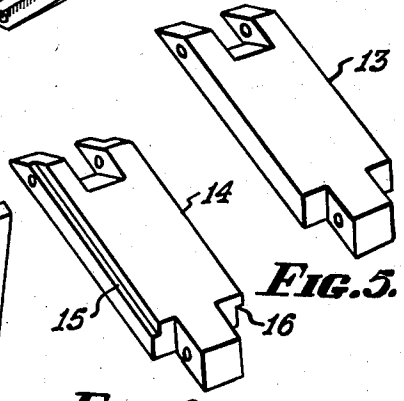


FIG. 5.

FIG. 8.

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UNITED STATES PATENT OFFICE

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REINFORCED WOODEN CULVERT AND THE LIKE

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Application July 2, 1942, Serial No. 449,433

6 Claims. (Cl. 138—79)

There has recently been considerable commercial interest in wooden culverts or arch-shaped structures of particular types, made up of wooden elements in which the grain is directed transverse to the major axis of the culvert, and which elements are formed so as to be interlocking in such a way as to resist compressive stresses as well as crushing loads. These structures are so made that they are capable of acting like the familiar corrugated metal culverts of commerce, in that they are elastic and can distort under top loads in a fill, seeking side support, until the pressures about the periphery of the culvert are substantially equalized. Under conditions of substantially equalized pressures, the ultimate strength of the culvert is at its maximum. Experience has shown that, due to these factors and others, such as the possibility of making the wooden elements from scrap lumber or other odd pieces of relatively low cost (since the elements are short), it is possible to make wooden culverts at costs no greater than those of the metal structures and having strengths equal to and in many cases in excess of the strengths of the metal structures. This, however, is not true in all sizes. In the making of metal structures, it is usual to employ a standard gauge of metal and a standard pitch and depth of corrugation for culverts of varying sizes up to a certain maximum diameter. Beyond this, it is usual to employ a heavier gauge of metal or a different pitch and depth of corrugations, or both. Metal is readily and accurately formed in a plurality of gauges; but while it is true that wood can be cut to substantially any thickness desired, yet the manufacture of culverts from special thicknesses and grades of lumber adds unduly to the raw material cost. It is far better to be able to make culverts of all commercial sizes (except the very small ones), from lumber of standard thickness, and cut into elements of the same cross-section and the same end configurations, but differing from each other only in the lengths of the individual elements. In this way, a standard and cheap raw material may be employed, and the same cutters and other elements of productive machinery used for all sizes of culverts. Hitherto, however, this has not been possible. It is an object of my invention to provide a structure in which it may be done and in which, in spite of the use of standard widths and thicknesses of lumber, the amount of wood in any given culvert length may be quite accurately proportioned to the diameter of the culvert and the load which it is to sustain, and all without the use of other than standard elements.

There are many ancillary objects attained by my invention such as the provision of water-tight conduits, the provision of improved ways of joining prefabricated conduit sections and the like. These and other objects of my invention which will be set forth hereinafter, or will be apparent to one skilled in the art upon reading this specification, I accomplish by that certain construction and arrangement of parts, of which I shall now describe certain exemplary embodiments. Reference is made to the accompanying drawing wherein

Figure 1 is an elevational end view of a culvert constructed in accordance with my invention.

Figure 2 is an elevational side view thereof.

Figure 3 is a perspective view.

Figure 4 is a perspective view of one of the individual wooden elements.

Figure 5 is a perspective view of such an element without side interengagement means.

Figure 6 is a perspective view of a culvert or conduit construction which not only is reinforced throughout its length, but also incorporates a membrane.

Figure 7 is a sectional view thereof taken along the line 7—7 of Figure 6.

Figure 8 is a perspective view of an element having a side rabbet.

A culvert of the type referred to hereinabove, and the elements which go to make up that culvert, are illustrated and described in the copending application of Spaulding and Robertson, entitled Culverts, Serial No. 432,434, filed February 26, 1942. I preferably employ this structure and these elements at least for the main or interior pipe or conduit form of my structure, a particular advantage being that the outer surface of the culvert or conduit formed from such elements is smoothly polygonal in form and devoid of protuberances. For the reinforcement, I may employ the same elements or similar ones, cut to longer lengths. But I also may employ such elements as are shown and described in my copending application entitled Wooden culvert construction, Serial No. 449,432, filed July 2, 1942, now Patent # 2,334,846, dated November 23, 1943.

Briefly, in the practice of my invention, I provide a wooden culvert or conduit, preferably of the type or types shown in the said copending application of Spaulding and Robertson, of individual elements cut from lumber of standard width and thickness. The culverts are of polygonal cross-section and have more than four

sides. The type of culvert illustrated in the drawing of the present application are octagonal, but it will be understood that this particular polygonal form is not a limitation upon the present invention.

In making up such a basic pipe or conduit, I am not limited to any particular width and thickness of lumber, being able to employ any width or thickness which is commercially available in large enough quantities to make the setting of the cutting tools worthwhile. Thus, where special widths and thicknesses are available, they may be used; but in normal operation, and in view of the fact that the individual elements may readily be cut from scrap or random lengths or short pieces of lumber of relatively low first cost, in commercial operation, the greater part of the lumber used will be of standard width and thickness. Thus, a convenient and universal raw material comprises the so-called 2 x 4's and 2 x 6's of commerce, which, as is well known, are not precisely of those dimensions. However, it has been found in tests, by way of example, that wooden culverts of polygonal cross-sections may be made from the 2 x 4's of commerce with adequate strengths up to about 40 inches in diameter, but that larger culverts could advantageously be made of heavier lumber. As indicated, such heavier lumber is not usually commercially available, nor is it possible in most sizes to go to the next heavier commercial grade of lumber. For example, it would not be commercially feasible to make a culvert which was only slightly in excess of 40 inches of so-called 4 x 4 lumber, not only because such lumber is more expensive and is not as readily available, but also because the weight of lumber and the inherent strength of the structure would be excessive for such culverts.

I have found that culverts of the type under discussion may be reinforced by the use of added structures, where these structures are of such character as not to inhibit the flexing of the culverts under load. I have further found that where less additional strength is required than would be obtained from an added structure of the full length of the original or basic culvert, reinforcing, ring-like structures may be added at intervals, and that such structures will be effective in increasing the over-all resistance of the culvert to top loads and to compressive strains. Where strength requirements and economy permit, the added structure may be co-extensive with the main culvert and still the combined structure may be made more cheaply than a single unitary conduit of double the thickness of the lumber.

In Figure 4, I have shown an element of the type similar to that described in the said copending application of Spaulding and Robertson and comprising a body 1 having spaced tongues 2 and 3 at one end and a tongue 4 at the other. The width of the tongue 4 is less than the width of the body and the spacing between the tongues 2 and 3 is sufficient to accommodate the tongue 4 of another and similar section. The planes, along which the body is cut to form the shoulders adjacent the tongues and the ends of the tongues themselves, bear an angularity to the plane of the outer or inner surface of the body determined by the angularity between the sides of that polygonal figure which is chosen for the culvert cross-section; and the length of the tongues is such that when the elements are interengaged to form a circumferential ring of the culvert, the tongues will not project beyond the surface of adjacent elements. At the sides of the bodies 1 form undercut or dovetailed rabbets 5 and 6, one of which is directed outwardly and the other of which is directed inwardly.

Elements such as illustrated in Figure 4 may be interengaged, as shown in Figure 3, to make ring-like structures in which the several tongues are interengaged, and in which dowels or pins 8 pass through perforations in the tongues to maintain the assembly. Moreover, adjacent ring-like structures may be built up in endwise-engaged fashion through the interlocking of the rabbets, as illustrated at 9 in Figure 3.

The structure is such that any two elements resist very strongly any forces tending to increase the angularity between them, and the interlocking of the members is such as to resist very strongly compressive stresses exerted on the peripheries of the several rings. Yet, the rings themselves, and by consequence the entire length of the culvert or conduit so built up, are resilient and are capable of slight deflection under top load whereby to seek side support.

In the fashion indicated, I build up a basic or fundamental pipe or conduit 10 in Figures 1, 2 and 3. Where the diameter of the structure is such that additional strength is required, I add to the basic pipe or conduit, some reinforcing rings. While from the standpoint of strength it would be possible to place these rings inside the basic conduit, where interspaced rings are employed these would interfere with the flow of water through the conduit. As a consequence, the reinforcement is most advantageously built up on the outside of the culvert in the form of rings 11 and 12. These rings may be formed of elements similar to the elements just described and having the same interengagement. They need differ from the elements shown in Figure 4 only in the matter of length and will be accurately cut to size, so that, when properly interengaged, they will form rings 11 or 12 in tight engagement with the periphery of the basic conduit. The number of rings required will depend upon the additional strength found necessary in a culvert of any given diameter. As the diameter of the basic culvert increases, the number of rings may be increased and their spacing diminished. Where interspaced rings are employed, it is not necessary to provide the individual elements with side-interengagement means, and elements in the form shown at 13 in Figure 5 may be employed. Even where an entire outer conduit is to be built up in the manner indicated over the outside of the basic conduit, elements without side-interengagement means may be employed since the inner conduit will serve to maintain the integrity of the outer conduit. Where some interengagement is desired, a simpler construction and one somewhat easier to assemble is illustrated at 14 in Figure 8, where the sides of the body are provided with square rabbets 15 and 16. However, it is possible to employ the elements illustrated in Figure 4, since these are capable of assembly about a basic conduit, with the interengagement of the rabbets as previously described.

As indicated, the rings or complete overstructure should have a relatively snug fit on the basic conduit. I have ascertained that their reinforcing effect is best under these circumstances and that the reinforcing effect of a loose ring is not as effective. It would be possible to spike the

outer rings to the basic conduit, but this has not been found necessary.

In instances where an overstructure, co-extensive with the basic conduit, is to be employed, it is possible to position a membrane or the like between the two structures. Such a membrane is illustrated at 17 in Figure 6. It may be in the nature of a mastic coating covering the basic conduit, or it may be in the nature of a wrapping of tarred paper, felt, or cloth, or any webs saturated or treated with any suitable proofing substance. The use of a membrane is particularly desirable where a liquid-tight conduit is required. Instances of this character are not limited to the transportation of fluids under pressure, although they exist in that field. Frequently, in drainage problems, it is desired that the drainage conduit be water-tight to prevent the water it carries from seeping into hillsides, for example, where earth slides might be expected. Where a complete overstructure is employed with an inner or basic conduit in prefabricated sections, the structure provided by my invention furnishes an advantageous way of joining adjacent sections. The overstructure may be terminated short of the end of the basic conduit at one end of the section, and may overlap at the other. This gives a bell and spigot construction in which the joints may be easily interengaged.

As indicated above, I am not limited in my overstructures to the use of elements such as those shown in Figures 4, 5 and 8, but may employ elements such as those shown in my copending application. Whatever elements are employed may, of course, be treated as desired with wood-preserving and water-proofing agents. It will be evident that the principles of my invention may be applied to arch-shaped culverts, in which reinforcement for the arch, as distinguished from the base is usually all that is required, although reinforcement may be applied to both if desired.

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

1. In a culvert or conduit structure, a resilient basic conduit, and a reinforcing overstructure therefor, comprising a series of tongued elements with their tongues crossing and interengaged to form a structure in which an increase in the angularity between elements is strongly resisted, the tongues of one element resting on end portions of other elements conformed to the angularity of interengagement, said elements being interengaged one with another to form a ring superposed upon and extending circumferentially of the basic conduit and closely conforming thereto.

2. The structure claimed in claim 1 wherein the basic conduit bears a plurality of said reinforcing overstructures spaced from each other along the length of the basic conduit, the number and spacing of said overstructures being such as to provide an increase of strength proportioned to the diameter of said basic conduit.

3. The structure claimed in claim 1 wherein there are a plurality of said reinforcing overstructures arranged in side-by-side relationship so as to form substantially an additional conduit overlying and concentric with said basic conduit.

4. The structure claimed in claim 1 wherein said basic conduit is formed of individual elements having substantially the same circumferential interengagement as characterizes the elements of said reinforcing overstructure.

5. The structure claimed in claim 1 wherein said basic conduit is formed of individual elements having substantially the same circumferential interengagement as characterizes the elements of said reinforcing overstructure, and in which there are a plurality of said overstructures arranged in side-by-side relationship to provide substantially an outer conduit superposed on said inner conduit and closely conforming thereto.

6. A culvert or like structure formed of individual wooden elements arranged in the direction of their length circumferentially of said culvert, said elements having tongues at their ends and said tongues being in crossing interengagement such that said elements form the sides of a polygonal figure of more than four sides, the tongue of one element resting on an end of another element configured to the angularity of the interengagement, and the interengagements of the ends of said elements being such as strongly to resist forces tending to increase their angularity to each other, such structure being of a diameter such that the thickness of the individual elements does not provide a desired strength, and a reinforcement for said culvert comprising an overstructure of similar elements in similar interengagement, differing from the first mentioned elements primarily in length, said overstructure being in close conformity to the first mentioned structure.

GEORGE E. SHAFER.