United States Patent

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[33] **Japan**
[31] **42/88552**

[54] **FIBER-CEMENT PIPE**
7 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **138/143,**
52/723, 138/153, 138/174
[51] **Int. Cl.** **F16s 9/08**
[50] **Field of Search** 138/138,
143, 151—153, 156, 172, 174, 175, 177, DIG 6,
DIG 10, 128, 133, 144; 52/722, 723; 156/187

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ABSTRACT: A small diameter asbestos-cement pipe has a small bending resisting strength in the longitudinal or axial direction of the pipe. In order to overcome this defect, a thin plate is would together with the thin layers of asbestos-cement mixture when the latter is in the form of paste. The paste layers are wound around a core so as to fabricate a pipe, and the plate is interposed between two of the layers whereby an asbestos-cement pipe reinforced by the plate is obtained. The present invention is intended to disclose the structure of the thus-formed pipe and an apparatus for manufacture thereof.

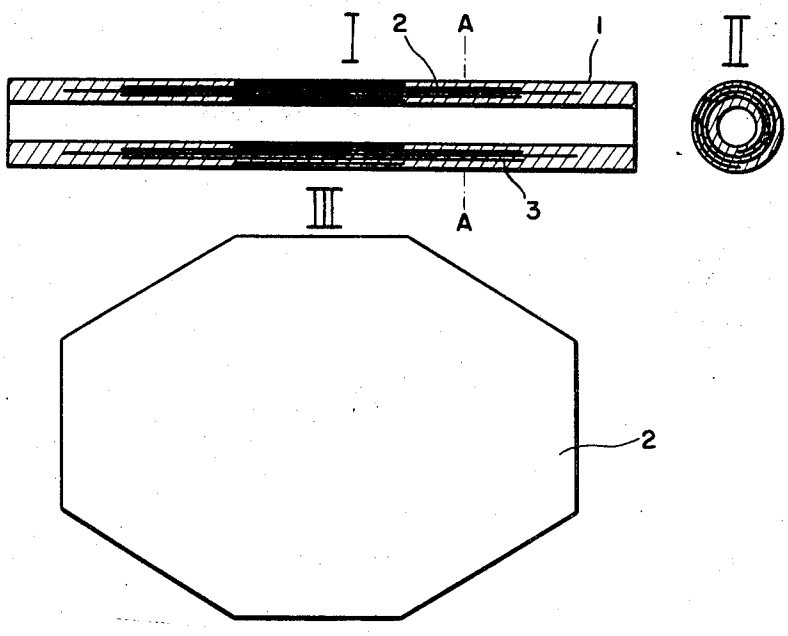


Fig. 1.

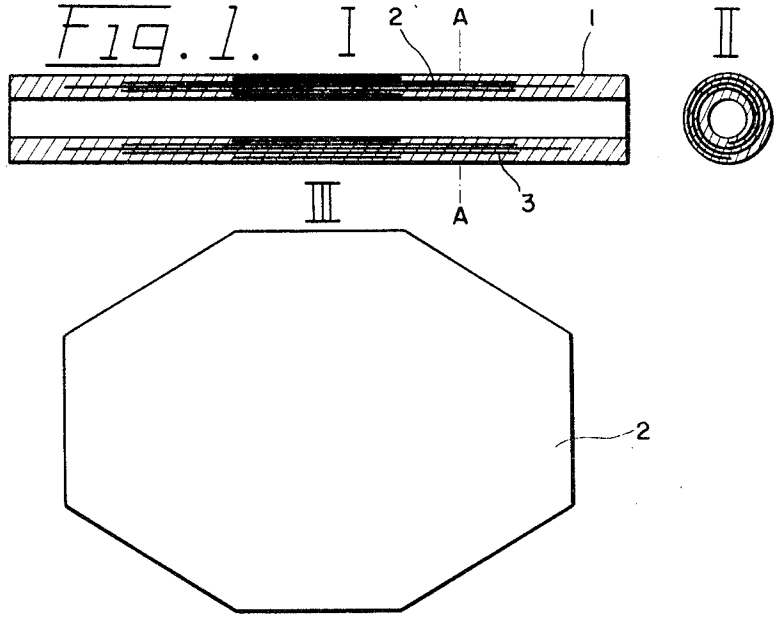
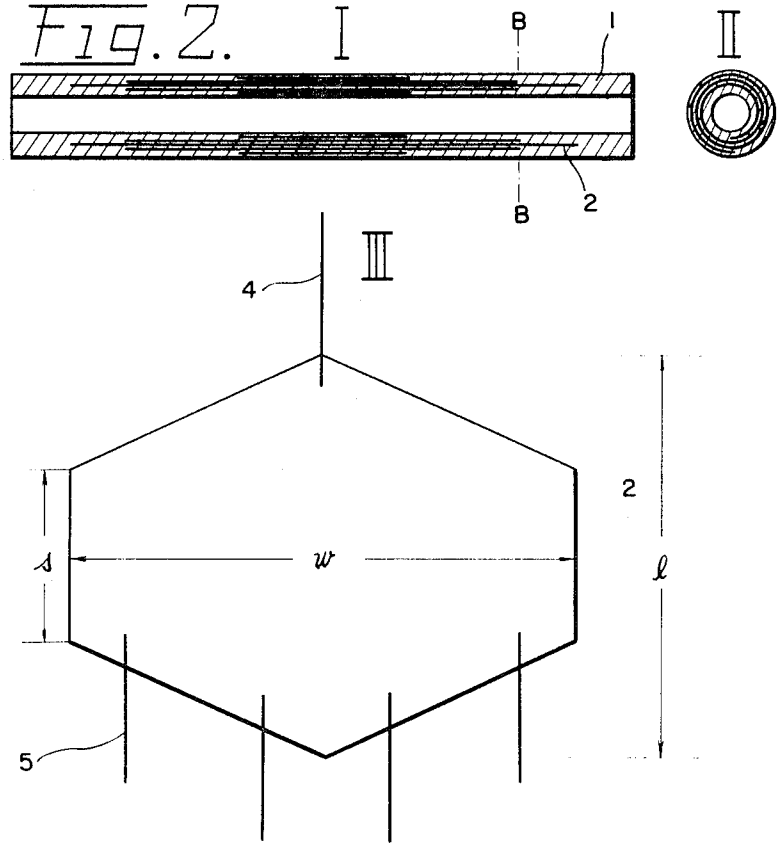


Fig. 2.



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Fig. 3.

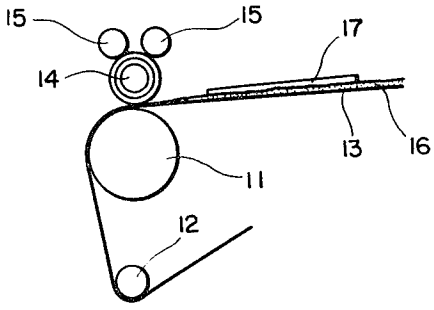
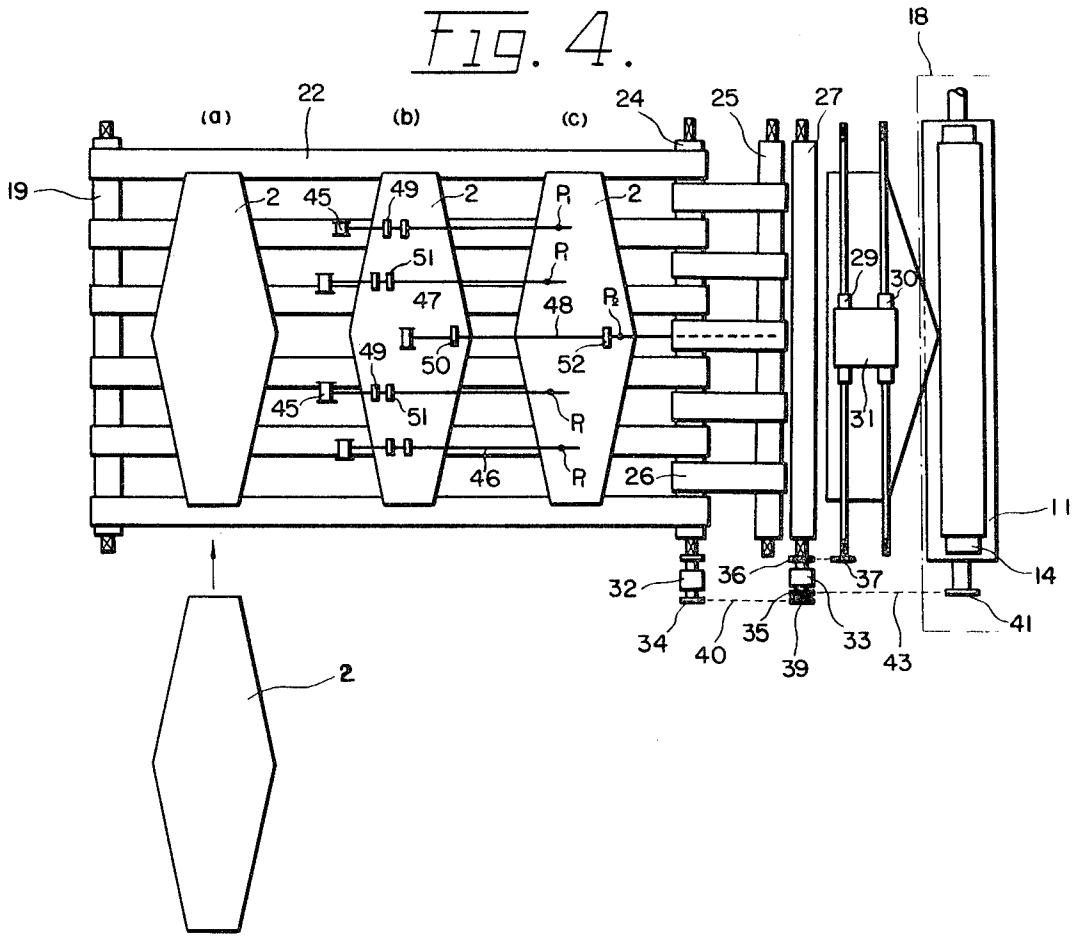


Fig. 4.



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Fig. 5.

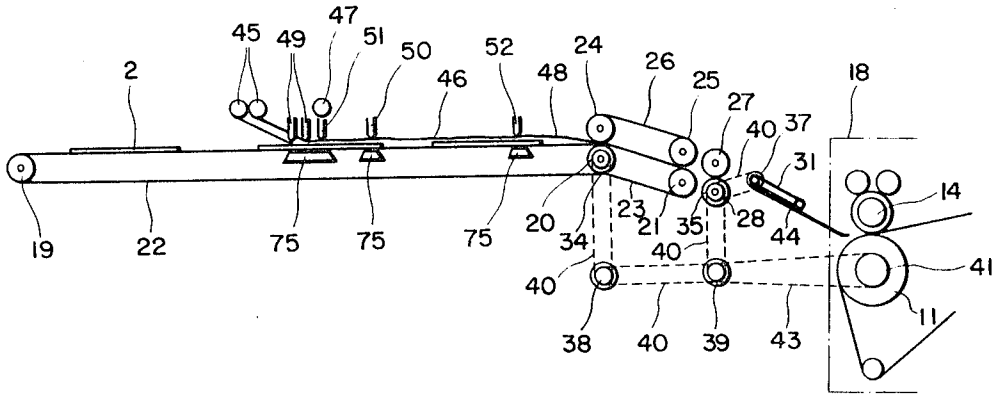


Fig. 6.

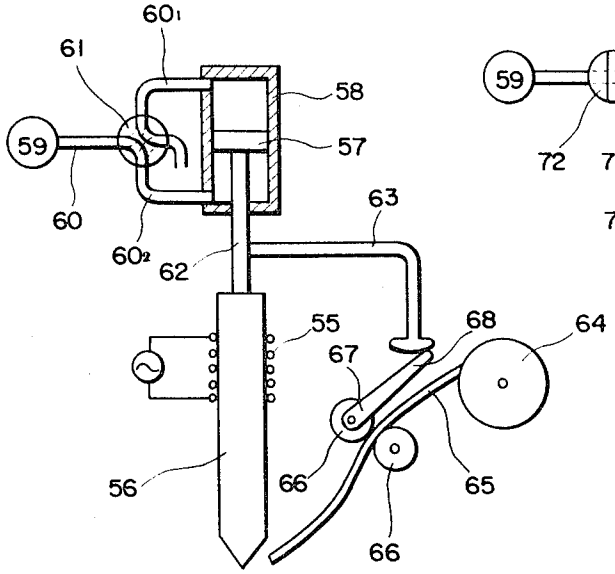
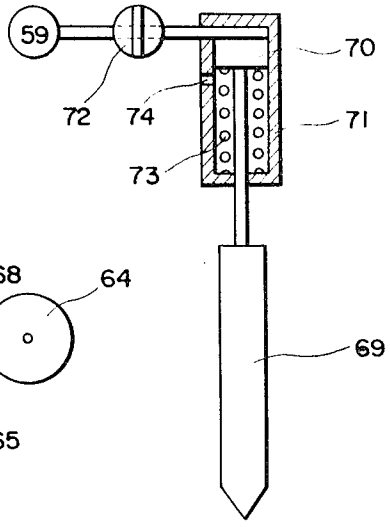


Fig. 7.



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FIBER-CEMENT PIPE

BRIEF DESCRIPTION OF THE INVENTION

The present invention relates to a fiber-cement pipe in which a reinforcing cylinder consisting of a wound or rolled plate is embedded in the layers of the pipe wall and to an apparatus for manufacture of the pipe of the type. There has been known a method for manufacturing of the fiber-cement pipes including the steps of placing a thin layer of fiber-cement mixture, for example asbestos-cement mixture upon an endless belt so as to dehydrate the thin layer during its transportation and winding thus thin layer around a core under high pressure. The fiber-cement pipes manufactured by this method have excellent corrosion-resisting character, a relatively high strength and may be produced with manufacturing costs so that they are widely used for water mains, sewer pipe, fume venting and other purposes. However, in small diameter pipes, for example 3 inches, 4 inches and 6 inches in inner diameter, there is a defect that the bending resisting strength in the longitudinal or axial direction of the pipe is so small that the pipe tends to be broken. To improve this strength, high quality asbestos having long fibers may be used in large quantity, but the strength is increased not sufficiently enough to remedy the essential and inherent defect that the pipe is completely broken into two sections.

In view of the above, the first object of the present invention is to provide a fiber-cement pipe which is completely free from the above described defect.

Another object of the present invention is to provide a fiber-cement pipe which is fabricated by winding a plurality of thin layers of fiber-cement mixture in the form of paste into a cylindrical lamination and in which a reinforcing plate wound or rolled in the form of a cylinder is embedded in the lamination wall of the pipe.

A still further object of the present invention is to provide a fiber-cement pipe whose wall is a fiber-cement lamination formed by winding, into the cylindrical form, a plurality of thin layers of fiber-cement mixture in the form of paste and in which a reinforcing plate wound or rolled into the form of a cylinder is disposed in said lamination wall and tightly fastened by wires.

A further object of the present invention is to provide an apparatus for use in manufacturing the pipes of the type described comprising means for transporting a plate toward the winding section of a conventional fiber-cement manufacturing apparatus, means for fusion-welding, winding and fastening wires to said plate and cutting off said wires into a predetermined length while said plate is being transported, and means for directing said plate having said welded and cut wires toward said winding section. According to the present invention, a fiber-cement pipe which is highly resistant against bending and will not be separated into two sections even if it is broken or fractured can be provided.

Other features and advantages of the present invention will be apparent from the following description taken in conjunction with the accompanying drawings in which:

FIG. -I is a longitudinal sectional view of a fiber-cement pipe according to the present invention;

FIG. 1-II is a sectional view taken along the line A-A of FIG. 1-I;

FIG. 1-III is a developed or top view of a plate to be embedded in a fiber-cement pipe according to the present invention;

FIG. 2-I is a longitudinal view of another embodiment of the present invention;

FIG. 1-II is a sectional view taken along the line B-B of FIG. 2-I;

FIG. 2-III is a developed or top view of a plate to be embedded in a fiber-cement pipe according to the present invention;

FIG. 3 is a schematic view of a well known winding device for winding the thin layers of asbestos-cement mixture to be used in the manufacture of fiber-cement pipes according to the present invention;

FIG. 4 is a top view of a novel apparatus for feeding plates to be embedded in fiber-cement pipes for use with a conventional fiber-cement pipe manufacturing apparatus according to the present invention;

FIG. 5 is a side view of FIG. 4;

FIG. 6 is a schematic view of one of the welding machines used in said plate feeding apparatus; and

FIG. 7 is a schematic view of one of the cutters used in said plate feeding apparatus.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, a fiber-cement pipe according to the present invention is generally designated by 1. Reference numeral 2 designates a plate and 3, a thin layer of fiber-cement mixture. The fibers to be used in manufacturing the fiber-cement pipe 1 are glass fibers, asbestos fibers, etc., and the plate 2 is formed of a relatively tough material such as aluminum plate, steel plate, punching metal, plastics materials, fabric made by glass fiber and the like. Each plate 2 is made substantially in the form of rhomb or elongated hexangle as clearly shown in FIGS. 1-III and 2-III so that the plate 2 may be most deeply overlapped at the intermediate of the ends of the fiber-cement pipe 1. At the same time the longitudinal length of the plate 2 must be less than the length of the fiber-cement pipe 1 so that the plate 2 may not project beyond the ends of the pipe 1.

Next a method of manufacturing fiber-cement pipes 1 of the type described above will be described in detail hereinafter. In FIG. 3, reference numeral 11 designates a main roller; 12, a follower roller; 13, a belt made of felt and passing on both of the rollers 11 and 12; 14, a mandrel or core disposed upwardly of the main roller 11 and adapted to rotate in one direction; and 15, press rolls disposed opposite to the mandrel or core 14. The apparatus whose components have been described above corresponds to a winding station or section for winding thin layers of asbestos-cement mixture in an asbestos-cement pipe manufacturing apparatus well known to the art.

A thin layer 16 of asbestos-cement mixture is placed on the felt belt 13 and directed toward the main roller 11 and the mandrel or core 14, both of which cooperate to press the transferred asbestos-cement mixture thin layer 16 to further reduce the same. The thus reduced asbestos-cement mixture thin layer 16 is separated from the felt belt 13 and is wound around the mandrel or core 14. Thus, in the same manner as described above, asbestos-cement mixture thin layers 16 are successively fed into this winding machine and wound around the mandrel or core 14 in superimposed relationship, so that an asbestos pipe consisting of a lamination of asbestos-cement mixture and thin layers 16 is formed. The above described device and method for manufacturing the asbestos pipes are well known to the art.

In the course of the above described manufacturing process and after thin layers 16 have been laminated in a suitable thickness, a plate 17 is placed on a thin layer 16 and wound around the mandrel or core 14 together with the thin layer 16. In this case, the plate 17 is forcibly pressed by means of the press rolls 15 so as to be wound into the form of a cylinder. Around thus wound plate 17 are further laminated thin layers 16, and when the mandrel or core 14 is withdrawn, the asbestos-cement pipe having the plate 17 embedded in the pipe wall as shown in FIG. 1 can be obtained.

The fiber-cement pipes manufactured as described hereinbefore have the reinforcing plates 2 wound in the form of multiwall cylinders integrally of the thin layers 3 of fiber-cement mixture so that the strength of the fiber-cement pipes according to the present invention is remarkably increased by more than two times as compared with conventional fiber-cement pipes which are produced by merely winding a plurality of thin

layers of fiber-cement mixture around a core in the form of a lamination. Furthermore, the fiber-cement pipes according to the present invention have an economical advantage because a conventional asbestos-cement pipe manufacturing apparatus can be employed without any modification in the manufacture of the fiber-cement pipes of the present invention in such a manner that only plates 2 are fed at a suitable time interval into the winding station or section for winding thin layers of fiber-cement mixture.

Now reference is made to FIG. 2, in which another embodiment of the fiber-cement pipe according to the present invention is generally designated by 1. Reference numeral 2 designates a plate; 4, a wire for facilitating the winding of the plate 2 hereinafter, referred as "winding wire"; and 5, wires for facilitating the tight fastening of the plate 2, referred to as "fastening wires" hereinafter for brevity. The plate 2 is the same as the plate described with reference to FIG. 1 and both of the wires 4 and 5 are 0.5 to 1.0 mm. in diameter and made of a relatively tough, but relatively soft material such as steel, aluminum, glass fiber, plastic wire and the like. One ends of wires 4 and 5 are fixed to the plate 2 by ordinary means.

A thin layer 3 of fiber- or asbestos-cement mixture of the type described with reference to FIG. 1 may or may not be interposed between the overlapped portions of plate 2. The winding wire 4 is wound on the inner fiber-cement mixture thin layer while the fastening wires 5 are wound, around the outer peripheral surface of the plate 2. The plate 2 having the wires 4 and 5 can be embedded into the wall of the fiber-cement pipe 1 by means of a plate feeding apparatus, as shown in FIG. 4, which has a novel construction and is adapted to be used together with a conventional fiber-cement pipe manufacturing apparatus, and has the same effect as that shown in FIG. 1.

Now referring particularly to FIGS. 4 to 7 inclusive, the novel plate feeding apparatus according to the present invention will be described hereinafter. In FIGS. 4 and 5, the reference numeral 18 designates the winding station or section shown in FIG. 3 of a conventional asbestos-cement pipe manufacturing apparatus. Reference numerals 19, 20 and 21 designate respective rollers around which are directed a plurality of belts 22 and 23. .Rollers 24 and 25 which are disposed in opposed relation with respect to the rollers 20 and 21 carry a plurality of driven belts 26 which are disposed in opposed relationship with respect to the belts 23. A pair of rollers 27 and 28 are disposed adjacent to the rollers 21 and 25 while a pair of rollers 29 and 30 are disposed adjacent to the rollers 27 and 28 respectively. A belt 31 passes over rollers 29 and 30. Clutches are designated by 32 and 33 respectively. Power transmission wheels 34, 35, 36 and 37 are carried by the shafts of the rollers 20, 28 and 29 respectively. Reference numerals 38 and 39 designate intermediate transmission wheels respectively. Power transmission or drive elements 40 interconnect the power transmission wheels 34 and 38; 38 and 39; 39 and 35 and 36 and 37 respectively. A transmission wheel 41 carried by the shaft of the main roller 11 is connected with the transmission wheel 39 by means of a transmission drive element 43. Thus, each of the above described rollers can be driven from the main roller 11 which is a power source. A guide plate 44 is disposed underneath the belt 31. A first reel 45 and a second reel 47 have windings of fastening wire 46 and winding wire 48 respectively.

Reference numerals 49 and 50; and 51 and 52 designate conventional welding machines and cutters respectively.

FIG. 6 schematically shows a welding machine 49 or 50. An iron 56 which is adapted to be heated by means of an electric heating coil 55 is carried by a piston rod 62 of a piston 57 which in turn is disposed slidably within a cylinder 58 whose upper and lower chambers are communicated through connection pipings 60_1, 60_2 and 60 with for example an air compressor 59. A switching valve 61 is interposed in the connection piping 60. One end of a projecting rod 63 is fixedly secured to the piston rod 62. Soldering wire 65 is withdrawn from the reel 64 and normally held stationary between a pair of feed rollers 66. A conventional ratchet drive mechanism 67 is carried by the shaft of one of the feed rollers 66 and an actuating rod 68 of the mechanism 67 is engaged with the projecting rod 63.

When the switching valve 61 is turned and positioned so that the communication indicated by the dotTed lines is established between the air compressor and the cylinder, the air under pressure is directed from the air compressor 59 through the connection pipings 60 and 60_1 into the upper chamber of the cylinder 58 above the piston 57.

Therefore, the piston rod 62 and the iron 56 are caused to come down. At the same time the projecting rod 63 pushes down the actuating rod 68 so that the feed rollers 66 can supply a predetermined length of soldering wire 65 to the tip end of the iron 56, thereby soldering the wire 46 or 48 to the plate.

FIG. 7 shows a schematic view of a cutter 51 or 52. A vibrating chisel 69 is connected to a piston 70. The upper chamber of a cylinder 71 is communicated through a switching valve 72 with the air compressor 59 which can be commonly used with the welding machines 49 and 50. In the lower chamber of the cylinder 73 below the piston 70 is loaded a spring 71 and an exhaust port 74 is bored through the cylinder wall.

When the switching valve 72 is turned and positioned so as to establish the communication as shown by the dotted lines, the fluid under pressure from the air compressor 59 is introduced into the upper chamber of the cylinder 71 above the piston 70 so that the piston 70 is caused to be lowered. But when the upper surface of the piston 70 reaches the lower side of the exhaust port 74, the air under pressure is exhausted through this port 74 so that the piston 70 is caused to rise by the biasing force of the spring 73. By repeating the same actuation cycle as described above, the piston 70 makes a vertical oscillation so that the chisel 69 is caused to oscillate vertically, thereby cutting into a predetermined length, the wire 46 or 48. The reference numeral 75 in FIG. 5 designates the supporting or base plates for welding machines and cutters disposed below the belts 22.

Next the operational function of the apparatus of the present invention will be described in more detail hereinafter. When the main roller 11 is driven by means of a conventional prime mover, the rollers 20, 27, 29 and 30 are rotated through the power transmission wheels 41, 39, 38, 34, 35, 36 and 37 and the power transmission or drive elements 43 and 40, and also the belts 22, 26 and 31 are driven. In this case, a metallic plate 2 from the storage is placed one by one upon the belts 22 by means of a vacuum lift or the like and is gradually transferred from a position *a* to the position *b* in the right direction in the figures. In FIG. 4, the preceeding metallic plate 2 is positioned at *c* and shown as being in such a state in which the wires 46 withdrawn from the reels 45 are welded to the metallic plate 2 as at points P_1 while the wire 48 withdrawn from the reel 47 is welded to the metallic plate as at POINT P_2. When the metallic plate 2 at the position *a* is once transferred to the position *b*, the belts 22 are stopped in such a manner as described hereinafter so as to permit the welding of the wires 46 to the metallic plate 2 by means of the welding machines 49, and to permit cutting of the wires 46 by means of cutters 51 at points close to the welding machines. At the same time the wire 48 is welded to the metallic plate 2 by means of the welding machine 50, and is cut into a predetermined length by means of the cutter 52 when the metallic plate 2 reaches the position *c*.

During the above described welding and cutting steps, the belts 22 can be stopped by actuating the clutch 32. Thus, the metallic plate 2 which has been transferred from the position *b* to the position *c* in FIG. 4 has the wires connected thereto as shown in FIG. 2–III, the wire 4 in FIG. 2–III corresponding with the wires 48 in FIG. 4 while the wire 5, with the wires 46.

The metallic plate 2 having the wires 46 and 48 welded thereto is then inserted from the position *c* between the belts 23 and 26; the rollers 27 and 28; and the belt 31 and the guide plate 44. In this case, by actuating the clutch 32, the belt 22 can be stopped at any time.

When the wall thickness of a fiber-cement pipe reaches approximately one-half of the whole thickness, the metallic plate

2 which is provided with wires 46 and 48 is wound.

In this case, the feeding of the fiber-cement mixture slurry upon the felt belt 13 may be continued or discontinued. In either case, the rotational speed of the main roller 11 must be decreased.

When the winding of the metallic plate 2 is started, the winding wire 48 is first wound. Since the wire 48 is made of a soft steel wire, the wire 48 is wound around and embedded into the soft, laminated fiber-cement mixture layers so as to facilitate the winding of the metallic plate 2. Next, the metallic plate 2 is wound and finally the fastening wires 46 are wound around the plate 2 so as to tightly hold the metallic plate 2 in position.

Upon completion of the winding of the metallic plate 2, the rotational speed is returned to its normal r.p.m. and the feeding of the fiber-cement mixture upon the felt belt 13 is restarted if this feeding has been stopped during the plate winding operation. Around the outer peripheral surface of thus wound plate 2 is formed a lamination of thin layers of fiber-cement mixture until a predetermined wall thickness is obtained, and the whole lamination is withdrawn from the core after the mixture has been set, whereby the fiber-cement pipe according to the present invention is provided.

As described hereinbefore, the apparatus according to the present invention can ensure the correct and very efficient operation of winding and embedding a plate into the fiber-cement pipe according to the present invention.

The bending resisting strength of the fiber-cement pipe according to the present invention is remarkably stronger that that of any conventional pipe of the type described as shown by the following comparison table obtained by the tests conducted by the inventors.

(Testing procedures)

Each of the pipes subjected to the tests had the inner diameter of 100 mm., the wall thickness of 12 mm. and a length of 3 meters. Each pipe was supported by two points respectively 150 mm. from the end of the pipe, the distance of two points of application of the support being 2,700 mm. At each one-third point of the distance between the supports, that is, at each point 900 mm. from each supporting point load is vertically applied from the above so as to bend the pipe. Each of pipes of the present invention used in the tests had a steel plate embedded in the wall of the pipe and the dimensions were 0.5 mm. in thickness, 27 mm. in width (*w*) and 700 (*in length* (*l*) and 300 mm. in side (*s*) as shown in FIG. 2–III. V,1

Pipes tested	Specimen Number	Bending load (kg.) First stage	Second stage
Pipes of the present invention	1	860	1,050
	2	890	1,230
	3	870	1,095
	4	860	1,115
	5	920	1,210
Conventional pipe JIS 5301		550	

Remarks:

1. The first state is the stage in which the cracking sound of the pipe is heard.
2. The second state is the stage in which the bending load surpasses the elastic limit, the pipe is subjected to buckling, and the pipe starts to bend to a great extent even without increasing the load.

The essential features of the present invention have been described in this specificatlon without restricting the invention in minor details, materials and proportions other than by the scope of the following claims:

What we claim is:

1. A pipe construction comprising alternate layers of a fiber-cement and a reinforcing plate being bonded together and wound around the central axis of said pipe, said fiber-cement being in the form of a single sheet of material, the width of which is substantially equal to the length of the pipe, said plate having a central portion which is longer than at least one of its end portions, whereby when said fiber-cement and said plate are wound together a variation in the amount of reinforcement afforded by said plate is provided along the length of the pipe such that an area of maximum reinforcement is provided substantially centrally with respect to the ends of said pipe.

2. A pipe construction according to claim 1, wherein said plate is of a form such that the central portion of the wall thickness of said pipe is provided with a reinforced zone which is of a greater axial length than the reinforced zones provided by said plate at the inner and outer portions of said pipe wall thickness.

3. A pipe, according to claim 2, wherein said plate is of octagonal form, the central portion thereof being of uniform length, and a transition position on each end of said central portion tapering inwardly to a shorter length.

4. A pipe, according to claim 2, wherein said plate includes a uniformly dimensioned central portion and an end portion on each side of the central portion tapering to a shorter dimension.

5. A pipe, according to claim 2 including at least one wire connected to said plate in the reinforced zones at the inner and outer portions of said pipe wall thickness and being wound with said layers of fiber-cement.

6. A pipe, according to claim 5, wherein said plate is metal and includes one zone with a plurality of wires connected thereto the opposite zone having a single wire.

7. A pipe construction, according to claim 1, wherein said fiber cement is asbestos which is longer than said plate, said plate having a long central portion arranged intermediate the wall thickness of said pipe.