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(54) METHOD AND APPARATUS FOR THE CONSTRUCTION OF PIPELINES OR RIGID LININGS INSIDE WELLS

(57) Method and apparatus for the descent of pipelines in vertical or inclined wells, or their coating, even in conditions of well's or pipeline's axis not perfectly straight.

Those method and apparatus are used in the construction of systems for the transport of water, gas and other fluids, in which the laying of pipelines or the lining of the above mentioned wells is achieved assembling together individual tubular units joined together to form a continuous tubing. The proposed method and apparatus are particularly advantageous in situations where the high height of the well or a small diameter make the making of a metallic coating complicated and expensive.

The proposed method and apparatus allow the laying (descent) of the covering inside the well as a continuous pipeline, assembled outside the well, without the need for assemble the individual units of the pipeline and perform the checks inside the well.

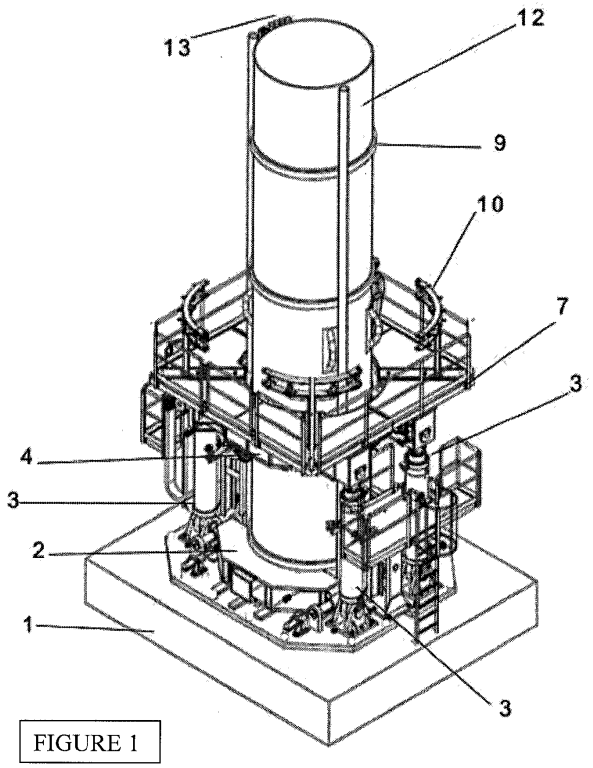

FIGURE 1

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Description

Field of application of the invention:

[0001] Method and apparatus for lining vertical or inclined wells, even in conditions of axis of the well not perfectly straight, in the construction of systems for the transport of water, gas and other fluids. Particularly relevant is the application for the installation of penstocks of hydroelectric plants. In addiction, the system can be applied for lining wells in surface water and wastewater collection systems, lining ventilation shafts, laying single or multiple service pipes for mines for deep tunnel mines.

State of the art

[0002] Wells and pipelines are made by digging from the surface downwards, according to various excavation techniques.
Usually the cladding is made by assembling single units, pipes, in steel.
The choice of steel and the thickness of the coating is structural, i.e. consolidation of the well and subsequent casting of external concrete or for the transport of water. In both cases, resistance and stiffness of the coating is required depending on the use. The quality of the assembly of the individual units, that is, of the individual pipes, must be such as to guarantee tightness over time and airtightness.
According to the usual installation technique, the lining of these wells is put in place after completing the excavation operations, or during the excavation itself. The usual technique used for the shoring of wells or for the laying of pipes inside vertical and sub-horizontal wells, involves operating from above using overhead cranes or winches for the launch of the sectors of the metal lining or of the pipe segments (segments of length 4-12 m).
These are lowered to the base of the well and then, by assembling and welding them inside the well, we proceed in sequence to climb up to the upper vertex.
The quality of the assembly and welding of the various sectors or pipes is of great importance for the purposes of the structural characteristics of the final product and its durability. The usual installation technique has the following drawbacks which are overcome by the present invention:

- in case of high well height or small diameter, the installation of a rigid lining, for example metal pipes or hard plastic, is complicated and expensive
- the use of manpower inside wells, especially if of great depth, involves problems for safety at work and plant complications for the preparation of scaffolding, lifts, ventilation systems, etc.
- the quality control of the assembly of the individual cladding units, for example the welding of two contiguous pipes, is complicated to perform inside wells and often not very accurate.

[0003] The main object of the present invention is to provide a solution for the realization of the internal lining of vertical or inclined wells such that the lining is assembled, welded and controlled externally and then put into operation in the form of a single continuous pipe. , guaranteeing a high level of safety for the staff.
[0004] A further purpose of the present invention is therefore to provide a solution for the direct verification of the quality of the assembly of the individual coating units outside the well by the operators without the need for any subsequent intervention inside the well.

Summary of the invention

[0005] These and other objects are achieved in accordance with the present invention according to the technical solution reported here and claimed in the section of the claims.
Further advantageous aspects of the present invention are presented here and set forth in the dependent claims.
The basic idea is that the lining is lowered into the well as a continuous tubular structure as the individual units are assembled and that the quality of their assembly is verified externally in conditions of complete accessibility both internally and externally.
[0006] For this purpose, an assembly sequence of the individual units and simultaneous descent of the assembled piping inside the well is carried out
[0007] In the preferred embodiment, the assembly and descent system is equipped with gripping, means consisting of hydraulically controlled clamps, which can be closed or opened by hooking or unhooking the individual units and the entire pipe. The aforesaid vices are distinguished in a fixed "lower clamp", positioned near the mouth of the well, and a "upper clamp" movable from the low position up to a high position.
The system does not require guides for the sliding of the mobile upper vice.
[0008] The function of the lower vice is basically to keep a part of the pipeline outside the well by retaining the entire assembled pipeline, while the function of the upper vice is twofold: to keep the new piping units hooked during their assembly (high position) and keep the pipe hooked during the descent inside the well while the lower clamp is in the open position. The pipe falls inside said well under the thrust of the weight force of the same pipe, the upper clamp causes said pipe to drop at a uniform speed and, in the event of frictions and obstacles present during penetration inside the well, it can exert a downward thrust force to overcome said obstacles.
[0009] By means of an appropriate opening / closing sequence of these clamps, new piping units are assembled and the entire pipeline is lowered into the well.
[0010] In the preferred embodiment, the duct to be positioned in the well is composed of single units of pipes arranged with rings and / or shaped steel plates externally welded and of such geometry as to guarantee an effective and safe constraint to the vices. Said rings and / or plates

welded externally to the piping units are used for support during descent operations, they remain welded to the pipeline becoming an integral part of it. In this way a further advantageous effect is obtained, in fact said rings and / or plates also perform a structural function of armor plating (by internal pressure) and stiffening (by external pressure) of the pipe.

[0011] The operations of measurement and quality control of the assembly of each additional piping unit are carried out by operators with special measuring instruments integrated in said assembly structure before proceeding with each descent maneuver.

[0012] Particularly advantageous is the possibility guaranteed by said assembly method to carry out all the checks and any repairs outside the well, with obvious benefits in terms of safety at work and reliability of the controls.

In fact, welding and quality controls are carried out by personnel who work on a platform set up with all the necessary systems that allows easy access to the entire perimeter of the pipeline in the joint area. This work platform, mounted integral with the mobile carriage of the machine, is always in the same position at the time of coupling and welding the pipes: all equipment, accesses, power supplies to the users are therefore always at the same position throughout job development.

[0013] On the contrary, according to the known art, the working position changes continuously during the remount assembly inside the well, requiring the continuous movement and adjustment of all equipment, structures and utilities.

[0014] A further advantageous aspect of the proposed solution is to allow the simultaneous installation of several pipes and / or additional pipes to the main one, for example pipes for casting concrete, drainage pipes, conduit pipes for the passage of electrical cables, etc.

[0015] The proposed solution provides for a way of constraining the piping down system such as to allow its natural alignment to the axis of the well even when the latter undergoes deviations along its development

List of figures

[0016] The main characteristics of the descent structure of the present invention are exemplified in the figures shown below, provided by way of non-limiting example, with reference to the attached drawings in which:

Figure 1, shows an overall view of the assembly and descent apparatus, in particular for the assembly of a main pipe (12) and secondary pipes (13).

Figure 2, shows a view of one of the vices, in particular you can see the shaping (8) by virtue of which a firm coupling is obtained on the rings arranged in relief on the pipes and the hydraulic pistons (11) for opening / closing the vice

Figure 3, shows a view of a portion of the base, with one half of the lower vice anchored, the fixing plates of the hydraulic lifting cylinders (6) and the sliding guide (5)

Figure 4, shows a sequence (from S1 to S6) of opening and closing the clamps relative to the insertion of the first two piping units

Detailed description of the invention

[0017] The assembly and descent apparatus essentially consists of a base (1) with support vices called lower vices (2), a lifting system (3), a mobile carriage with support vices called upper vices (4), a command and control system. All the drives are hydraulic.

The base: is fixed on a foundation slab suitably sized according to the loads involved. It consists of a base structure on which the sliding guides of the lower clamps (5) and the fixing plates of the hydraulic lifting cylinders (6) are mounted. The hydraulic circuits coming from the control unit and the main distribution system that feeds the lifting and lower clamp actuator are connected to the base. The lower clamps slide along guides and rest on high resistance steel shoes (5).

[0018] Lifting system: The total load of the pipeline that is lowered into the well must be able to be fully supported by the descent apparatus. The hydraulic cylinders of the system, which can be controlled via manifolds with integrated proportional valves or similar methods, are double-acting, i.e. in addition to lifting they provide the possibility of being able to push the pipes downwards. This solution is particularly advantageous when any friction with the walls of the well could prevent the correct descent of the pipe (this happens especially in the case of inclined wells in the early stages of assembly).

[0019] Mobile carriage: the mobile structure that carries the upper clamps (4) and the welding and control platform (7) is fixed to the top of the cylinders, equipped to accommodate operators and mechanical devices for coupling the pipes (10). The upper clamps are hinged to the piston joints which in turn slide on two horizontal cylindrical guides with a synchronism system for opening / closing. These upper clamps are equipped with shaping (8) in order to be able to properly engage on the rings arranged in prominence on the tubes (9) necessary for both the support and the eventual downward thrust. The projections are each time designed according to the diameter, maximum weight of the pipes as well as the possible presence of several small diameter pipes to be lowered simultaneously.

[0020] Command and control system: the assembly and descent apparatus as a whole is controlled by a hydraulic power unit and control panel with PLC and SCADA. It is possible to set and control in real time all the operating parameters which in turn are displayed in numerical and graphic form on an operator panel and are stored in the memory for any subsequent analysis.

The opening and closing of the clamps and the movement of the mobile carriage are controlled both electrically and by means of a hydraulic circuit with intrinsically safe in-

terlocking systems. The movement of the hydraulic pistons is controlled by position transducers for correct alignment during the up and down stroke and by a series of pressure switches for continuous monitoring of the load.

[0021] The pipeline assembly and descent sequence includes the following steps:

a) a part of the first piping unit (20) is lowered into the well (22), while the remaining part is kept outside the well hooked by the lower vice (23).
The upper clamp (24) is held open, see figure 4 / S1

b) a second piping unit (25) is hooked by the upper vice (24) in a high position and held in position for mechanical assembly with the first piping unit, see Figure 4 / S2. In this configuration, the mechanical assembly is carried out between the piping immersed in the well and the new duct unit, thus creating a continuous section of the lining piping (26), see Figure 4 / S

c) the lower vice (23) is opened, see figure 4 / S4, and the upper vice (24) is lowered from the high position to the low position, causing the descent of the pipe (26) inside the well. A part of the second piping unit is kept outside the well, see Figure 4 / S5. The lower vice is closed to hook said second part of the second piping unit, the upper vice is opened and brought to the high position, see figure 4 / S6

d) further piping units can be assembled and lowered according to the above sequence In the preferred embodiment, the duct to be positioned in the well is composed of individual tubing units arranged with rings and / or shaped steel plates externally welded and of such geometry as to guarantee a firm coupling with said clamps.

[0022] In said preferred embodiment, said rings and / or plates can be used as gripping elements of the piping unit and said "b." and "c." can be changed as follows:

b'. a second tubing unit is hooked by the upper clamp at a constraint ring and held in position for mechanical assembly with the first tubing unit

c'. the lower vice is opened and the upper vice is lowered by a distance corresponding to the distance between the constraint ring to which it is attached and the subsequent constraint ring, causing the tubing unit to descend inside the well by a length corresponding to the distance between the two constraint rings. The lower vice is closed on the constraint ring, and the upper clamp is raised to the next constraint ring. The operation is repeated up to the last link.

Claims

1. Method of assembling ducts or pipes for covering wells, starting from single piping units, by means of an apparatus that allows to operate outside in proximity to said well
characterized in that
it includes the following consecutive steps:

   a) descent inside said well of a part of the first pipe unit, the remaining part of said first pipe unit remaining outside of said well being supported by said assembly apparatus
   b) assembly of a further pipe unit and assessment of the assembly quality, being said assembly operations and assesment of assembly quality carried out outside said well
   c) descent inside said well of part of said further pipe unit
   d) repetition of phases b) - c) up to the last piping unit
   e) descent of the remaining part of said last pipe unit inside said well

2. Assembly method according to any one of the preceding claims, wherein said assembly operations of step b) comprise the welding of consecutive pipes

3. Assembly method according to claim 1 in which said consecutive steps of assembly are carried out for the simultaneous assembly of a plurality of pipes

4. Assembly method according to any one of the preceding claims in which step a) is preceded by a step of preparing the individual piping units in which mechanical inserts, for example steel rings or plates, are applied to said piping units in order to prepare them for descent operations

5. Assembly method according to any one of the preceding claims, in which said steps b) and c) are carried out by means of a system of clamps opened and closed in sequence, so that a lower clamp closes on the pipe in order to support part of it outside the well during phase b) and a top clamp closing on the pipe accompanying its descent into the well during phase c)

6. Apparatus for assembling ducts or pipes for covering wells comprising a system for gripping the individual piping units, a handling system, an assembly station of the individual piping units and quality control of said assembly, a control unit for manage and the gripping and handling sequence, a mechanical support base for said gripping and handling systems
characterized in that

   - said gripping system is substantially a system

of clamps which can be operated to hook the individual piping units and which can slide along the axis of the well, vertical or inclined, anchored to said support base, said clamps can be opened or closed independently one from the other
- said handling system comprises an actuator system, for example hydraulic pistons, for moving said clamps of said gripping system
- said control unit of the gripping and moving sequence is an electronic control unit which implements the opening / closing steps of said clamps and the actuation of said actuator system

7. Assembly structure as claimed in claim 6, wherein said actuator system of said handling system has a double effect, i.e. in addition to lifting provide the possibility to push the pipe downward to overcome the occurrence of any resistances along the descent

8. Assembly structure according to claims 6 or 7, wherein said clamps are shaped so as to firmly hook onto rings, plates or other inserts applied to the individual tubing units

9. Assembly structure according to claims 6, 7 or 8, wherein said clamp system comprises only two clamps, a lower clamp anchored with said support base and an upper clamp that can slide along the axis of the well, said clamps supporting the piping and new individual piping units during the assembly phase and accompanying the pipeline during the descent into the well

10. Assembling apparatus according to claims 6, 7, 8, or 9 wherein said assembly station of the individual piping and quality control units of said assembly is integral with the upper clamp so as to be able to be moved vertically facilitating the assembly operations of the piping and assembly control

11. Assembling apparatus according to claims 6, 7, 8, 9, 10 wherein said assembly station of the individual piping units can align with the axis of the well even when said axis undergoes deviations along its development

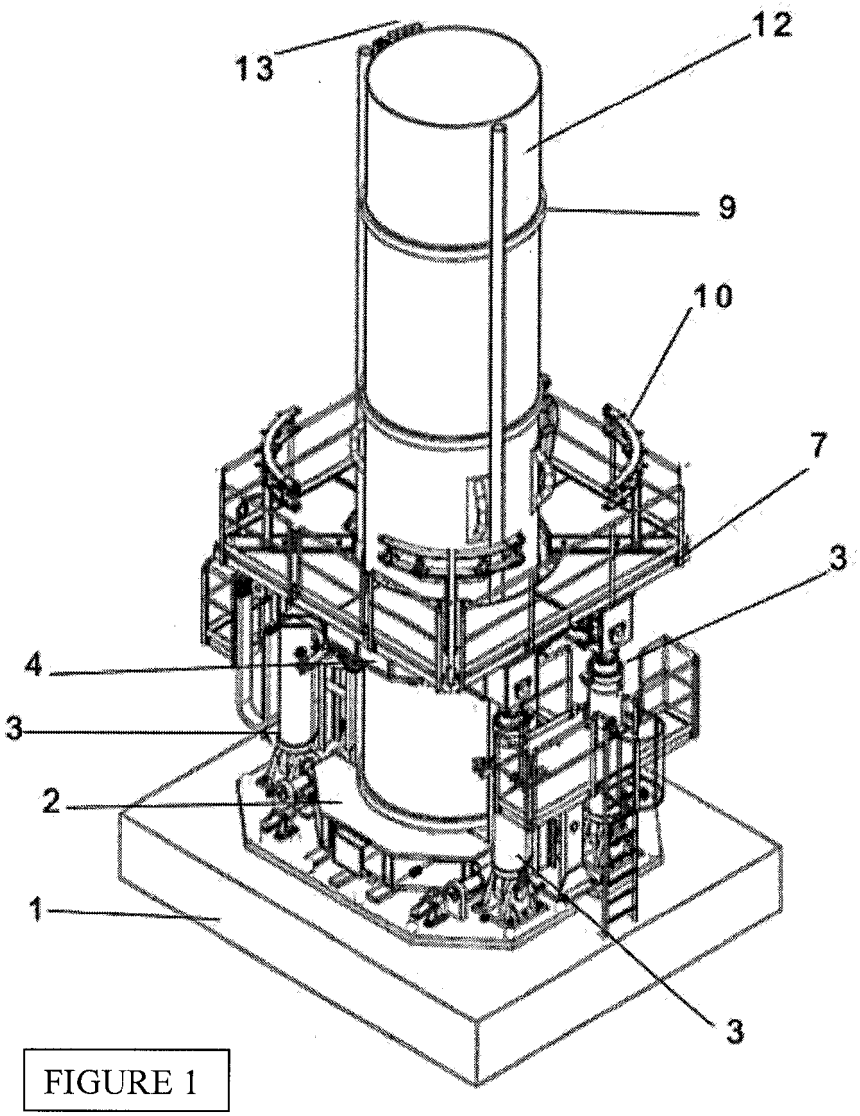

FIGURE 1

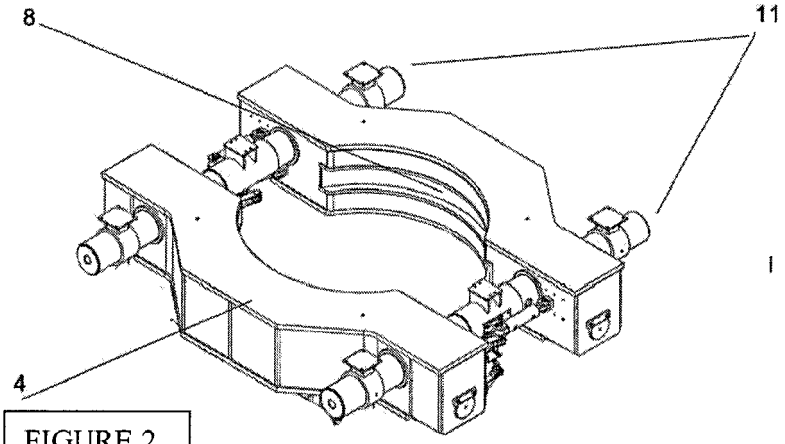

FIGURE 2

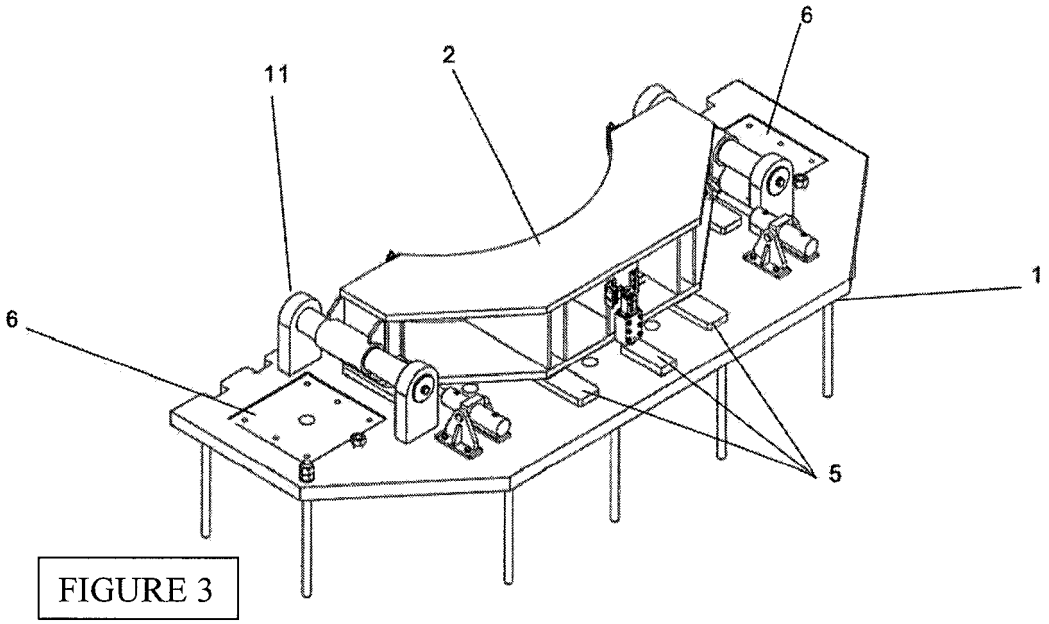

FIGURE 3

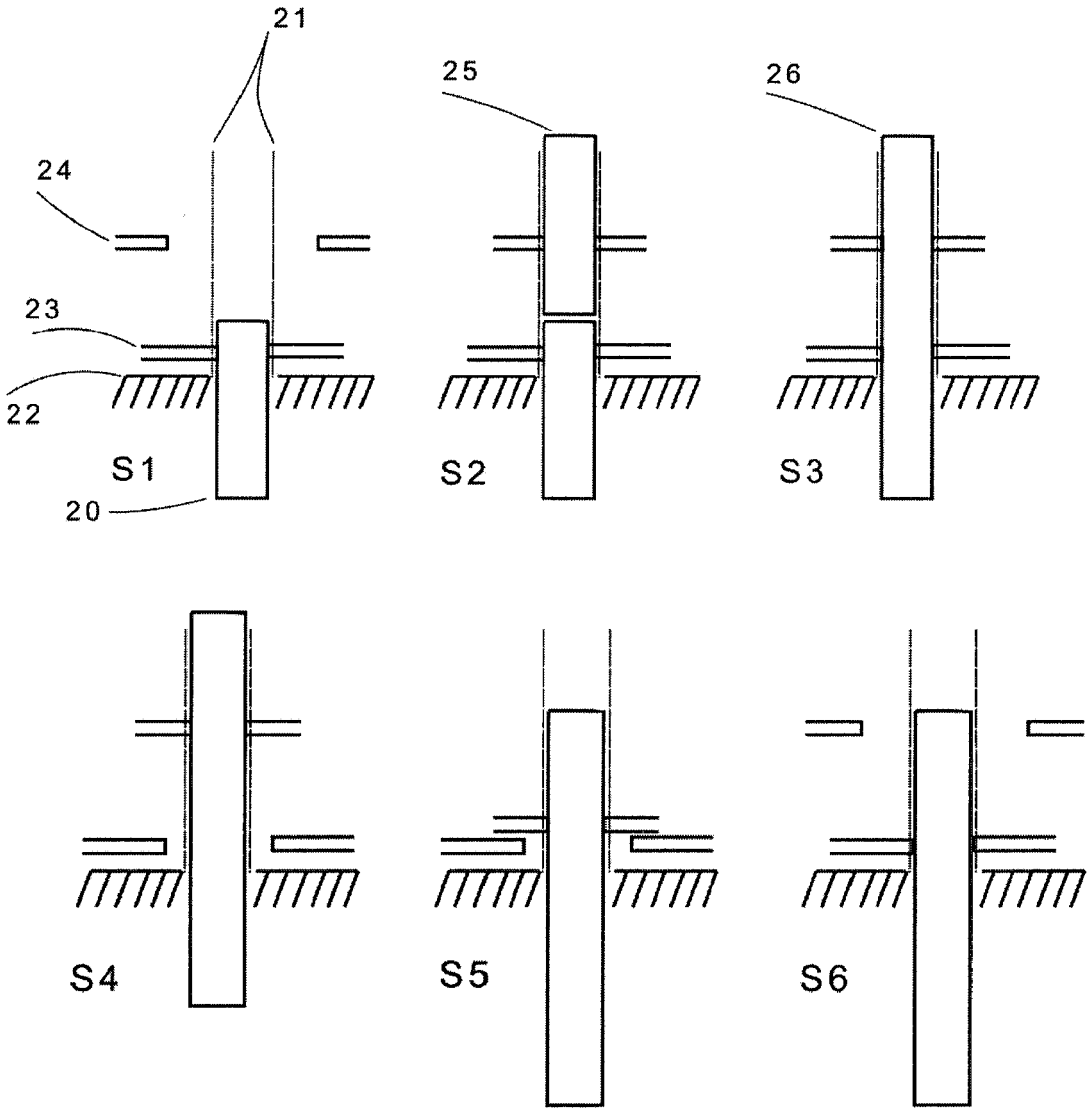

FIGURE 4

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EUROPEAN SEARCH REPORT

Application Number
EP 20 02 0525

DOCUMENTS CONSIDERED TO BE RELEVANT

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TECHNICAL FIELDS SEARCHED (IPC)

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 March 2021	Morrish, Susan

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 02 0525

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