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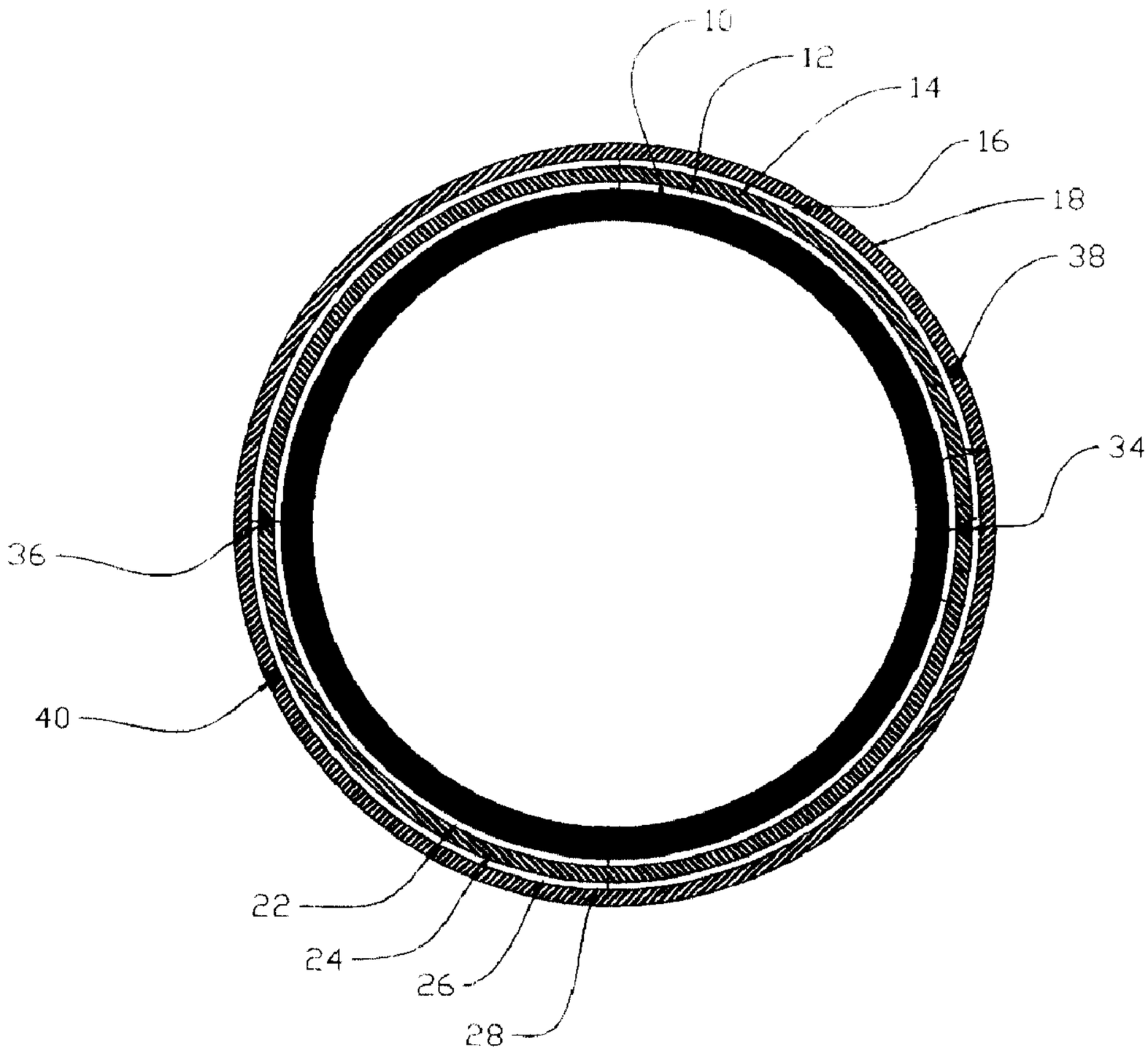
(54) Titre : METHODE DE REPARATION D'UN TUYAU A L'AIDE D'UN MANCHON PRECONTRAINT

(54) Title: METHOD OF REPAIRING A PIPE USING A PRE-STRESSED SLEEVE



(57) Abrégé/Abstract:
A method of repairing a pipe using a pre-stressed sleeve. The method includes a step of forming a repair sleeve of a required thickness on a pipe by sequentially applying more than one independent pre-stressed full encirclement sleeve layer.

ABSTRACT OF THE DISCLOSURE

A method of repairing a pipe using a pre-stressed sleeve. The method includes a step of forming a repair sleeve of a required thickness on a pipe by sequentially applying more than one independent pre-stressed full encirclement sleeve layer.

TITLE OF THE INVENTION:

Method of repairing a pipe using a pre-stressed sleeve

FIELD OF THE INVENTION

The present invention relates to a method of repairing a pipe using a pre-stressed sleeve.

BACKGROUND OF THE INVENTION

Oil and Gas pipelines commonly develop defects on the exterior wall of the pipe. This may be result of corrosion pitting or other types of defects as dent, gouge, groove or crack. A full encirclement sleeve is the most widely used method of repair, as it is cost effective and less disruptive than removal of a pipe section. To date the sleeve is either pre-stressed onto the pipe and not welded to the pipe or completely welded to the pipe to form a pressure vessel. The use of a pre-stressed sleeve is preferable, as welding to pipe can create an environment where hydrogen stress cracking occurs and will result in the failure of the pipe. There have been numerous examples of pipe failures due to welding and hydrogen stress cracking. Examples of pipeline repair sleeves are described in United States Patents 5,123,451 (Savard 1992) and 5,199,464 (Savard 1993). An example of a pipe clamp suitable for use in applying the repair sleeves is described in United States Patent 5,012,842 (Savard 1991).

A problem is currently being experienced in pre-stressing sleeves, where the wall thickness approaches or exceeds one inch. A sleeve with a one inch wall thickness is rigid and, consequently, difficult to pre-stress.

SUMMARY OF THE INVENTION

What is required is an alternative method of repairing a pipe with a pre-stressed sleeve.

According to the present invention there is provided a method of repairing a pipe using a pre-stressed sleeve. The method includes the step of forming a repair sleeve of a required thickness on a pipe by sequentially applying more than one independent pre-stressed full encirclement sleeve layer.

The invention, as described above, advances the pipeline repair technique by producing contact pressure between pipe and sleeve layers mounted one inside the other. After longitudinal welds are applied, a contact pressure between sleeve layers and pipe is produced and is called the shrink fit pressure. The magnitude of this pressure and stresses produce by it can easily be calculated by using equation from any engineering handbook. Composing the repair sleeve from several thin layers instead of one thick sleeve, provides advantages of better fit and easier control of stresses in pipe and the layered sleeve because it act in unison with each other and line pipe. Alternating length of individual layers (making subsequent layers shorter) provides additional benefits by controlling secondary bending stresses at ends of sleeve that are critical especially in applications where line pipe have thinner wall. Layers of the repair sleeve are not welded to each other or to the line pipe by longitudinal welds. External force of devices used for sleeve installation is limited by strength of parts therefore it is more difficult to shape thick sleeve on pipe than layered sleeve.

This method provides reinforcement to a pipe so that the sleeves are stressed onto the pipe and in full contact with one another so that they respond to pressure as one. The result is that the stress arising from the fluid in the pipe is transferred to the sleeve and the stress on the pipe is reduced or eliminated. There are a number of existing

ways to stress a sleeve on to a pipe and one of those methods would be used with this sleeve. At present when sleeves are manufactured they are rolled to a specified dimension to fit the pipe to be repaired. In most all cases the pipe to be repaired is not perfectly round and the fit between the manufactured sleeve and the pipe is not appropriate to ensure all stresses are transferred to the sleeve. Thus, using existing devices thick walled sleeves may not be properly stressed to the pipe. This invention enables the use of existing device to stress sleeves on thick wall pipes. At present the existing devices for stressing sleeves onto a pipe are limited by the thickness of the sleeve that can be stressed onto a pipe. Under certain circumstances where sleeves must be transported manually or by helicopter weight becomes a factor and having lighter components is essential. When installing the multi-layered sleeve it is important to ensure that each layer is independent of the other (not attached) to ensure that the maximum strength can be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to in any way limit the scope of the invention to the particular embodiment or embodiments shown, wherein:

FIGURE 1 is an end elevation view, in section, of a pipe repaired with a repair sleeve in accordance with the teachings of the present method.

FIGURE 2 is a detailed end elevation view, in section, of a portion of the pipe and repair sleeve illustrated in **FIGURE 1**.

FIGURE 3 is a side elevation view, in section, of the pipe and repair sleeve illustrated in **FIGURE 1**.

FIGURE 4 is an end elevation view, in section, of a pipe

repaired with a repair sleeve in accordance with the teachings of the present method, with alternative side bar and filet welds.

FIGURE 5 is an end elevation view, in section, of a pipe repaired with a repair sleeve in accordance with the teachings of the present method, with alternative overlapping engagement.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred method of repairing a pipe using a pre-stressed sleeve will now be described with reference to **FIGURES 1** through **5**.

A single sleeve layer for repairing a pipe would be constructed in four segments such that the segments can applied to the exterior of a pipe. Two segments to form a welding barrier and two segments for stress control. Each reinforcing sleeve segment would be manufactured to cover one half of the pipe and when both segments are welded together they would cover the full circumference of the pipe.

Referring to **FIGURE 1**, weld barrier segments 12 and 22 of thin metal (1/8", 1/16) would first be positioned on the pipe 10. Sleeve segments 14 and 24 would then be positioned on the barrier segments and a stressing device (us patent 5012842) would be used to apply external force to provide required stress level to the pipe. Referring to **FIGURE 2**, once the appropriate stress level is achieve welds 34 and 36 would be made to form one contiguous reinforcing sleeve. Welds 34 and 36 will attach to the weld barriers 12 and 22 and not to the pipe 10. This is critical, as the stress controlling sleeve must not be welded to the pipe 10. This would complete the first layer of the sleeve.

Referring to **FIGURE 3**, when the multi-layer thick

sleeve is being applied and one wishes to reduce the local secondary stresses between the sleeve and the pipe, the first sleeve layer can be manufactured so that each subsequent layer is shorter by about two thicknesses at each end so that at the foot 32 of the sleeve discontinuous stress will be reduced. Reduction of local bending stresses is important with respect of the life span of the repair. When the need for reducing stress at the foot 32 of the sleeve is not required sleeve layer 17 and 30 can be of same length.

Referring to **FIGURE 1**, the second weld barrier segments 16 and 26 of (1/8", 1/16) metal are positioned on sleeve segments 14 and 24. Sleeve segments 18 and 28 would then we positioned on the weld barrier segments 16 and 26 and a stressing device (us patent 5012842) would be used to bring stress of the sleeve/pipe segments to desired level. Once the appropriate stress is achieved welds 38 and 40 would be made to form one contiguous reinforcing sleeve. Welds 38 and 40 will attach to the weld barriers 16 and 26 and not to the sleeve segments 14 and 24. Thus the second layer comprising of welded segments 18 and 28 would be not attached to previously installed layers. All sleeve layers (weld barrier and sleeve) must be independent of each other.

Using the thin weld barrier metal material allows the installation of multi-layered sleeves ensuring that each layer is appropriately stressed to each other and yet acting in unison to reinforce pipe of any wall thickness. At present there is a limit to the thickness of the sleeve that can be applied to pipe as the stressing devices are of limited force capacity to reform thick segment and apply appropriate stress to the pipe.

Variations:

Referring to **FIGURE 4**, outer layer welds can be made

either with a butt weld 34,36,38,40 or using a side bar 44,50 and filet welds 42,46,48,52 both procedure are being used at the present time.

Referring to **FIGURE 5**, another option, would be to have the outer most sleeve 28 formed with a cavity 56 to over lap segment 18. This would allow for minor adjustments required when sleeve and pipe dimensions are different. Using the cavity 56 would reduce welding requirement.

This invention relates to the repairing of a pipe with a multi layered sleeve of similar material so that the pipes pressure carrying capacity is restored. The invention was originally conceived for the repairing of oil and gas pipelines but is not limited to pipelines as it can be used in any application where a pipes structural capacity must be restored.

In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the element is present, unless the context clearly requires that there be one and only one of the elements.

It will be apparent to one skilled in the art that modifications may be made to the illustrated embodiment without departing from the spirit and scope of the invention as hereinafter defined in the Claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method of repairing a pipe using a pre-stressed sleeve, comprising the step of:

forming a repair sleeve of a required thickness on a pipe by sequentially applying more than one independent pre-stressed full encirclement sleeve layer.

2. The method as defined in Claim 1, including the further step of separating each sleeve layer by a welding barrier layer.

3. The method as defined in Claim 1, each sleeve layer being formed of two sleeve segments.

4. The method as defined in Claim 3, the sleeve segments being joined by welding.

5. The method as defined in Claim 1, each sleeve layer that is sequentially applied being shorter in length than preceding sleeve layers.

6. A method of repairing a pipe using a pre-stressed sleeve, comprising the step of:

forming a repair sleeve of a required thickness on a pipe by sequentially applying more than one independent pre-stressed full encirclement sleeve layer formed of two sleeve segments joined by welding, with each sleeve layer being separated by a welding barrier layer and each sleeve layer that is sequentially applied being shorter in length than preceding sleeve layers.

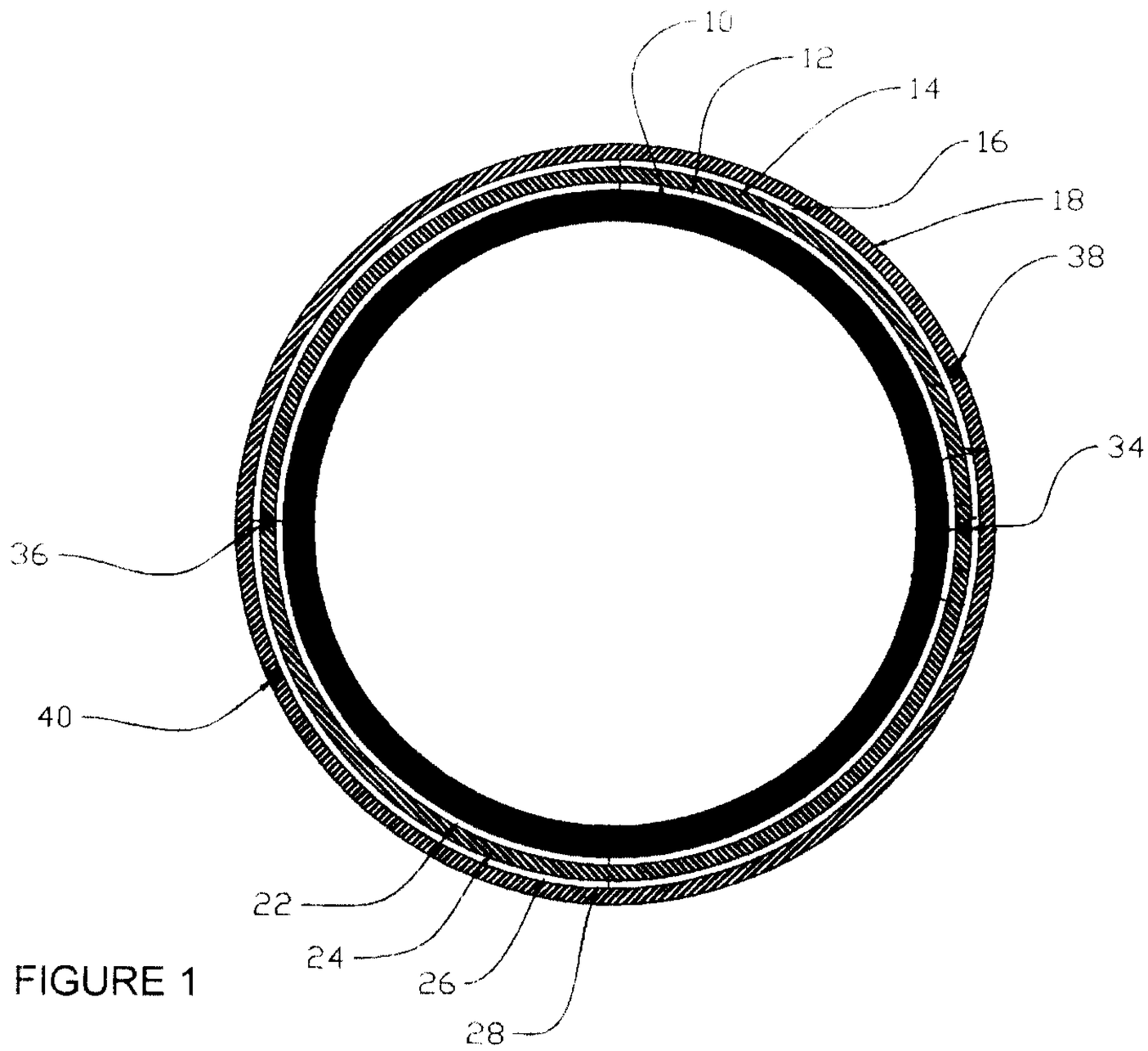


FIGURE 1

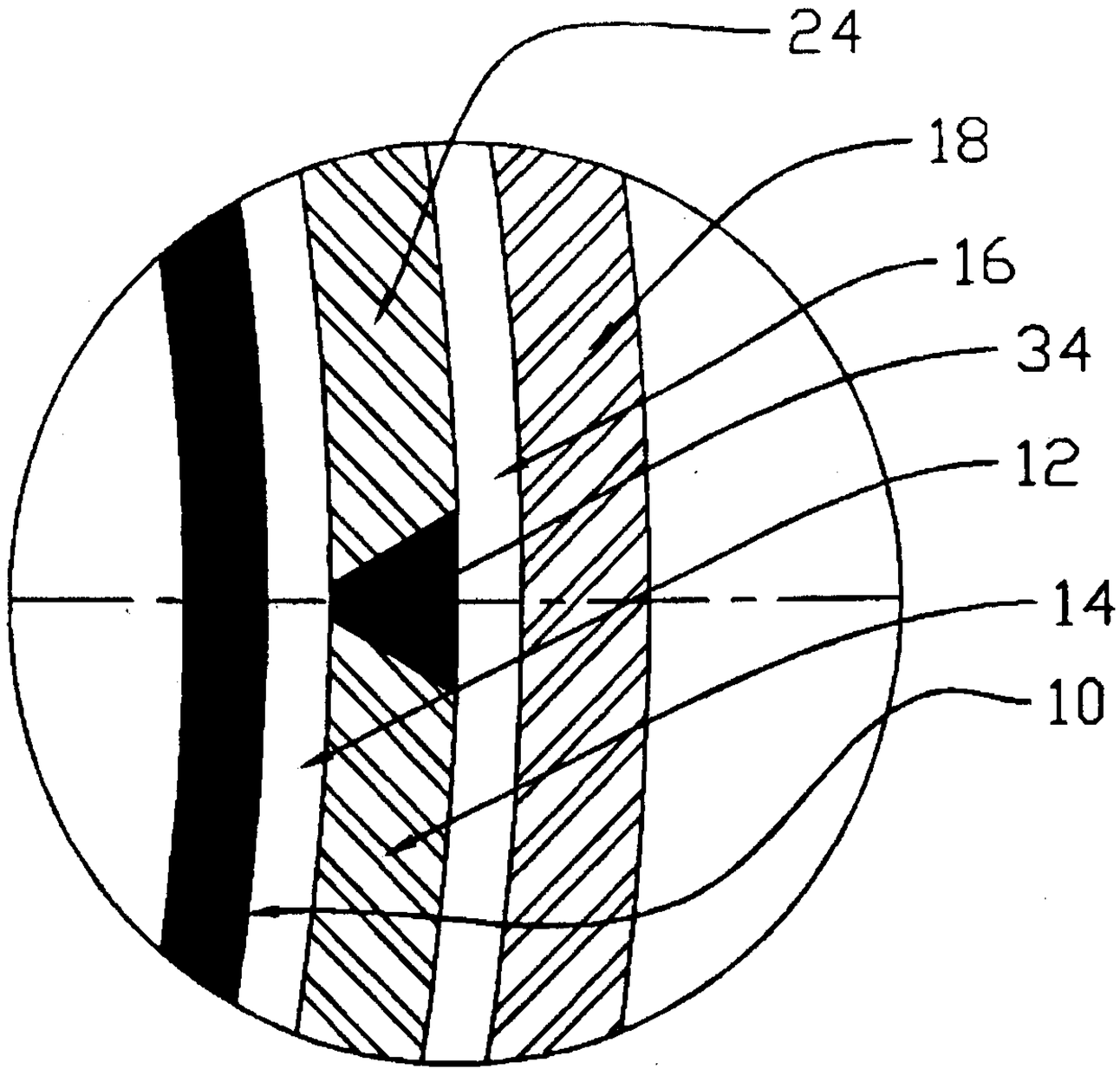


FIGURE 2

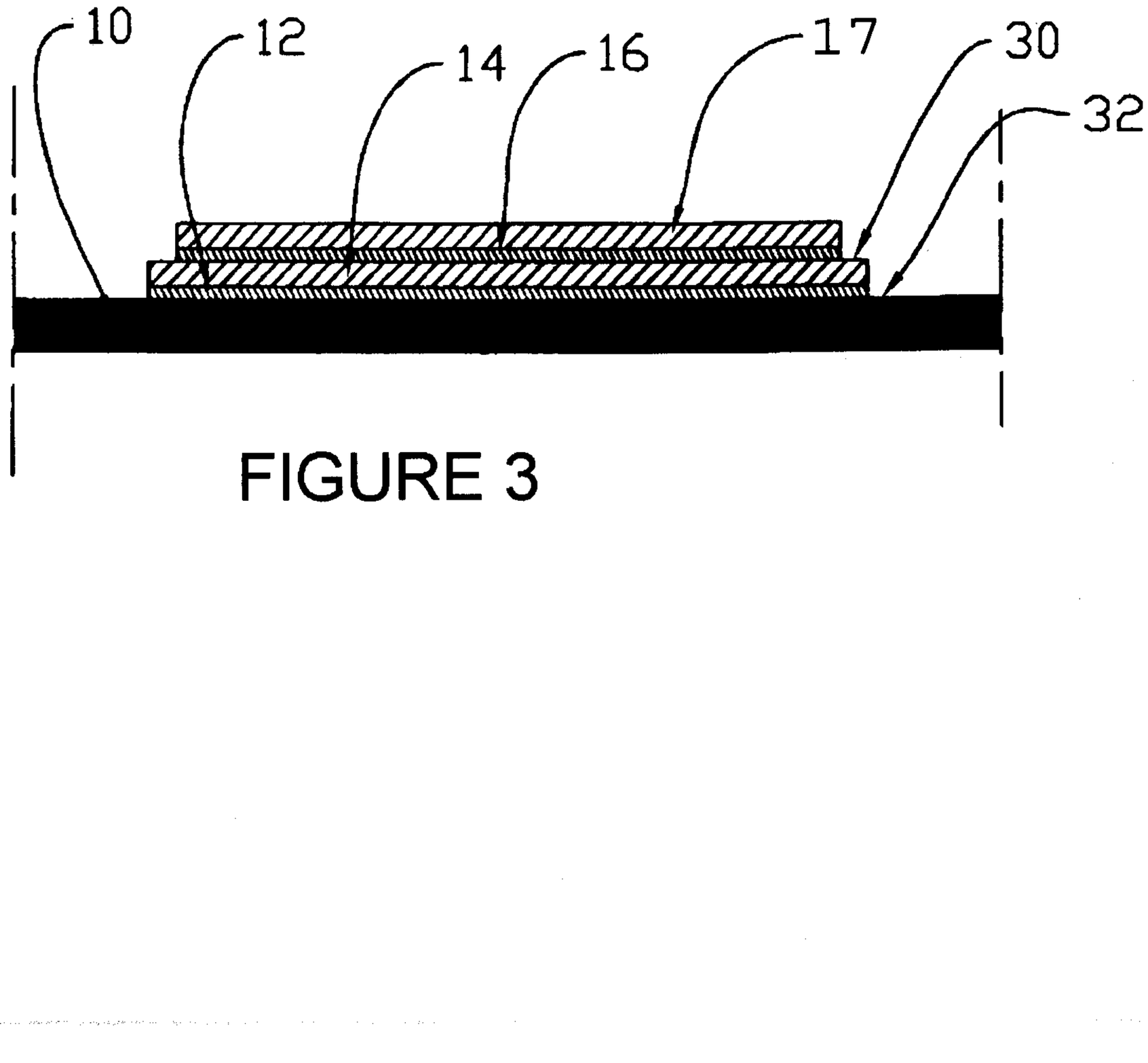


FIGURE 3

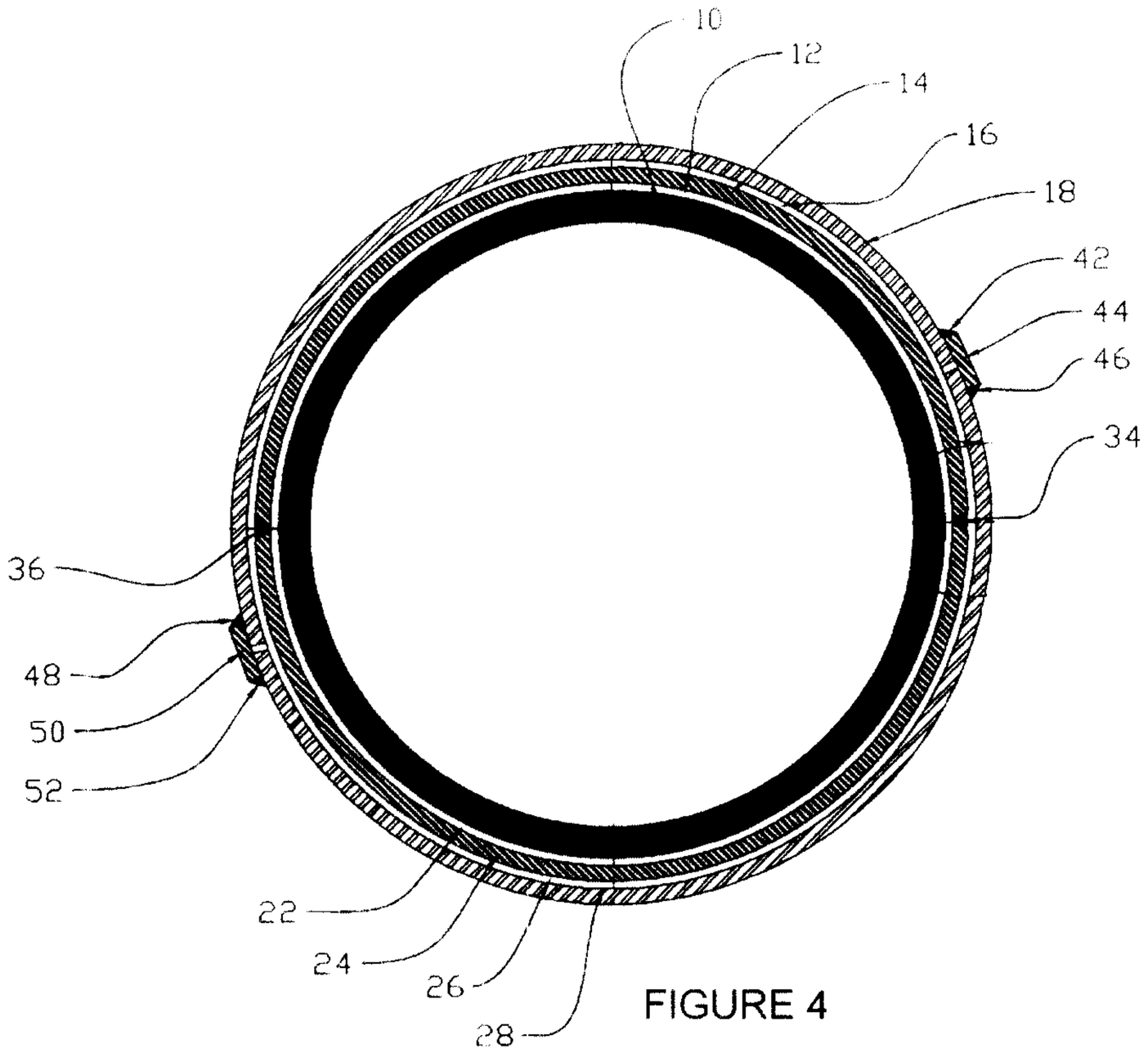


FIGURE 4

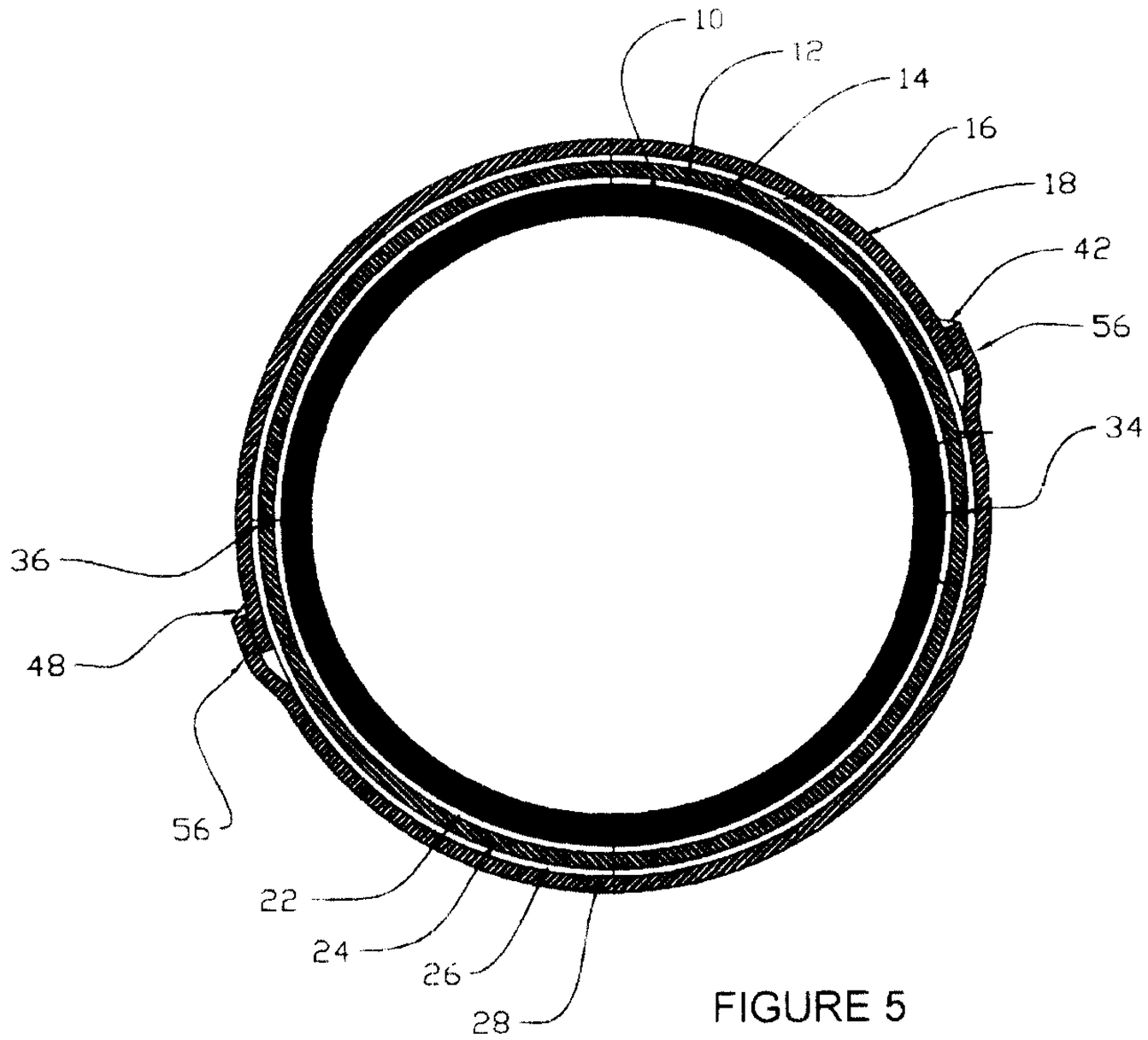
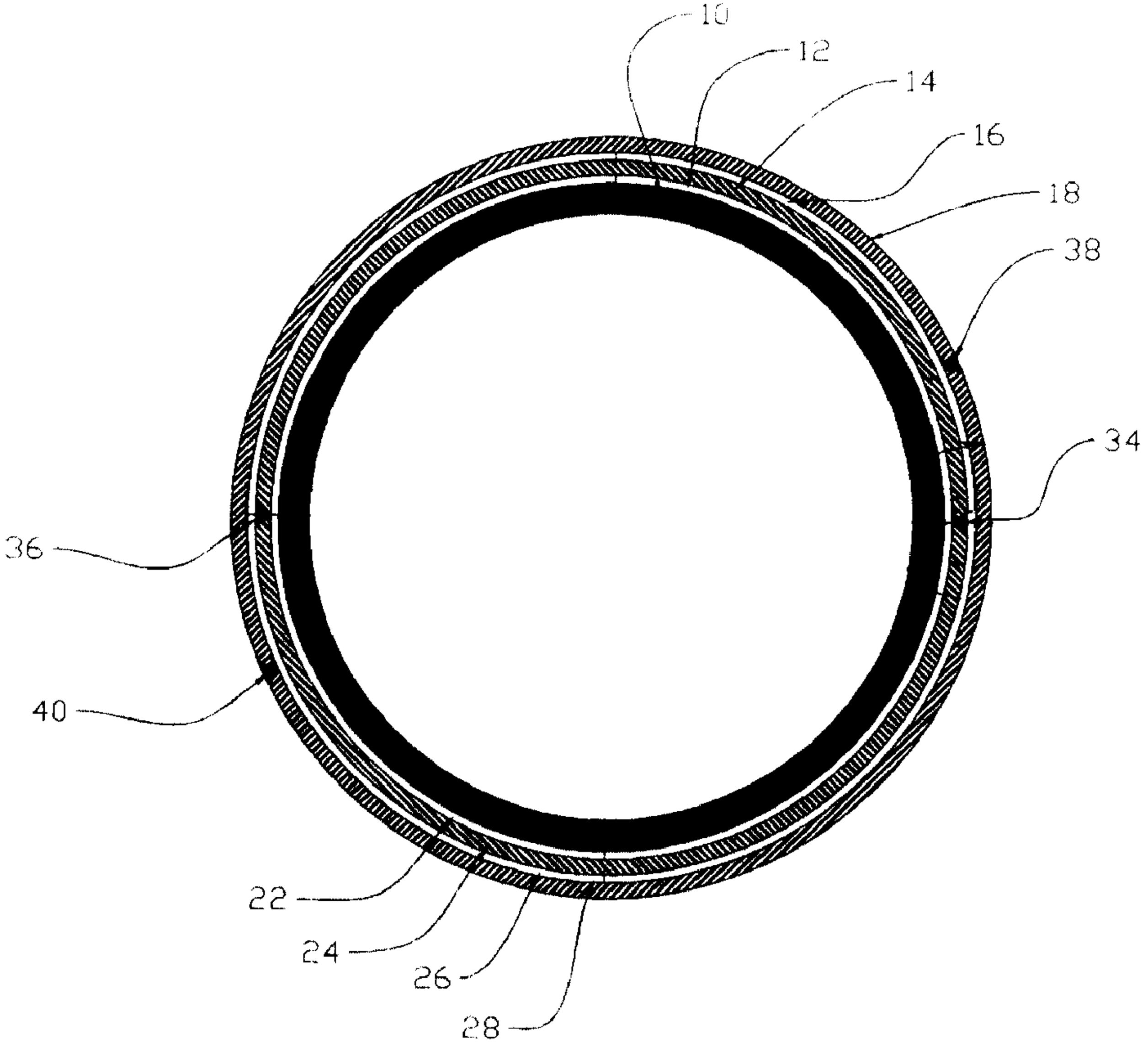


FIGURE 5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