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APPARATUS AND METHOD FOR RELEASING LOADS ON STRESSING BEDS FOR MAKING PRESTRESSED CONCRETE

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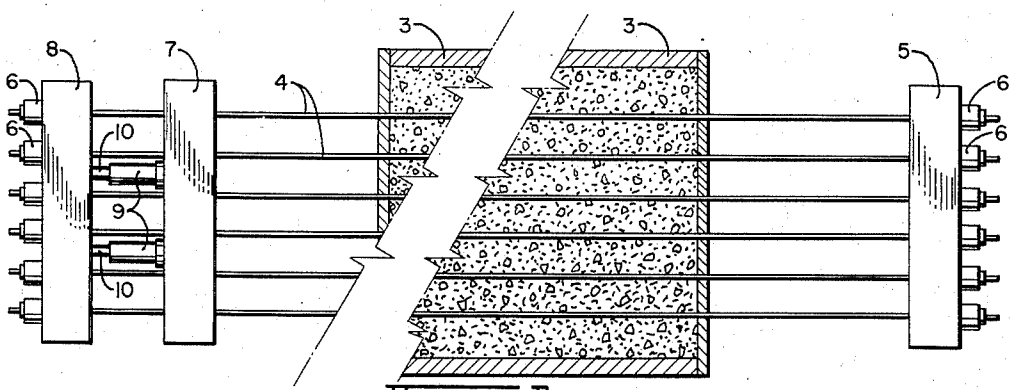


FIG. 1

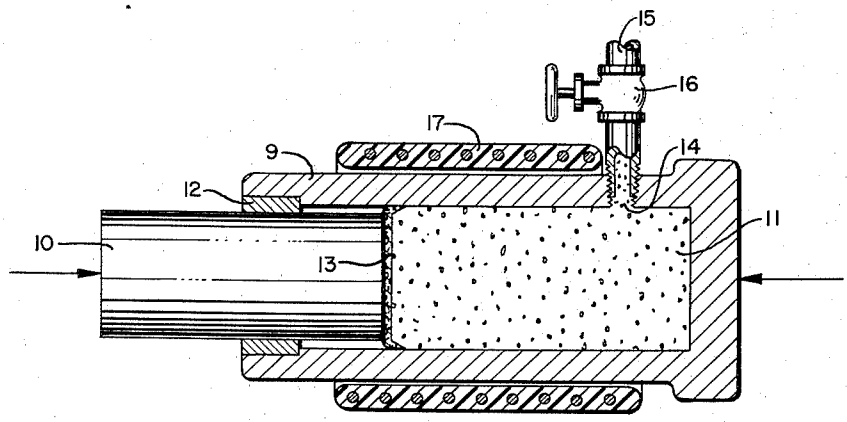


FIG. 2

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APPARATUS AND METHOD FOR RELEASING LOADS ON STRESSING BEDS FOR MAKING PRESTRESSED CONCRETE

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7 Claims. (Cl. 25—1)

The invention relates to the manufacture of prestressed concrete, and has special reference to an apparatus and method for "letting down" the load on a long pretensioning line.

Summary

The pretension method of making prestressed concrete requires that a multiplicity of tendons be drawn to a high tension and held under stress between two anchor points on a stressing bed. Concrete is then cast around the tendons which must harden and mature sufficiently to develop an anchorage by bond, at which time the tension at the end of the line of tendons is released, transferring a force into the concrete.

In the manufacture of large concrete members, the total tension in the tendons may amount to several hundred tons. In applying the tension, the number of tendons which may be drawn up at a given time is limited by the capacity of the equipment used. It has been found in practice that a hydraulic ram with a capacity of 50 to 100 tons is most convenient. Thus, if the total force required exceeds this value, groups of tendons may be drawn up in succession and anchored between the fixed anchor points at the ends of the stressing bed.

After the concrete is cast around the tendons, it hardens and shrinks, introducing additional tension in the exposed tendons at the ends of the stressing bed. Because the total tension existing in the tendons may exceed by many times the capacity of the hydraulic rams used to apply the initial tension to individual tendons or separate groups of tendons step by step, a problem is presented how to effect a gradual release of the total force. One method which has been tried is to use "spacer" blocks to hold the load, and then let down the load by the following sequence of operation: (1) lift the load off the spacers by the use of several powerful hydraulic jacks, (2) remove the spacers, and (3) let the load down upon the hydraulic jacks. When loads up to a million pounds are encountered, the amount of hydraulic equipment required becomes a problem in itself.

Moreover, because of the aforementioned shrinkage of the concrete upon hardening, the tension build-up in the exposed tendons at the ends of the stressing bed in the production of long sections of concrete is so great that the force required to free the spacer blocks can cause rupture of the tendons. When the tendons start to rupture, a chain reaction can take place with explosive results.

In order to accomplish a gradual release of the total force without initially increasing the force by hydraulic rams, I hit upon the idea of making one end of the stressing bed controllably movable by carrying the total force on a cylinder, or a group of cylinders, filled with paraffin wax which under normal room temperatures is a solid, but which when warmed becomes sufficiently fluid to extrude or flow out through bleeder pipes. Valves on the bleeder pipes are opened to allow a controlled flow. My invention can be practised with the use of other

materials than paraffin wax, for example, sulfur or other thermoplastic materials, or some of the low melting point metals. In any case the material should be one having flow characteristics susceptible of control so as to maintain solidity against flow under one condition but which under another condition can flow to allow the material to bleed from the cylinder for gradual release of the load. Another material which can be used if desired, is one of the available special oils which can be made to act as a solid when subjected to a strong magnetic field, so that when the magnetic field is turned off or diminished, the oil can be bled from the cylinder.

In general my method of releasing the load on a stressing bed comprises tensioning one or more tendons against an enclosed column of material having flow characteristics susceptible of control so as to maintain solidity against flow during the tensioning step, and after the concrete has set around the tendon(s) on the stressing bed, effecting a change in the control of the flow characteristics of the material within the enclosed column so that such material can flow through an opening in the enclosed column for releasing the tension on the tendon(s). The apparatus may comprise fixed and movable blocks at one end of the stressing bed, means operatively associated with the movable block for anchoring one or more tendons or groups of tendons under tension, a cylinder and coacting pistons arranged between the fixed and movable blocks to hold them apart by coaction of the piston element with one of the blocks and of the cylinder with the other.

In the specification, and in the appended claims, I use the term "tendon" to refer to any of the wires or strands which may be employed in making prestressed concrete. For example, the tendon may be a single wire or it may be stranded wire, i.e. wire made up of a group of smaller wires, or strands twisted together as in a wire "rope," as where a center wire, or core, is surrounded by, say, six other wires of the same size twisted helically around the core wire.

Description

Referring to the drawings, I shall now describe the best mode contemplated by me of carrying out my invention.

Fig. 1 is a general arrangement view showing, in plan, the opposite ends of a prestressing bed to which my invention is applied.

Fig. 2 is a cross sectional view through one of the cylinders containing the material of special flow characteristics used to controllably release the tension in the exposed ends of the tendons after setting of the concrete.

In Fig. 1, I have shown two ends of the mold 3 for casting a prestressed concrete section such as a beam. A group of high tensile steel wires, or tendons, 4 extend through the mold lengthwise of the beam and are anchored at one end to a fixed abutment 5 as by means of suitable wire grips 6. These grips may be of any well known construction and can advantageously be of the construction disclosed and claimed in my copending application for patent, Serial No. 406,671, filed January 28, 1954.

My apparatus comprises in its general arrangement a fixed block 7 and movable block 8 at one end of the stressing bed, means such as wire grips 6, operatively associated with the movable block 8 for anchoring the tendons or groups of tendons 4 under tension, cylinders 9 and coacting pistons 10 arranged between the fixed and movable blocks to hold them apart by coaction of the piston with block 8 and of the cylinder with block 7. Cylinder 9 contains the material 11 which I have described as having flow characteristics susceptible of control so as to maintain solidity against flow under one condition but

which will flow under other conditions. A suitable guide bushing 12 is provided between the piston 10 and one end of the cylinder 9. Affixed to the inner end of the piston element is the usual type of hydraulic cup packing or piston seal 13 made of leather, neoprene, or other suitable material. An opening 14 is provided near the inner end of the cylinder and affords an outlet to a bleeder pipe 15 in which is arranged a control valve 16. Coil 17 surrounding cylinder 9 represents an induction heater employed for warming the paraffin wax, sulfur, etc. 11, or a coil for creating a magnetic field where the material 11 is an oil capable of acting as a solid when subjected to the influence of such a field.

In the preferred practice of my invention, the cylinders 9 are filled with paraffin which is allowed to harden, and the valves 16 of the cylinders are closed. The cylinders and their coacting pistons now serve as spacers between the fixed and movable blocks 7 and 8. Next the tendons are anchored by the grips 6 at one end of the prestressing bed, and tension is applied to them at the opposite end by any well known means, and this tension is maintained by grips 6. This tension may be applied to one tendon, or group of tendons, at a time. After all the tendons have been set up under tension, the total force in the tendons is resisted by the solid paraffin in the cylinders. Now the concrete is cast around the taut tendons and allowed to harden and shrink, developing a bond to the tendons which increases the load carried by the paraffin in the cylinders. When the tension in the tendons is released from the stressing bed to the concrete, the paraffin is warmed as by means of induction coil 14, and slowly released from the cylinders through the bleeder pipes 15 as the valves 16 are opened. I have found that pressures in excess of 10,000 p.s.i. (pounds per square inch) can be held for long periods of time at normal room temperatures without leakage of the paraffin. When warmed to 80 or 90° F., the paraffin will slowly extrude, affording excellent control over the rate at which the movable block 8 recedes, lowering the force in the tendons.

The terms and expressions which I have employed are used in a descriptive and not a limiting sense, and I have no intention of excluding such equivalents of the invention described, or of portions thereof, as fall within the the scope of the claims.

I claim:

1. Apparatus for releasing the load on a stressing bed for making prestressed concrete, comprising fixed and movable blocks at one end of the stressing bed, means operatively associated with the movable block for anchoring a tendon under tension, a cylinder and coacting piston arranged between the fixed and movable blocks to hold them apart by coaction of the piston with one of the blocks and of the cylinder with the other, the cylinder containing a material having flow characteristics susceptible of control so as to maintain solidity against flow under one condition, and an opening in the cylinder through which, under another condition, said material can flow to allow the piston to move into the cylinder for releasing the tension on the tendon.

2. Apparatus according to claim 1, in which the material contained in the cylinder is one whose flow characteristics are susceptible of control by changes in temperature.

3. Apparatus according to claim 1, in which the material contained in the cylinder is one which maintains solidity against flow at ordinary room temperatures and flows when warmed to higher temperatures.

4. Apparatus according to claim 1, in which the material contained in the cylinder is one which maintains solidity against flow only when subjected to a strong magnetic field, and in which the apparatus includes means for creating such a magnetic field.

5. Apparatus according to claim 1, in which the material contained in the cylinder is paraffin.

6. Apparatus according to claim 1, in which the material contained in the cylinder is sulfur.

7. Apparatus according to claim 1, in which the material contained in the cylinder is oil capable of acting as a solid when subjected to a strong magnetic field.

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