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HYDRAULIC JACK FOR THE PRESTRESSING OF
CONCRETE REINFORCEMENTS
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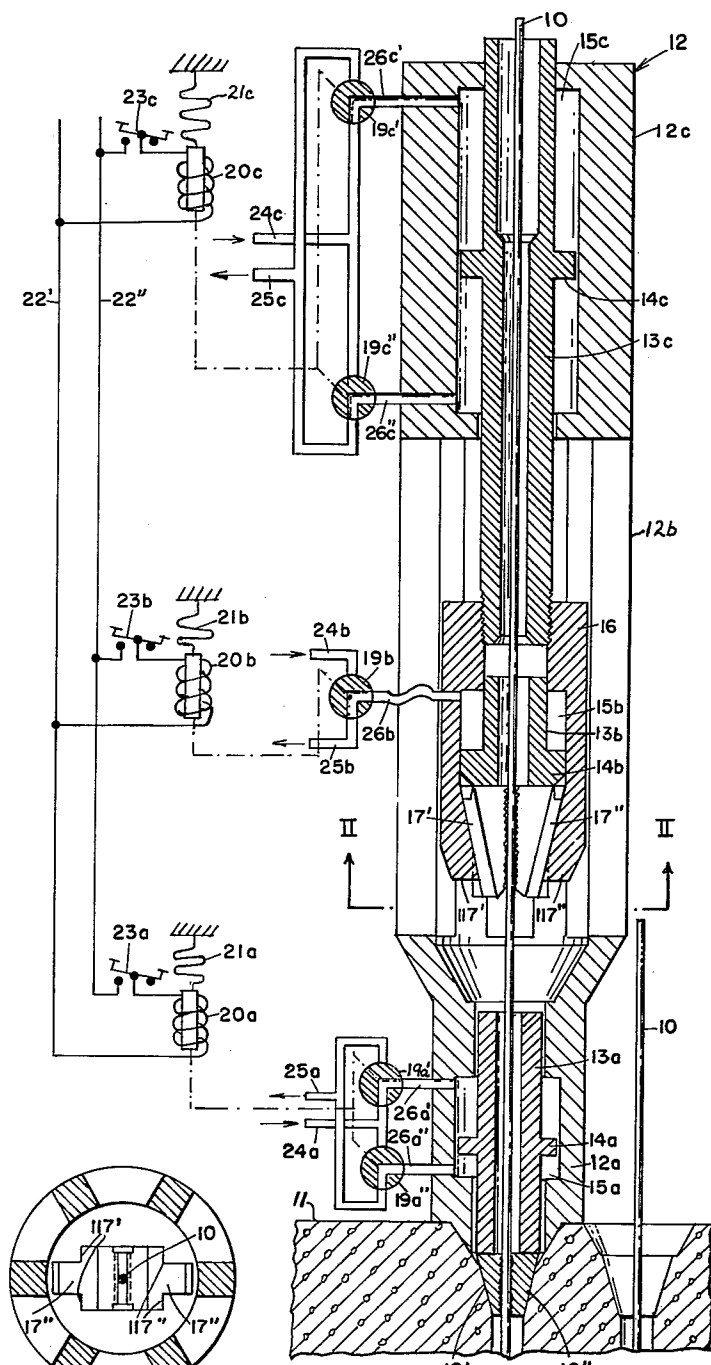


FIG. 2

FIG. 1

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3,090,598 HYDRAULIC JACK FOR THE PRESTRESSING OF CONCRETE REINFORCEMENTS

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9 Claims. (Cl. 254-29)

My present invention relates to a hydraulic jack of the type used to impart tension to the prestressing elements of concrete structures.

In the prestressing of such structures it is customary to anchor one or more tensionable elongated elements, such as rods or cables, to a support for a concrete layer to be poured around these elements (pre-tensioning), or to the layer itself if the concrete has already hardened (post-tensioning), and thereafter to attach a hydraulic jack to the opposite end of each individual element or a group of such elements to impart the necessary tension thereto. When the desired degree of stress has been reached, each tension element is anchored also at its last-mentioned end to the concrete or its supporting structure by suitable means. In many instances the anchorage is only temporary since the stroke of the jack may be insufficient to provide the necessary tension in one operation, and/or because shrinkage of the concrete may require a subsequent retensioning.

The releasable anchoring of the prestressing elements alternately to the structure and to the jack requires the provision of clamping means which heretofore had been rather cumbersome and necessitated a sequence of fastening and unfastening steps incapable of being performed in the proper sequence by a single operator. It is, therefore, an object of my present invention to provide a simplified hydraulic system for the purpose set forth which can be operated by a single person in automatic or semi-automatic fashion and which securely engages a single prestressing element or a group of such elements at any stage of its operation.

The invention realizes the foregoing object by the provision of a hydraulic tensioning device, a hydraulic clamping device and a hydraulic locking device, the latter serving to anchor the tensionable element or elements to any adjacent part of the structure prior to the release of the clamping device, such release occurring whenever the tensioning device is reset (i.e. advanced toward the structure) in preparation for a new tensioning stroke or when the jack is to be removed upon the completion of the stressing operation. The clamping device is, advantageously, disposed between the tensioning and locking devices in such manner that the hydraulic plunger of the locking device is able on its return stroke to assist the plunger of the tensioning device, at least at the beginning of the operating stroke of the latter, by bearing upon the locking device which is then held in its engaged position. The plungers of the three hydraulic devices mentioned above are preferably of tubular configuration and coaxially positioned so that the prestressing element or elements engageable thereby can pass axially through all three plungers in series.

I have found that, in a hydraulic system of the character just described, only the plungers of the tensioning and locking devices need to be designed as double-action pistons whereas the plunger of the intermediate clamping device may be just a single-action piston. The stroke of these pistons may be conventionally controlled by manual actuators, such as push-buttons, which serve for the selective energization of associated valve-positioning means (e.g. solenoids) adapted to direct oil or some other hydraulic fluid into the proper inlet and outlet conduits.

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The invention will be described in greater detail with reference to the accompanying drawing in which:

FIG. 1 illustrates, partly in diagrammatic form, an improved hydraulic jack according to this invention as used in the post-tensioning of a concrete structure; and

FIG. 2 is a sectional view taken on the line II-II of FIG. 1.

The device shown in the drawing, designed for the successive tensioning of a plurality of single-wire prestressing elements 10 projecting at one end from a concrete structure 11 to which their other ends are conventionally secured, comprises a jack 12 with a tripartite housing 12a, 12b, 12c respectively containing a hydraulic locking device, a hydraulic clamping device and a hydraulic tensioning device.

The locking device of jack 12 consists essentially of a tubular plunger 13a having a collar 14a which constitutes a double-action piston within a cylinder 15a. The tensioning device similarly comprises a tubular plunger 13c whose collar 14c forms a double-action plunger in a cylinder 15c. The clamping device is represented by a sleeve 16 which is secured onto the adjacent end of plunger 13c and forms a chamber 15b for plunger 13b, the latter having a shoulder 14b effective as a single-action piston. The clamping device also includes a pair of jaws 17', 17'' whose wedge-shaped flanks are guided between complementary camming extensions 117', 117'' of sleeve 16 and which project from that sleeve toward the plunger 13a. The latter co-operates with generally similar clamping wedges or releasable anchor means 18', 18'' positioned in a recess of concrete structure 11 to engage the prestressing element 10.

In the embodiment illustrated it has been assumed that the prestressing elements 10 project upwardly from the structure 11 which may be considered, for example, as a column-supported slab. Thus, the plungers 13a, 13b, 13c share a common vertical axis and have aligned bores through which the element 10 may be progressively drawn upwardly, even to the extent of projecting from the upper end of the jack.

An electrically controlled hydraulic system, including a source of fluid under pressure (e.g. pump and reservoir) not further illustrated, comprises a pair of valves 19a', 19a'' for the plunger 13a of the locking device, a similar pair of valves 19c', 19c'' for the plunger 13c of the tensioning device, and a single valve 19b for the plunger 13b of the clamping device. These valves, provided with inlets and outlets for the admission of high-pressure fluid to the associated piston cylinders and for the return of such fluid to the low-pressure side of the source, are under the control of respective cylinders 20a, 20b, 20c and restoring springs 21a, 21b, 21c. The coils 20a, 20b, 20c are energizable from two bus bars 22', 22'' via respective pushbutton switches 23a, 23b, 23c which may be manually operated, although automatic actuation is of course also possible.

More particularly, valves 19a', 19a'' are provided with a common supply conduit 24a, a common return duct 25a and respective connecting ducts 26a', 26a'' leading to opposite extremities of cylinder 15a. Valves 19c', 19c'' similarly connected to a common supply conduit 24c, a common return conduit 25c and respective connecting ducts 26c', 26c'' extending to the upper and lower ends of cylinder 15c. Valve 19b has a supply conduit 24b, a return conduit 25b and a single connecting duct 26b, the latter being in the form of a flexible tube to enable axial displacement of the cylinder 15b to whose upper end it is connected.

In operation, the tensionable element 10 is initially freely movable between the wedge members 18', 18'' when the jack 12 is brought to bear upon the structure

11 so as to be at least partly traversed by this element 10. At this instant, with switches 23a, 23b, 23c all unoperated, plungers 13a, 13b, 13c are in their bottom positions or moving toward it, as shown; cylinders 15a, 15c communicate through their upper ducts 26a', 26c' with the respective high-pressure conduits 24a, 24c while cylinder 15b is connected to low-pressure conduit 25b so that its plunger 13b bears only lightly upon the clamping jaws 17', 17'' whereby the element 10 is free to pass therebetween.

Next, switch 23b is closed to reverse valve 19b whereby pressure is exerted upon plunger 13b and the jaws 17', 17'' are actuated to grip the element 10. Then, switches 23a and 23c are closed concurrently or in immediate succession. Switch 23a, in reversing the valves 19a' and 19a'', raises the plunger 13a to insure that the wedges 18', 18'' will not interfere with the subsequent partial withdrawal of element 10 from the concrete structure 11; this action also causes the plunger to assist in the initiation of such withdrawal as its upper end bears upon the projecting lower faces of jaws 17', 17'' which at this instant firmly embrace the element 10. Naturally, the hydraulic system must be so designed that the plunger 13b will not yield to the resulting pressure so that this plunger, jaws 17', 17'' and cylinder 16 will move upwardly as a unit while securely gripping the element 10. With switch 23c closed, such upward movement is accelerated by the action of the hydraulic fluid upon the lower piston face of collar 14c as the reversal of valves 19c', 19c'' causes the plunger 13c to rise; the ascent of plunger 13c continues beyond the upward stroke of plunger 13a so that the jaws 17', 17'' are lifted out of engagement with the last-mentioned plunger until the limit of the tensioning stroke of the jack is reached or until the stress in element 10 has reached a desired value.

Next, switch 23a is opened to reverse the movement of plunger 13a which thereupon descends to drive the wedges 18', 18'' into tight contact with the element 10, thereby locking it in position. Switch 23b is then opened to release the pressure upon the jaws 17', 17'', and switch 23c is also opened to return the plunger 13c to its starting position. If the element 10 is relatively rigid (e.g. a steel rod), then it will be promptly disengaged by this action from the jaws 17', 17'' of the clamping device as the latter is moved downwardly by the plunger 13c on which it is mounted. If it is flexible, e.g. a relatively thin wire or cable, it may bend in the space between clamps 17', 17'' and 18', 18'' so that release will not be complete until the jaws 17', 17'' strike the top of housing portion 12a whereby these jaws are driven upwardly with respect to cylinder 16 and the plunger 13b is forced back; the bent wire or cable will then straighten out, by virtue of its resiliency, whereupon it can be further tensioned in the manner described. With all of the switches 23a, 23b, 23c open, the same sequence of operations may be repeated as often as necessary.

It will be apparent that several jacks of the type shown in the drawing may be mounted side-by-side in a common frame for simultaneous operation on a plurality of parallel elements 10, and that the construction of the jack may be modified in various ways without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A hydraulic jack adapted for the stressing of an elongated tensionable element anchored at one end to a structure provided with releasable anchor means for said element remote from said one end, comprising a tubular housing positionable to surround a projecting portion of said element while bearing with a forward extremity upon said structure, hydraulic locking means for said element at the forward extremity of said housing adapted to cooperate with said releasable anchor means at said structure, hydraulic tensioning means for said element mounted rearwardly of said locking means, and hydraulic clamp-

ing means in said housing secured to said tensioning means at a location between the latter and said locking means and operable independently of said tensioning means for releasably engaging said element.

2. A hydraulic jack according to claim 1 wherein said clamping means and said tensioning means are provided with separate hydraulic circuits having independently operable control means for the circulation of fluid therein.

3. A hydraulic jack according to claim 1 wherein said clamping means, said locking means and said tensioning means are provided with separate hydraulic circuits having independently operable control means for the circulation of fluid therein.

4. A hydraulic jack adapted for the stressing of an elongated tensionable element anchored at one end to a structure provided with releasable anchor means for said element remote from said one end, comprising a tubular housing positionable to surround a projecting portion of said element while bearing with a forward extremity upon said structure, hydraulic locking means for said element at the forward extremity of said housing adapted to cooperate with said releasable anchor means at said structure, hydraulic tensioning means for said element mounted rearwardly of said locking means, and hydraulic clamping means in said housing secured to said tensioning means at a location between the latter and said locking means for releasably engaging said element; said locking means, said clamping means and said tensioning means respectively including a first, a second and a third plunger of tubular configuration in coaxial alignment for traversal by said element, said locking means and said tensioning means further including respective cylinders for said first and third plungers rigid with said housing, said clamping means further including a movable cylinder for said second plunger, said movable cylinder being rigidly connected with said third plunger.

5. A hydraulic jack according to claim 4 wherein said movable cylinder is provided with a forward end portion positioned in the path of the return stroke of said first plunger for concurrent rearward displacement by said first and third plungers in the stressing of the tensionable element engaged thereby.

6. A hydraulic jack adapted for the stressing of an elongated element anchored at one end to a structure provided with releasable anchor means for said element remote from said one end, comprising a tubular housing positionable to surround a projecting portion of said element while bearing with a forward extremity upon said structure, hydraulic locking means for said element at the forward extremity of said housing adapted to cooperate with said releasable anchor means at said structure, hydraulic tensioning means for said element mounted rearwardly of said locking means, and hydraulic clamping means in said housing secured to said tensioning means at a location between the latter and said locking means for releasably engaging said element; said locking means, said clamping means and said tensioning means respectively including a first, a second and a third plunger of tubular configuration in coaxial alignment for traversal by said element, said locking means and said tensioning means further including respective cylinders for said first and third plungers rigid with said housing, said clamping means further including a movable cylinder for said second plunger, said movable cylinder being rigidly connected at its rear end with said third plunger and being provided at its forward end with jaw means engageable with said element under pressure from said second plunger.

7. A hydraulic jack according to claim 6 wherein said jaw means projects forwardly from said movable cylinder upon being urged into clamping engagement with said element by said second plunger, the projecting part of said jaw means being positioned in the path of the return stroke of said first plunger for concurrent rearward displacement of said movable cylinder by said first

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and third plungers in the stressing of the elongated element engaged by said jaw means.

8. A hydraulic jack according to claim 7 wherein said rigid cylinders are each provided at opposite ends with fluid inlets for the displacement of said first and said third plungers, respectively, in opposite directions, said movable cylinder being provided with a fluid inlet only at its rear end for the forward displacement of said second plunger.

9. A hydraulic jack according to claim 8 wherein said 10

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housing forms an abutment forwardly of said movable cylinder in the path of said jaw means for positively disengaging the latter from said element upon full forward displacement of said movable cylinder by said third plunger.

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