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A. HOREL ETAL

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TENSIONING DEVICE FOR WIRES OR CABLES

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Fig. 1.

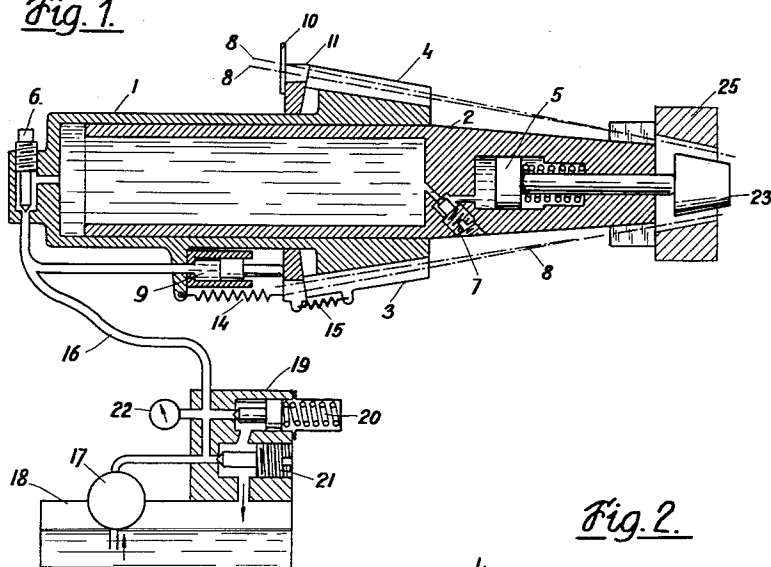


Fig. 2.

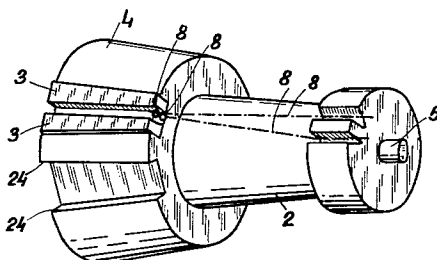


Fig. 3.

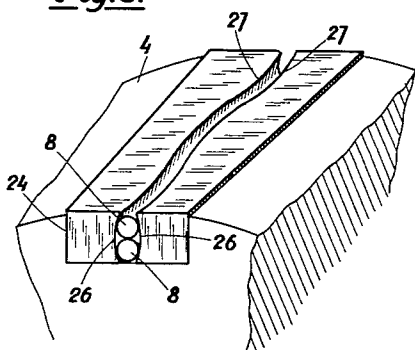
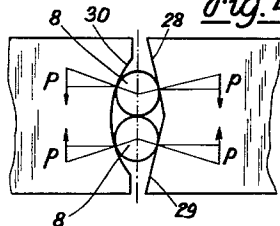


Fig. 4.



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**TENSIONING DEVICE FOR WIRES OR CABLES**

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In the production of structural elements from prestressed concrete rods or cables of a high-strength material are tensioned, anchored in the tensioned state and embedded in concrete so as to impart a permanent preliminary tensional stress to the concrete element produced.

Rods, cables, and similar elongated tension members which in the following disclosure will be generically referred to as "wires," are preferably combined into a bundle in which they are tensioned simultaneously.

Many types of anchoring and tensioning systems are known, and it is desirable to render the anchoring elements and tensioning devices cheap and safe in operation. They should facilitate the tensioning operation which has to be simple and quick. It is particularly required that the tensioning device should be capable of tensioning simultaneously an entire bundle containing as many wires as possible.

It is an object of the present invention to provide a device for tensioning wires, which permits the tensioning of bundles comprising a large number of wires.

It is a further object of the invention to provide a device for tensioning wires which permits quick and simple operation while meeting all requirements for safe work.

According to the invention two wires are simultaneously secured in the apparatus in one wedge-like clamp, comprising two wedge-shaped jaws defining a gap therebetween, said wedge-shaped jaws being adapted to move in a conforming to shaped groove arranged in a collar on the hydraulic cylinder of the tensioning device.

An example of the tensioning device embodying the present invention is shown in the accompanying drawing, wherein:

FIGURE 1 shows a longitudinal section of the tensioning device,

FIGURE 2 shows in a perspective view the front part of the tensioning device, illustrating at the same time how the pairs of wires to be tensioned are inserted into the wedge-shaped clamping jaws.

FIGURE 3 shows in greater detail the shape and the operative surfaces of the wedge-shaped clamping jaws on a larger scale, and

FIGURE 4 shows in a diagrammatic representation the forces which urge the wires against one another so as to place them in the most suitable position for the clamping operation.

The clamping device according to the invention comprises a hydraulic main cylinder 1 in which a piston or plunger 2 is slidably mounted. A locking or pressure piston 5 is guided in the piston 2, the purpose of the pressure piston 5 being to press an anchoring cone 23 into an anchoring sleeve 25 with the wires 8 therebetween so that, when the tensioning of the wires 8 is completed, the wires are locked between cone 23 and sleeve 25 so as to permanently anchor the wires in a tensioned state. A passage in the plunger 2 connects the cylinder 1 with the cavity of the plunger in which the locking piston 5 is movable. The passage is selectively opened and closed by a control valve 7 which is accessible from the outside during operation of the apparatus.

The cylinder 1 carries at its open end a head-piece or collar 4 provided at its circumference with wedge-shaped flutes or grooves 24. Inserted in the wedge-shaped flutes 24 are wedge-shaped jaws 3. Between the wedge-shaped jaws 3 a pair of wires 8 is placed. The

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clamping surfaces of the wedge-shaped jaws 3 define therebetween a gap or groove 26.

The groove 26 is defined by two planes 28, 29 forming a suitable angle in order to cause the wires to slide along them as far as the position in which they are pressed against each other (see FIG. 4). The clamping surfaces thus exert a uniform clamping action on both wires 8.

The two planes forming the aforementioned angle for lateral sliding motion of the wires 8 can be replaced by a concave arc 30 complying with the requirement that the wires 8 should slide laterally until they bear against one another.

The initial clamping of the wires 8 in the wedge-shaped jaws 3 is achieved by means of a body 11 which can be pressed by an auxiliary hydraulic cylinder 9, or mechanically, against the front ends of the wedge-shaped jaws 3.

The re-opening of the wedge-shaped jaws 3 is assisted (as will be described in greater detail hereinafter) also by the jaws 3 being connected resiliently by means of a spring, or rigidly by means of a connecting member 15, with the body 11. Said body 11 is returned either resiliently or positively into its initial position by means of a spring or connecting piece 14 secured to an immovable part of the cylinder 1.

The wires 8 are placed into the opened jaws 3 two at a time. It is of course possible to place only one wire 8 into the jaws 3. To prevent the wires 8 from becoming released from the opened jaws 3 i.e. from the groove 26, the wires are secured by means of a lock 10 located either on the body 11 or elsewhere. In order to facilitate the opening of the wedge-shaped jaws 3 after the wires 8 have been tensioned, the grooves 26 in one embodiment of the invention have the wavy or undulant formation as indicated by the reference numeral 27 on FIG. 3. The wires 8 in clamped condition are bent according to the wavy formation 27 of the grooves 26 and in this way resilient arcs are formed on the wires 8, said arcs, due to their elastic deformation, assisting the opening of jaws 3 after the pressure has been released.

The tensioning device according to the invention is operated hydraulically by means of a hand-operated or motor driven pump. The hydraulic system is arranged so that the tensioning device is fed by the pump through only one supply-pipe, the device being nevertheless capable of effecting all required operations, namely filling of the space between the cylinder 1 and piston 2, depression of the pressure piston 5 and closure of the jaws 3 by means of the auxiliary cylinder 9, in the required sequence.

Pressure liquid is conveyed from a pump 17, placed on an oil-container 18, to a distributor 19 arranged conveniently on the container 18. The distributor 19 comprises a distributor throttling-valve or control valve 21 through which the pressure liquid is returned to the container 18 after the wires 8 have been tensioned. The distributor 19 contains further a pressure relief valve 20 by means of which the maximum pressure is ensured. Said distributor comprises also a pressure gauge 22, although this is not essential. The pressure liquid passes from the distributor 19 through a single tube or flexible hose 16 into the tensioning device itself. In front of the main throttling or control valve 6, placed usually on the cylinder 1, the pressure liquid is branched off directly into the auxiliary hydraulic cylinder 9, by means of which the body 11, and thereby the wedge-shaped jaws 3, are subject to pressure.

The tensioning operation proceeds as follows:

The tensioning device is applied to the fixed bundle of wires 8 which are passed through the anchor sleeve 25 and secured by the cone 23. The wires 8 are inserted,

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two at a time, into the opened wedge-shaped jaws 3 i.e. into their grooves 26. The pairs of wires 8 are secured in inserted position by the locks 10. When all pairs of wires 8 have been placed in position in the corresponding wedge-shaped jaws 3 along the periphery of the head-piece 4, the pumping operation is started. When a motor driven pump is used, the motor of the pump 17 is set in operation. Pressure liquid flows thus through the distributor 19 into the auxiliary cylinder 9, as the distributor throttling valve 21 is closed.

The wedge-shaped jaws 3 are thus clamped. Both the main throttling or control valve 6 as well as the intermediate throttling valve 7 are closed. Hereupon the main throttling valve 6 is gradually opened, with the result that the space between the cylinder 1 and piston 2 is filled with pressure liquid. The socket outer end of the piston 2 bears against the anchor sleeve 25. Consequently, the cylinder 1 and together with it the head-piece 4 with the wedge-shaped jaws 3, are set in motion and the wires 8 are drawn out of the anchor-sleeve 25, the required tension being thus imparted to them.

After the required tension has been reached, the intermediate throttling valve 7 is gradually opened and consequently the space for the liquid between the cylinder 1 and the piston 2 is connected with the space lying in front of the pressure piston 5, by means of which the cone 23 is pressed further into the anchoring sleeve 25 to clamp the wires 8 therebetween.

It will be appreciated that the pressure between the cylinder 1 and piston 2 does not drop, as the pressure liquid is permanently supplied by the pump 17 so that the pressure is retained at the required level by the reduction valve 20. After the tensioning operation has been terminated and the cone 23 pressed in, the distributor throttling valve 21 is opened and the liquid released from all working spaces 1, 2, 9 and from the space in front of the piston 5, whereupon the tensioning device is removed from the tensioned wires.

#### We claim:

1. In a device for tensioning a plurality of elongated tension elements arranged in a bundle, the combination of a main cylinder having an axis and defining a space therein; a plunger axially reciprocable in said space, said plunger having an axially extending cavity therein and a conduit extending from said cavity and opening at an end of the plunger in said space within the cylinder; valve means in said conduit for controlling the passage of fluid under pressure through the latter from said space to said cavity; a locking piston axially reciprocable in said cavity; a piston rod secured to said piston for joint movement with the latter and having a portion projecting from said plunger for axial movement relative to the latter in a predetermined path; said plunger having an abutment face disposed outside of said cylinder and lying in a plane transverse to said path of movement of the projecting portion of said piston rod; a plurality of pressure fluid actuated tension element clamping means on said cylinder, said clamping means being circumferentially spaced apart about said axis of the cylinder and axially spaced from said abutment face of the plunger; a source of hydraulic fluid; and further valve means for sequentially admitting hydraulic fluid from said source to said clamping means and then to said space within the cylinder.

2. In a device for tensioning a plurality of elongated tension elements arranged in a bundle, the combination as in claim 1; wherein said cylinder has a plurality of axially elongated, circumferentially spaced grooves, each of said grooves tapering axially in a direction toward said abutment face; and wherein each of said tension element clamping means includes two axially elongated wedge members in a related one of said grooves and being cammingly engageable with the walls of said groove, said clamping means further including a pressure fluid operated actuator for jointly moving the wedge members of said plurality of clamping means in the respective grooves

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in said direction in which the grooves taper so as to clamp tension elements disposed between said wedge members in each groove.

3. In a device for tensioning a plurality of elongated tension elements arranged in a bundle, the combination as in claim 2; wherein said two wedge members in each of said grooves have confronting faces of conforming undulating shape to impart an undulating configuration to tension elements clamped between said faces when said wedge members are moved in said direction.

4. In a device for tensioning a plurality of elongated tension elements arranged in a bundle, the combination as in claim 2; wherein said two wedge members in each of said grooves have confronting faces defining an axially extending gap therebetween for receiving the tension elements which are to be clamped, said gap having two open sides and increasing in width from said open sides toward a center portion intermediate said sides so that tension elements in said gap are urged toward each other at said center portion upon movement of said wedge members toward each other.

5. In a device for tensioning a plurality of elongated tension elements arranged in a bundle, the combination as in claim 3; wherein at least one of said confronting faces of the wedge members is inclined away from the other of said confronting faces in directions toward the center of a gap defined between said confronting faces.

6. In a device for tensioning a plurality of elongated tension elements arranged in a bundle, the combination as in claim 3; wherein at least one of said confronting faces of the two wedge members is concavely arcuate in a plane transverse with respect to said direction of movement of the wedge members.

7. In a device for tensioning a plurality of elongated tension elements arranged in a bundle, the combination as in claim 2; wherein said pressure fluid operated actuator includes an auxiliary cylinder having an auxiliary piston reciprocable therein, and motion transmitting means connected to said auxiliary piston and acting against said wedge members of the plurality of clamping means for jointly moving said wedge members in said direction upon admission of fluid under pressure to said auxiliary cylinder.

8. In a device for tensioning a plurality of elongated tension elements arranged in a bundle, the combination as in claim 7; wherein said additional valve means includes a first control valve communicating with said source and permanently communicating with said auxiliary cylinder, and a second control valve interposed between said main cylinder and said auxiliary cylinder, so that sequential operation of said clamping means, said plunger and said locking piston may be controlled by said first and second control valves and by the first mentioned valve means interposed in said conduit between said space and said cavity.

9. In a device for tensioning a plurality of elongated tension elements arranged in a bundle, the combination as in claim 8; further comprising pressure relief means communicating with said auxiliary cylinder of the pressure fluid operated actuator.

10. In a device for tensioning a plurality of tension elements arranged in a bundle, the combination as in claim 7; further comprising resiliently yieldable means continuously urging said wedge members to move in a direction axially away from said abutment face of the plunger.

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