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PROCESS OF MANUFACTURING REINFORCED CONCRETE PRESSURE PIPES.

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1,107,235. Patented Aug. 11, 1914.

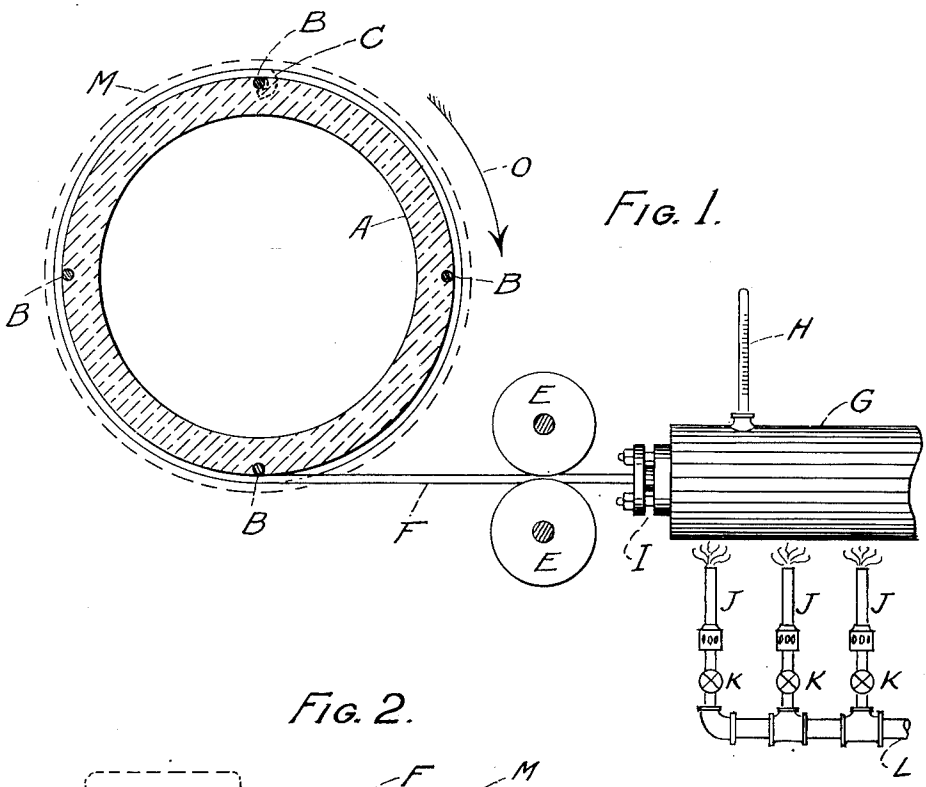
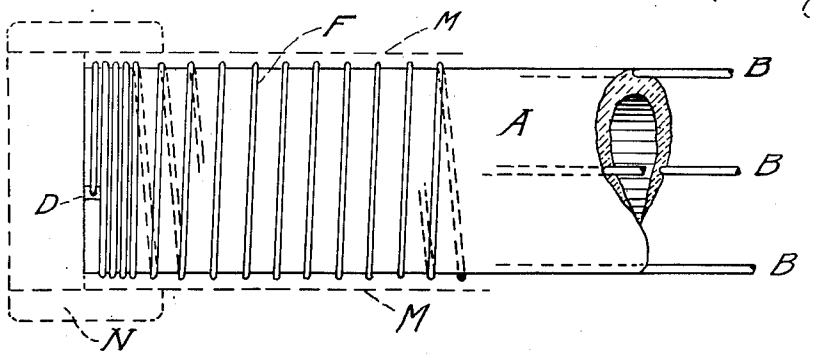


FIG. 1.

FIG. 2.



WITNESSES

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PROCESS OF MANUFACTURING REINFORCED-CONCRETE PRESSURE-PIPES.

1,107,235. Specification of Letters Patent. Patented Aug. 11, 1914.

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To all whom it may concern:

Be it known that I, GEORGE RAE, a citizen of the United States, residing at 251 Tenth street, in the city of Portland, county of Multnomah, and State of Oregon, have invented new and useful improvements in the process of manufacturing reinforced-concrete pressure-pipes designed or intended to resist tension stresses and analogous composite structures of materials having properties similar to those composing reinforced concrete, of which the following is a specification.

This invention relates to improvements in the art or process of manufacturing pressure pipes or similar structures of combinations of materials of differing properties, by which the materials are united in such a way as to efficiently utilize the more valuable properties of the various materials combined.

It is the experience of those familiar with the present state of the art of manufacturing reinforced concrete pressure pipes, that under pressures producing economical working stresses in the steel, fine cracks are formed in the concrete by reason of the fact that concrete in combination with steel ruptures long before the steel has attained its safe working stress.

The object of this invention is to obviate such injurious cracking in reinforced concrete pipe and like composite structures subject to tensile stresses by maintaining the continuity or integrity of the concrete. This process is particularly valuable in the manufacture of reinforced concrete pressure pipe and pipe of similar construction, also hooped column shells and the like.

I am aware that tension material in a state of initial tension has been embedded in green concrete heretofore, and also that rods, etc., have been put in tension during the hardening and contraction of the concrete through the use of tensioning devices incorporated in the structure. This invention is an improvement in that no tensioning devices are incorporated and in that the concrete is normally in a state of induced compression, which is automatically relieved concurrently with an increase in the initial tensile stress in the steel to a desired amount upon the application of an internal working pressure.

This invention relates to a new, novel, and useful process for the manufacture of such combination structures whereby the tension resisting material attains the desired working stress without permitting such cracks to form, and in the case of pressure pipe and hooped column shells, or the like, the tension resisting properties of the steel or other tension resisting material are initially available, without the preliminary deformation now necessary to develop the full resistance of the structure.

Figure 1 shows a cross section of the core, together with a method of applying the process and a diagram of a device which may be used. Fig. 2 shows a portion of pipe with the reinforcing applied, the outer coating to be applied later being indicated by dotted lines for the sake of clearness.

In the drawing, A is the shell or core of suitable length, previously formed and hardened, embedded in which, preferably at the surface, are the longitudinal reinforcing rods B.

C and D are devices for holding end of helical reinforcement F.

E are guide rollers having a friction drag not shown.

G is the heating chamber containing an alloy or material of suitable melting point, with stuffing box I at each end, and thermometer H to indicate the temperature within.

J are burners fed from supply pipe L, through the regulating valves K. The guide rollers and heating apparatus are mounted on a suitably moving carriage not shown, the movement of which in conjunction with the rotary movement of the core A indicated by the arrow O, serves to apply the reinforcement F in the form of a helix.

The practical application of the process by the device shown is as follows:—The core A is centered in a lathe or similar machine capable of rotating it. The heating and guiding devices being mounted on a movable carriage, are caused to move at a rate which in conjunction with the rotary motion of A will produce a helix of the desired pitch. The supply pipe L is connected by means of a flexible tube to a gas main or the like. The reel of reinforcing material may also be mounted on the movable carriage. The material F, having attained the desired temperature in its passage through the heating chamber G, passes over the grooved guide rollers E which through the action of the friction drag mentioned cause the material F to come into close contact with the rotat-

ing core A. When the heated material F cools to the common temperature, the core A is compressed to an extent dependent on the temperature at which the material F is applied. It will be evident that the heating chamber G can be dispensed with by producing an elongation equal to that attained by the heating, through or by means of a tensile stress produced by a suitable arrangement of friction drags. Whether the material F is applied heated or in an elongated condition produced by tensile stress, it will be evident that it will strongly grip the core A, thereby securing the several turns of the helix in their designed position without the use of devices for tying them to the longitudinal rods.

The data for the proper application of the process is determined by calculation based on the physical properties of the materials involved. If concrete is to be used as the compression resisting material, its compressive strength and modulus of elasticity are to be determined. If the tension resisting material is to be steel, its tensile strength and modulus of elasticity are necessary in calculating the proper relation and initial stresses of the materials. This invention makes it possible to use steel of high tensile strength at its safe working stress.

As an example, the calculation for a 12-inch reinforced concrete pipe for a pressure of 200 lbs. per square inch may be indicated, assuming the following constants for the materials:

Concrete, modulus of elasticity	3,000,000 lbs
Concrete, ultimate compressive strength	2,000 lbs.
Steel, modulus of elasticity	30,000,000 lbs.
Steel, working stress, one-half elastic limit, say	20,000,000 lbs.

It is aimed to so adjust the relation between the steel and concrete that when the pipe is under its working pressure the steel will be stressed to 20,000 lbs. per square inch and the concrete will be substantially under no tensile stress. As an example of the application of the process, the steps necessary for manufacturing a 12-inch reinforced concrete pipe designed for an internal pressure of 200 lbs. per square inch will be indicated. A plain concrete pipe of 12-inches inside diameter is made with a thickness of shell of 1-inch. When this has attained a suitable compressive strength, say 2000 lbs. per square inch, it is wound with steel having an area of $\frac{1200}{20000}$ square inch per inch of length of pipe under a tension of 12,500 lbs. per square inch or at a temperature which will produce an elongation equal to that produced by this tension. A simple calculation in accordance with well known principles of mechanics will show that the compression in the concrete will then be 750 lbs. per square inch, and when the completed structure is subjected to an internal pressure of 200 lbs. per square inch, the compression in the concrete will be reduced to zero, and the tension in the steel will be 20,000 lbs. per square inch. As a result of this condition the concrete will not be ruptured, and its tensile strength will act as a factor of safety in conjunction with the increased tensile stress in the steel if subjected to greater pressure than that provided for in the construction. It is evident that the tension resisting material can be effectively applied to molded or cast cores of other material possessing compressive strengths great in comparison with their tensile strengths, as burnt clay, terra cotta, glass, etc., the initial tensile stress of the tension resisting material being adjusted in accordance with the relations of the physical properties of the materials used so that at the designed working stress there will be substantially no tensile stress in the compression resisting material.

After the steel is applied as indicated, a protective coating of a suitable corrosion resisting or fire-proofing material is applied externally, and an interior coating of waterproofing material intended to close the pores of the concrete may be applied. The steel or other tension resisting material may be effectively applied in a state of tension by a suitable means for producing the desired tension directly or by indirect means as by its application at such a temperature that when the steel or tension resisting material cools to the temperature of the concrete or other core, the desired tension will exist in the tension material and the desired compression in the compression resisting material.

I claim:

1. An improved process of manufacturing reinforced concrete pressure pipe and similar composite structures consisting in the application of the steel or tension resisting material to a hardened shell or core of concrete or similar material in the form of a continuous helix in a state of tension of such degree as will induce a determinate beneficial relation of stresses in the component parts of the structure, for the purposes set forth.

2. An improved process for manufacturing reinforced concrete pressure pipe and similar structures consisting in the application of tension material as a helix inclosing a core or shell of hardened concrete, said helix of tension material being applied at such a temperature that on cooling the induced compressive stress in the core will be of such degree that when the designed internal pressure is applied, there will be a designed increased tensile stress in said helix, coincident with a designed decreased compressive stress in said core or shell of concrete.

3. As an article of manufacture, a reinforced concrete pressure pipe composed of

a core or shell of concrete or similar material normally in a state of induced peripheral compression, produced by an incasing helix of tension material normally in a state of initial tension, the relations of cross sectional areas and initial stresses being such that when the pipe is subjected to the designed internal pressure, the tension in the tension material is thereby increased to a designed amount coincidently with a designed decreased compressive stress in the concrete core or shell.

GEORGE RAE.

Witnesses:
H. E. HEATH,
WM. C. SAUNDERS.