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P. L. NERVI

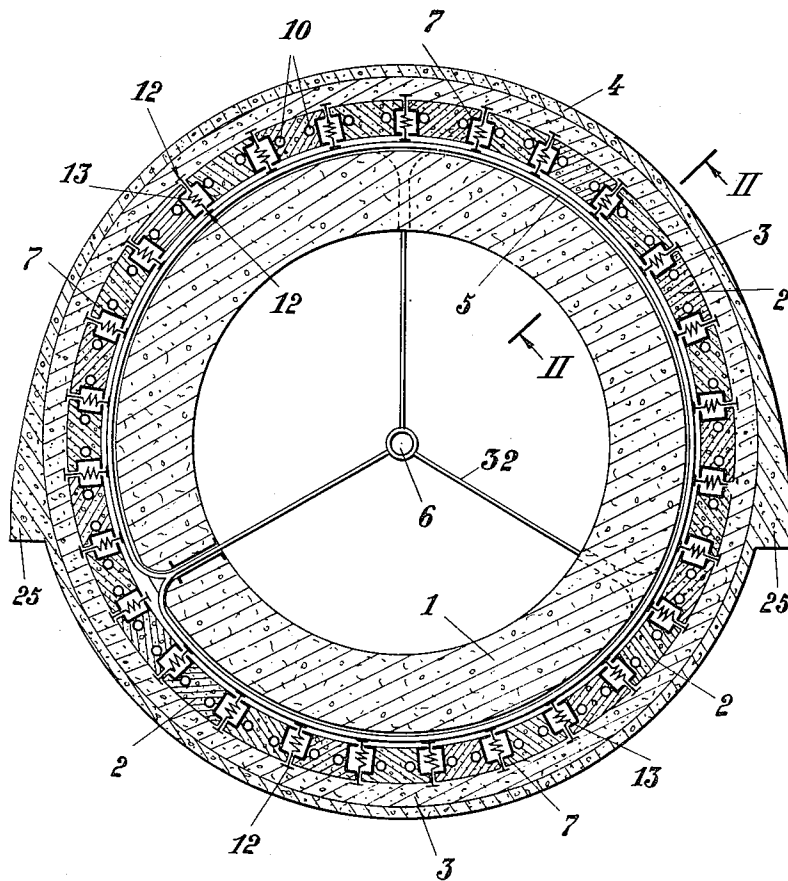
2,771,655

PROCESS OF MANUFACTURE OF FORCED PIPINGS MADE OF
PRECOMPRESSED CONCRETE, AND RELATIVE EQUIPMENT

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2 Sheets-Sheet 1

Fig.1



INVENTOR.

BY *Pier Luigi Kerai* INVENTOR

Mendocino, Lind + Ponack
DHYs

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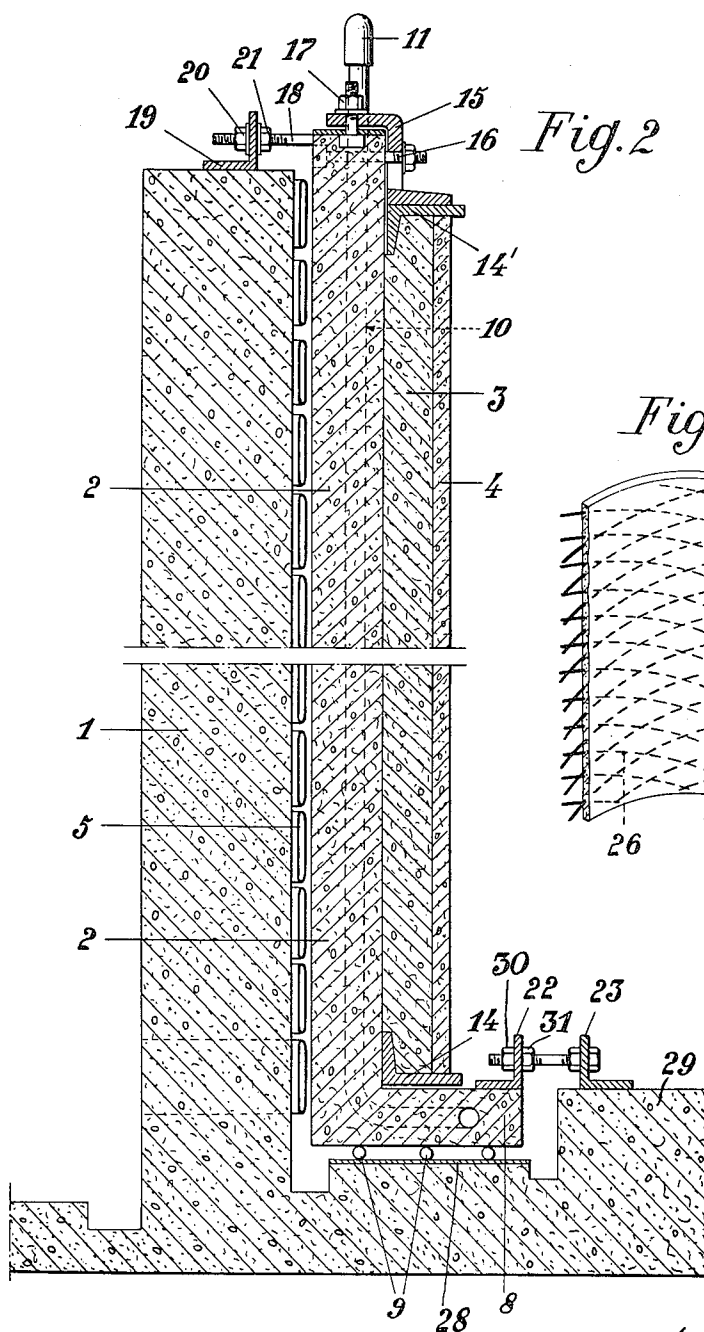
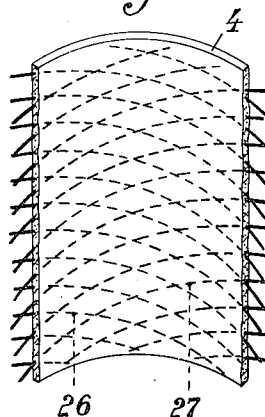


Fig. 3



INVENTOR.

Pier Luigi Nervi

BY

Wendroth, Lind & Ponack

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PROCESS OF MANUFACTURE OF FORCED PIPINGS MADE OF PRECOMPRESSED CONCRETE, AND RELATIVE EQUIPMENT

Pier Luigi Nervi, Rome, Italy

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6 Claims. (Cl. 25—30)

An object of this invention is a process for the manufacture of prestressed reinforced concrete piping.

A further object of this invention is the provision of apparatus for carrying out said process.

According to this invention the piping is formed by the cooperation of a thin prefabricated reinforced concrete pipe which is put under tension. On release of the tension it compresses an inner shell. The tension state of the outer pipe is obtained by direct pressure on the concrete of the inner shell, when in its fluid state. The pressure is kept constant until the hardening of the concrete. The pressure transmitted to the concrete forming the inner shell, which creates the tension in the outer shell, is balanced by a core member which is part of the equipment whereby the process is carried out.

According to this invention the best results for reinforcing the outer shell of the finished pipe is to place the reinforcing members, which are of high tensile strength steel, in the shape of two helices which are inclined at equal angles to the longitudinal axis of the pipe but which are inclined in opposite directions. When this form of reinforcement is used, it has been found that a stress is placed along the body of the finished pipe in an axial direction, the amount of which depends upon the angle of inclination of the helices.

The technical and economical advantages obtained by reinforcing the outer shell by high tensile strength steel are obvious. The losses of the tension when the core is removed is reduced and the effects of the deformability of the concrete and of the steel is diminished.

Heretofore in prestressed reinforced concrete piping the pressure is applied to the fluid concrete by means of pressure exerted on the material injected into the mold. According to the present invention, the pressure is exerted on the fluid concrete by means of the inside portion of the mold itself, the pressure being applied through a mechanical movement of that inner mold member. This pressure is in turn transmitted through the fluid concrete to the outer shell portion of the pipe, which during the molding process acts as the outer mold member. The pressure stretches this outer shell slightly and thereby places it under tension. The pressure conditions are left in this condition until the concrete has set. The inner structure of the mold is then released and withdrawn from the pipe, allowing the outer shell member to tighten around the now hardened inner shell. A particular advantage of this process is that the excess water expelled from the fluid concrete by the pressure applied thereto can easily pass through the slightly permeable concrete of the outer shell, so that the concrete of the inner shell member is given the maximum compactness and resistance to stresses.

In order to accelerate the process of setting and hardening the concrete forming the inner shell, heat is supplied by hot water or steam to obtain complete hardening in a very reduced number of hours.

With the above and other objects in view which will become apparent from the detailed description below, the invention is shown in the drawings in which:

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Fig. 1 is a cross-sectional view of the apparatus;

Fig. 2 is a section taken along line II—II of Fig. 1, and

Fig. 3 is a diagram of arrangement of the metallic reinforcement, made of high resistance steel in the prefabricated shell.

With reference to the drawings, in Figs. 1 and 2, 1 is a rigid core of concrete, or similar material, adapted to withstand the pressure exerted during the manufacture of the piping.

The core 1 is provided with a base of greater diameter than the core and integral therewith, having a surface 28 which supports the staves 2, and a peripheral surface 29 which supports the angle 23.

Reference numeral 3 is the concrete forming the body of the pipe to be formed and 4 the outer resistant shell of the pipe.

The pressure is transmitted to the concrete 3 through the radial displacement of the staves 2, under the expansion of the bags 5 mounted on the core 1 and made of hemp, or hemp and rubber, or metallic sheet, but preferably formed by a hemp bag having a resistant function, containing a rubber bag which insures the tightness.

Each of the bags 5 is supplied by a central collector 6 by means of the supplying tubes 32, radially arranged; the central collector 6 is connected with a plant supplying water under pressure.

In order to balance the greater pressure which would be in the lower bags, due to the height of the core 1, the distance between the bags may be decreased from the bottom of the core to its top; this decreasing spacing is not shown in the drawings.

Each stave 2 is formed by two channel irons, 7, having their backs facing each other, the space between said irons being filled with concrete. Said concrete is flush with the flange of the channel facing the core 1 and overlaps the opposite flange. The outer surface of the staves is treated with a product suitable to prevent the fresh concrete from adhering to the staves.

Each stave 2 is in the shape of an L, the foot of which is supported by means of the rollers 9 on the surface 28 of the core 1, thus permitting the stave to move freely under hydraulic pressure exerted through the bags 5 during manufacture of the pipe.

In the staves 2 there are embedded metallic tubes 10, preferably iron tubes; said tubes project from the upper portion of the stave and are connected to each other by means of joints 11 made of flexible material, which communicate with a source of heated fluid or gas and from the heating device for the concrete 3.

The tightness between the staves is obtained by means of the T's 12, the stems of which are inserted in the hollow space between the channels 7 of two adjacent staves, and are connected by springs 13 which keep the flanges of the T's adherent both to the external and internal surfaces of the staves.

Coaxially with the core is disposed a resistant shell 4, made of concrete and containing a reinforcement, preferably made of high tensile strength steel wires 26 and 27 arranged to form helices having equal inclinations but in opposite directions. The pipe 4 is provided with ribs 25, on which the formed pipes may rest when assembled and placed in a horizontal position. By placing the assembly in the horizontal position the weight of the parts is uniformly distributed along the length of the assembly.

Between the tube 4 and the staves 2, there is an annular space the width of which corresponds to the thickness of the pipe to be formed. The concrete 3 is poured into said annular space to form the body of the pipe.

Said concrete is hand compressed or is vibrated when it is poured.

Before pouring the concrete, sealing members 14 are disposed on the foot 8 of the staves under the shell 4. After pouring is completed, similar sealing members 14' are disposed on the top of the shell 4 as shown in Fig. 2. One leg of the sealing members 14 and 14' abuts the staves 2, thus forming in the poured concrete a step adapted to receive a joint for the junction of two consecutive pipes. There are as many sealing members 14 and 14' as there are staves 2.

Each upper sealing member 14' is held by a Z iron 15 which, by means of two bolts 16 and 17 is fixed on the upper extremity of each stave.

In order to obtain the withdrawal of the staves to their original position, when the manufacture of the piping is ended, according to this invention, controlling means are provided, said controlling means being formed, at the upper extremity of each stave, by a bolt 18. The extremity of said bolt is threaded and is inserted in an angle iron 19 fixed on the upper surface of the core 1 in front of each stave. On the bolt 18 are screwed, adjacent the two surfaces of the leg of the angle 19, two nuts 20 and 21 which allow the radial position of the stave to be controlled.

A similar device, comprising the two angles 22 and 23 carried respectively by the foot 8 of the stave and by the surface 29 through which angles is inserted a totally or partially threaded bolt, with two nuts 30 and 31 bearing on the surfaces of each of the aforesaid angles, also allows the radial position of each stave to be controlled at its lower extremity.

When the staves 2 are to be allowed to move away from core 1 under the pressure of bags 5, nuts 20 and 30 must be spaced from the angles 19 and 22 to permit such movement. When the staves 2 are to be separated from the hardened concrete pipe, nuts 21 and 30 must be spaced from angles 19 and 22 and nuts 20 and 31 rotated so as to bear against angles 19 and 22 respectively.

The two aforesaid devices act as stop elements, as well as auxiliary screw jacks to arrange the staves in any desired position during manufacture of the tube.

From the above description the operation of the apparatus is clear.

Under the action of the hydrostatic pressure in the bags 5, the staves 2 are pushed outwards, compressing the fresh concrete 3 which transmits the pressure to the outer resistant shell 4.

Thus a balance is obtained between the compression on the core 1 and the tension on the outer shell 4, through the fresh concrete poured in the annular space, which concrete is compressed according to the hydraulic pressure in the bags and to the pre-tension given the reinforcing wires 26 and 27.

The resistant shell 4 has a thickness of few centimeters, the minimum compatible with the constructive necessities and owing to the tension to which it is submitted, the pipe tends to crack with several small cracks, through which can easily escape the excess water in the concrete 3, so that said concrete is strongly compressed and submitted to a total elimination of said excess water, and it is brought to the best conditions for reaching the maximum compactness and resistance.

When the balance between the pressure in the bags 5, the compression of the concrete 3 and the tension of the shell 4 is reached, the pressure in the bags is kept constant until the complete hardening of the concrete 3.

The hardening of the concrete is accelerated by causing hot water or steam to pass through tubes 10.

When the concrete is brought to a temperature of about 70-80° C., the complete hardening is obtained in eight to ten hours. When the concrete 3 is hardened, the bags 5 are emptied and the staves 2 are removed

from the concrete 3 by means of the aforesaid upper and lower control devices.

When the operation is ended, the complete pipe is formed by the outer shell and by the compressed concrete. The tension in the reinforcing wires of the outer shell is continually exerted on the compressed concrete, thus forming a precompressed concrete pipe of two parts, an outer and inner shell.

The process above described has the following fundamental advantages:

1. The pressing of the concrete can be brought to very high values, being limited only by the resistance of the outer shell 4 and value of the pressure to which the bags may be subjected. It is therefore possible to prepare pipes suitable to very high internal tensions.

2. The compactness of the concrete, and therefore its water tightness and mechanical and chemical resistance depend upon the compression given it when it is in the state of paste, it being obvious that the compactness will be greater when the compression will be higher.

3. The compression of the concrete, when it is in the state of paste, does not cause therein secondary and unknown stresses as may occur when other processes are used.

4. By using this process it is possible to form at the ends of each pipe the seat for the joint to connect adjacent pipes without using a special piece other than the sealing piece or taking an extra forming step.

It is thought that the invention and its advantages will be understood from the foregoing description and it is apparent that various changes may be made in the process, form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing its material advantages, the forms hereinbefore described and illustrated in the drawings being merely preferred embodiments thereof.

I claim:

1. A process of manufacturing reinforced precompressed concrete pipes, comprising pre-arranging a stationary central rigid core and expansible means which coaxially surround said core, arranging a pre-fabricated concrete shell consisting of a reinforcement of untensioned high tensile strength steel wires covered by a thin layer of concrete, said shell being coaxial to the said stationary core and being distanced from said expansible means to form an annular space, pouring concrete in said annular space, submitting it to a pressure from the inside of said concrete by means of said expansible means, the water contained in said poured concrete escaping through the wall of said shell and the said steel wires becoming tensioned, keeping said poured concrete under compression until the drying and the hardening thereof is completed, removing the said pressure from the inside and separating said expansible means from said hardened poured concrete, whereby the said tensioned steel wires compress said hardened poured concrete from the outside and said outer concrete shell and said hardened poured concrete form a single pipe wherein said poured concrete is under the compression exerted by said steel wires.

2. A process of manufacturing reinforced precompressed concrete pipes, comprising pre-arranging a stationary central rigid core and expansible means coaxially surrounding said core, arranging a pre-fabricated concrete shell consisting of a thin concrete wall the outer surface of which is provided with two ribs longitudinally disposed along the whole length thereof, and further consisting of untensioned high tensile strength steel wires arranged in two helices equally inclined with respect to the axis of the shell but in opposite directions, said shell being coaxial with the said stationary core and being spaced from the said expansible means to form an annular space, predisposing removable sealing members at the bottom of the said annular space, pouring concrete in the said annular space, disposing removable sealing

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members at the top of the said annular space after the concrete has been poured therein, the said removable lower and upper sealing members being arranged to generate in the poured concrete a recess for a joint, subjecting said concrete to pressure from the inside said poured concrete by means of said expansible means, whereby the water contained in the poured concrete escapes through the wall of the said shell and the said reinforcing steel wires are tensioned, keeping said poured concrete under compression until drying and hardening thereof is completed, accelerating said drying and hardening by heating said expansible means adjacent to the said poured concrete, and separating said expansible means from said poured concrete, whereby said tensioned steel wires compress said hardened concrete and said outer concrete shell and said poured concrete form a single pipe wherein said poured concrete is under the compression exerted by said steel wires.

3. An apparatus for the manufacture of reinforced pre-compressed concrete pipes, comprising in combination a stationary central rigid core provided with a projecting circular base, a plurality of staves adjacent each other and tightly arranged with respect to each other to form an expansible cylinder member, said staves resting on the said circular projecting base and being radially movable on the said base with respect to the said stationary central core, a plurality of expansible bags adjacent each other between the said central core and the said plurality of staves, said bags being in communication with a hydraulic pressure source and pre-arranged to expand to radially move said staves from the said central core, hand operable means which adjustably connect said staves and said central core to limit the distance to which said staves may be moved from said central core sealing members associated with each stave at the bottom is adjacent the outer surface of the stave and the other leg of which projects outwardly from the stave.

4. An apparatus for the manufacture of reinforced pre-compressed pipes, comprising in combination a stationary central rigid core provided with a projecting circular base, a plurality of staves adjacent each other and tightly arranged with respect to each other to form an

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expansible cylinder member, said staves being L shaped, a plurality of rollers between the shorter leg and the said circular projecting base on which said staves are radially movable with respect to the interior of said said stationary central core, the two legs of the L shaped staves being provided with heating ducts, a plurality of expansible bags adjacent each other between said stationary core and said plurality of staves, the vertical distance of the said bags from each other decreasing from the bottom to the top of said staves, said bags being in communication with a single hydraulic pressure source and arranged to expand under said hydraulic pressure to move the staves from the said stationary core, hand operable means which adjustably connect said staves and said stationary core to limit the distance to which said staves may be moved from said stationary core and to approach said staves to the said stationary core, sealing members associated with said plurality of staves and at the bottom and the top thereof, said sealing members being in the shape of angles one leg of which is adjacent the outer surface of the stave and the other leg of which projects outwardly from the stave.

5. An apparatus as claimed in claim 4, wherein each stave is formed with two channels spaced from each other and with the backs facing to each other, a concrete beam connecting said channels the inner face of which is flush with one flange of the channel and the outer face of which protrudes with respect to the other flange of the channel and overlaps said outer face.

6. An apparatus as claimed in claim 5, wherein a sealing member is disposed between two adjacent staves, said sealing member comprised of two ties, stems on said ties, spring means connecting said stems to each other, the legs of said ties overlapping the channels of two adjacent staves.

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