Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
The present invention relates in general to a chain tensioning arrangement for a column pipe. The present invention relates especially to chain tensioning arrangement for an axially extending column pipe which is configured to house a submersible pump, the chain tensioning arrangement comprising a cross beam configured to extend in the radial direction in relation to the column pipe. A second aspect of the present invention relates to a pump station comprising an axially extending column pipe, a submersible pump arranged in the column pipe, a chain tensioning arrangement comprising a cross beam extending in the radial direction in relation to the column pipe, and an axially extending chain connected to the pump and configured to move the pump in the column pipe.

Background of the Invention and prior art

In some types of liquid handling, for instance transport of large volumes of lightly contaminated water such as surface water, a submersible pump in the form of an axial pump present a number of advantages. Axial pumps are arranged lowered into column pipes and are typically electrically driven wherein the power supply to the pump is effected via one or more cables that extend down to the pump via the inside of the column pipe.

Thus, the pump is normally intended to be placed in a column pipe that is partly lowered into the pumped media. Before start up the axial pump is lowered into the column pipe until it stands on a bottom flange in the column pipe and thereby seals tightly against the column pipe. Consequently the pump is entirely or partly submerged into the media when it has reached its operational position. During operation the column pipe also work as an outlet pipe for the pumped liquid. Before service the pump is hoisted and removed from the column pipe.

Lowering as well as hoisting of the pump is normally performed by means of a winch device such as a fixed or mobile crane comprising a strong chain having a hook in the lower end thereof. The hook is configured to hitch a lifting handle of the pump. Axial/vertical transportation of the pump through the column pipe is allowed when the hook is in engagement with the lifting handle.

When the axial pump occupies the operational position it is necessary according to prior art to unhook the hook from the lifting handle and entirely remove the chain from the column pipe. This is done in order to avoid that the strong liquid currents that always arise in the column pipe during the operation of the axial pump would bring the chain in violent motions. Such an uncontrolled rotating oscillatory motion of the chain would unavoidably damage the electric cables that extend from the pump and up inside the column pipe to the upper end thereof.

It shall be mentioned that the electric cables are attached to and axially displaceable along a stretched wire extending from the pump and to the upper end of the column pipe. If the electric cables would not be attached to the wire they would be brought in a rotating oscillatory motion and be damaged against the inner surface of the column pipe.

Thus, the pump is normally intended to be placed in a column pipe that is partly lowered into the pumped media. Before start up the axial pump is lowered into the column pipe until it stands on a bottom flange in the column pipe and thereby seals tightly against the column pipe. Consequently the pump is entirely or partly submerged into the media when it has reached its operational position. During operation the column pipe also work as an outlet pipe for the pumped liquid. Before service the pump is hoisted and removed from the column pipe.

ADDENDUM

Further elucidation of prior art

The present invention aims at obviating the aforementioned disadvantages and failings of previously known solutions by providing a chain tensioning arrangement comprising a cross beam configured to extend in the radial direction in relation to the column pipe, wherein an axially extending chain is connected to the cross beam and to the pump and is configured to move the pump in the column pipe.

Object of the Invention

The present invention aims at obviating the aforementioned disadvantages and failings of previously known solutions by providing a chain tensioning arrangement comprising a cross beam configured to extend in the radial direction in relation to the column pipe, wherein an axially extending chain is connected to the cross beam and to the pump and is configured to move the pump in the column pipe.

Another object of the invention related to the above is that the reduction/elimination of the oscillations of the chain is performed in a controlled and controllable way.
provide a chain tensioning arrangement, which admit permanent removal of the stretched wire that the electric cables are attached to according to prior art solutions.

[0012] It is another object of the present invention to provide a chain tensioning arrangement, that during lowering as well as hoisting of the pump admit retake, i.e. a temporarily pause during lowering/hoisting of the pump in order to for instance adjust the position at which the crane seize the chain, when the lifting height of the crane is less than the vertical length of the column pipe.

Summary of the Invention

[0013] According to the invention at least the primary object is attained by means of the initially defined chain tensioning arrangement and the pump station, having the features defined in claims 1 and 12 respectively. Preferred embodiments of the present invention are further defined in the dependent claims.

[0014] According to a first aspect of the present invention there is provided a chain tensioning arrangement as defined in claim 1, and according to a second aspect of the present invention there is provided a pump station as defined in claim 12.

[0015] Thus, the present invention is based on the insight that when the engagement member of the arm is in engagement with the chain, the oscillations of the chain is reduced by means of a displacement of the arm in the direction from the lower position towards the upper position, i.e. towards the open end of the column pipe, the chain is tightened and stretched.

[0016] Thereto, a tightened and essentially immovable chain provides the possibility to attach the electric cables to the chain and consequently a need for a dedicated wire therefor can be avoided.

[0017] Thereto, the use of the chain tensioning arrangement also makes it possible to hold the pump at a reached vertical position inside the column pipe during retake. The chain tensioning arrangement can support the entire weight of the hanging pump when the engagement member of the arm is in engagement with the chain.

[0018] According to a preferred embodiment the chain tensioning arrangement also comprises means for limiting to an adjustable extent the displacement of the arm by means of said at least one spring member. It is realized that an adjustable control of the extent of the displacement renders it possible to adapt it in a controlled way. More precisely, hereby the extent of the displacement can be adjusted in order to exactly match the slack of the chain, i.e. the displacement continues preferably until a completely stretched chain is obtained.

[0019] According to a preferred embodiment of the present invention the arm is pivotable in a radially extending plane between an active position and an inactive position. The chain tensioning arrangement has in this embodiment a pivotable arm, the engagement member thereof being in engagement with the chain, when the arm is in the active position. The chain tensioning arrangement according to this embodiment is especially suitable for use during a retake.

[0020] According to another preferred embodiment said at least one spring member is constituted by a helical spring. A simple technical solution is hereby obtained. Thereto, the use of a helical spring entail, when using a plurality of spring members, that these members easily can be arranged in such a way, for instance connected in series, that the total spring action increase in proportion to the number of spring members.

[0021] According to another preferred embodiment the means for limiting to an adjustable extent the displacement of the arm by means of said at least one spring member is constituted by a screw. Hereby a reliable and robust solution is obtained that during long time and without deteriorated functionality can manage the harsh environment inside the column pipe. The screw is manipulated by means of any suitable tool.

[0022] According to an alternative preferred embodiment the position of the lower end of said at least one spring member can be adjustable in the axial direction. Hereby a simple alternative way of adjusting the extent of the displacement of the arm is obtained. Displacement of the lower end of the spring member can for instance be made by means of a suitable screw.

[0023] Further advantages with and features of the invention will be apparent from the other dependent claims as well as from the following detailed description of preferred embodiments.

Brief description of the drawings

[0024] A more complete understanding of the above-mentioned and other features and advantages of the present invention will be apparent from the following detailed description of preferred embodiments in conjunction with the appended drawings, wherein:

Fig. 1 is a schematic cut-away front view of an installation comprising an inventive pump station having a chain tensioning arrangement.

Fig. 2a is a schematic perspective view from above of a fully operational pump station comprising an inventive chain tensioning arrangement according to a first embodiment, the column pipe disclosed partly transparent.

Fig. 2b is a schematic front view of only the chain tensioning arrangement according to the first embodiment in which it is fully operational in accordance with figure 2a.

Fig. 2c is a schematic view from above of the chain tensioning arrangement according to the first embodiment in which it is fully operational in accordance with figure 2b.

Fig. 3a is a schematic perspective view from above of a pump station in which the pump is hoisted/lowered, the column pipe is disclosed partly transparent.
Detailed description of preferred embodiments

[0025] The present invention relates especially to a chain tensioning arrangement configured to be used in a column pipe that is configured to house a submersible pump.

[0026] Reference is initially made to figure 1 that is a schematic cut-away front view of an installation of a pump station, generally designated 1.

[0027] The pump station 1 comprises a chain tensioning arrangement, generally designated 2, that is arranged in the area of the upper end of a column pipe 3 that house a submersible pump 4. The submersible pump 4 is in the disclosed embodiment constituted by an axial pump that has a weight in the range 1-1,5 tons, however it shall be pointed out that there are axial pumps that weigh a few hundred kilogram as well as other axial pumps that weigh several tons. The column pipe 3 is open in both ends, and is typically 4-8 meters long and usually has a diameter in the range 0.5-1 meters even thus other dimensions may exist. The disclosed submersible pump 4 stand on a bottom flange 5 in the column pipe 3 and is in tight connection with the column pipe 3. A chain 6 that is part of a winch device (not shown) is connected to the pump 4. The column pipe 3 establish a fluid path between a lower basin 7 that is filled with a medium to be pumped and an upper basin 8 that is meant to receive the pumped medium. The pumped medium may for instance be constituted by surface water, lightly contaminated waste water, etc. The chain tensioning arrangement 2 is arranged inside the column pipe 3, more precisely adjacent to the upper end of the column pipe in order to admit manipulation thereof. The different components and operational principles of the chain tensioning arrangement 2 will be described herein below in more detail and with reference to figures 2-5, which disclose a first embodiment of the present invention, and to figures 6-9, which disclose a second embodiment of the present invention, wherein the second embodiment is more general. It shall be pointed out that the chain tensioning arrangement 2 not nec-
nessary has to be arranged inside the column pipe 3, it
can be arranged straight above the column pipe 3, i.e. in
connection with the upper basin 8. It shall also be pointed
out that the chain tensioning arrangement 2 may also be
arranged in other pump stations/basins and is not limited
to be used in connection with a column pipe 3. A chain
is connected to the pump and the pump is connected in
a suitable way to the outlet pipe (i.e. an outgoing fluid
connection equivalent to the column pipe).

[0028] Reference is now made to figures 2a-2c, in
which figure 2a is a schematic perspective view from
above of a pump station 1 comprising a chain tensioning
arrangement 2 installed in the column pipe 3 and having
an axial pump 4 located at the bottom of the column pipe
3, wherein the chain 6 is stretched by means of the chain
tensioning arrangement 2. In the disclosed embodiment the
pump 4 is ready to take in operation in order to pump
the medium in the direction upwards in the figures. Two
electric cables 9 extend from the pump 4 to the upper
end of the column pipe 3 and further to a control cabinet
or the like. The electric cables 9 are connected to the
chain 6 by means of a plurality of two part electric cable
holder, generally designated 10, which will be described
in more detail herein below with reference to figures 11a
and 11b. A hook 11, or lifting eye, is arranged in the lower
end of the chain 6 and in engagement with a lifting
handle 12 of the pump 4.

[0029] The chain tensioning arrangement 2 comprises
a cross beam 13 extending in the radial direction and that
in the disclosed embodiment comprises at least one pin
14 in the respective opposite end thereof, the pins 14
being configured to be detachably connected to corre-
sponding seats 15 in the column pipe 3. In the disclosed
embodiments the cross beam 13 is horizontally arranged.
According to an alternative, not disclosed, embodiment
the cross beam is only connected to (in engagement with)
the column pipe 3 in one end and projects like a console
from the inner wall of the column pipe 3. According to yet
another, not disclosed, embodiment the cross beam
comprises three or more beam segments that, in the
shape of a star, are connected to each other and con-
ected to (in engagement with) the column pipe.

[0030] Thereto the chain tensioning arrangement 2
comprises a spring arrangement 16 that is connected to
the cross beam 13 and that comprises at least one spring
member 17. In the disclosed embodiment the cross beam
is horizontally arranged. The different components of the
chain tensioning arrangement are disclosed from the front in figure 2b
and from above in figure 2c. In figures 2b and 2c the
chain tensioning arrangement 2 is removed from the col-
umn pipe and the chain, but remains in operational po-

[0031] Said at least one spring member 17 is arranged
to displace the arm 18 in the direction from the lower
position towards the upper position, e.g. upwards in fig-
ures 2a-2c. Each such displacement of the arm 18, when
the engagement member 19 of the arm 18 is in engage-
ment with the chain 6, results in that the chain 6 is ten-
sioned and stretched such that the slack become less or
is entirely eliminated. Thereby the chain 6 is prevented
from rotation/oscillating in the column pipe 3 since the
freedom of movement of the stretched chain is greatly
limited compared to the freedom of movement of a slack
chain. Thereby, also the damaging effects of these os-
cillations to the electric cables 9 and the column pipe 3
are consequently reduced/eliminated.

[0032] In this way the basic object is attained, e.g. re-
move the need to remove the chain 6 from the column
pipe 3 before pump operation at the same time as the
electric cables 9 are kept undamaged. Of course this also
entails that readaptation of the hook at the lifting handle
of the pump is no more needed. Considerable time losses
and trouble in connection with service can thereby be
avoided by means of the inventive chain tensioning ar-

[0033] The chain tensioning arrangement according to
the first embodiment thereto comprises means for limiting
to an adjustable extent the displacement of the arm 18
in the axial direction by means of said at least one spring
member 17. Said means will be described in more detail
herein below with reference to figures 5a and 5b.

[0034] The different components of the chain tension-
ning arrangement are disclosed from the front in figure 2b
and from above in figure 2c. In figures 2b and 2c the
chain tensioning arrangement 2 is removed from the col-
umn pipe and the chain, but remains in operational po-

[0035] Thus, figure 2b discloses among other things
the spring arrangement 16 that in the disclosed embod-
iment comprises three spring members 17. The spring
members 17 are constituted by helical springs. This so-
lution is simple to scale since it allow serial connection
between the individual helical spring members. During
operation the arm 18 is located between the lower end
position and the upper end position and the spring mem-
ber 17 is thus partly released, i.e. neither fully com-
presed nor entirely expanded. According to an alterna-
tive, not discloses, embodiment the spring arrangement
16 comprises leaf springs, cup springs, etc. It is central
for the spring arrangement 16 that a comparative short
stroke is needed and high spring constant. In the dis-
closed embodiment the stroke is in the range 5-10 cen-
timeters. The spring member 17 shall be dimensioned
to stretch the chain 6 but not be able to lift the pump 4.

[0036] Reference is now made to figure 2c that among
other things disclose the arm 18 that is, as mentioned
above, movably connected to the cross beam 13 by being
axially displaceable in relation to the cross beam 13. The
arm 18 is in the disclosed embodiment in one end con-

[0037] The arm 18 is movable connected to the cross
beam 13 by being designating 20 that is part of the spring arrangement 16
and in the free end the arm 18 disclose above mentioned
engagement member 19, which will be described in more
detail with reference to figure 5a. The rod 20 is displace-
able in the axial direction together with the arm 18.
The arm 18 has a radial main extension and is preferably pivotable in a radially extending plane about a turning axis 21 running together with centre axis of the rod 20. The disclosed cross beam 13 extends in parallel with the plane in which the arm 18 is pivotable. In figure 2c the arm 18 is shown pivoted to an active position in which the engagement member 19 is in engagement with the chain (removed). Analogously, the arm 18 is in an inactive position when the engagement member 19 is pivoted away from the position disclosed in figure 2c. The arm 18 via the rod 20 is connected to the spring member 17. Alternatively a direct connection between the arm 18 and the spring member 17 can be realized.

In the following and with reference to figure 2a the function of the chain tensioning arrangement 2 according to the first embodiment is described in connection with installation of the pump 4 in the column pipe 3 as well as activation of the pump 4.

The pump 4 is lowered from ground level by means of the chain 6 and is arranged such that it is tight against the bottom flange 5 of the column pipe 3. When the pump 4 stands on the bottom flange the chain 6 is slack. The chain tensioning arrangement 2 is now attached to the upper end of the column pipe 3, and it is secured that the arm 18 is located in its lower position, abutting the cross beam 13 or located in close connection to the cross beam 13. The chain 6 is stretched/lifted by hand and is maximally tensioned. The chain link that best match the position of the arm 18 in the height direction is brought into the engagement member 19. The arm 18 is allowed to be displaced towards the upper position under the action of the spring member 17. The extent of the displacement is in the magnitude 5 centimeters. Thus, the chain 6 is tensioned and stretched such that its slack is considerably less or entirely eliminated. The pump is now ready for operation.

Reference is now made to figure 3a that is a schematic perspective view from above of the pump station 1 during the pump 4 being hoisted or lowered. Parts/functions that are like the embodiments according to figures 2a-2c are not referred to. Thus, the pump 4 is not in operation but is hoisted or lowered in the column pipe 3 by means of a suitable winch device. The chain tensioning arrangement 2 must not be detached from the walls of the column pipe 3 during hoisting/lowering. However, the engagement member 19 of the arm 18 must be unengaged from the links of the chain 6, e.g. the arm 18 ought to be located in its inactive position. This is accomplished as is shown in figure 3a by pivoting the arm 18 away from the chain 6.

Analogously to figures 2a and 2b the different components of the chain tensioning arrangement 2 are disclosed from the front in figure 3b and from above in figure 3c. By comparing the spring arrangement of figures 2b and 3b it is clear that the spring member 17 in figure 3b is maximally extended. Thus, the arm 18 that is connected to the spring member 17 is located in the upper position. The spring arrangement exerts no upwardly directed force against the arm 18, that thereby can be pivoted between its active and inactive positions, respectively.

In the following and with reference to figure 3a the function of the chain tensioning arrangement is described in connection with hoisting of the pump 4 from the bottom of the column pipe 3 to the top of the column pipe 3 and/or our of the column pipe 3.

The arm 18 is displaced in the direction towards the lower position by having the spring member 17 compressed, whereby the chain 6 is slacked and can be unengaged from the arm 18. The arm 18 is allowed to be displaced to the upper position and is thereafter pivoted away from the active position to the inactive (disclosed) position and thereby allows the pump 4 to be hoisted in a conventional way by lifting the chain 6. Before the pump 4 can be removed from the column pipe 3 the chain tensioning arrangement 2 must be removed from the upper end of the column pipe 3. In an alternative embodiment, in which the arm 18 is not pivotable, the chain tensioning arrangement is removed directly after the engagement between the arm 18 and the chain 6 is broken and the chain is slack, and before the pump 4 is started to be lifted by means of the chain.

Reference is now made to figure 4a that is a schematic perspective view from above of a pump station in an installation wherein so-called retake is needed. Once again, parts/functions that are like the embodiments according to figures 2a-2c and 3a-3c, respectively, are not referred to.

As has been mentioned above sometimes the situation/installation, for instance when the maximum lifting height of the crane is less than the length of the column pipe, demand for the hoisting or lowering of the pump 4 is divided into several stages and a retake is needed between these stages. In such situations the chain tensioning arrangement is preferably used to secure and remain the pump 4 at the reached height in the column pipe 3 during the retake operation.

In the following and with reference to figure 4a the function of the chain tensioning arrangement is described in connection with retake during hoisting of the pump 4. Since the pump 4 in the bottom of the column pipe 3 up to now has been in operation the starting situation is that the chain 6 is stretched, the arm 18 is in engagement with the chain 6 and is displaced in the direction towards the upper position during the action of the spring member 17.

During hoisting the arm 18 is displaced towards the lower position and the chain 6 starts to slack. The chain 6 is removed from the engagement member 19 of the arm 18. The arm 18 is thereafter moved to the upper position and is pivoted to the inactive position. The pump 4 is hoisted to a height admitted by the crane, the chain is thus tensioned since the pump 4 is now hanging in the chain 6 and the chain run centrally in the column pipe 3. The arm 18 is in the upper position and is pivoted from the inactive position towards the active position towards
the chain 6 such that the engagement member 19 engage the chain link that best match the height of the position of the arm 18. The pump 4 is thereafter lowered a few centimeters by means of the crane such that the entire weight of the pump 4 is supported by the chain tensioning arrangement 2. Thus, the arm 18 is forced to the lower position in which the arm 18 abut the cross beam 13. Thereafter the crane takes a new grip in the chain 6 close to the chain tensioning arrangement. The pump 4 is lifted a few centimeters such that the arm 18 comes to the upper position. The arm 18 is pivoted to the inactive position such that the engagement between the engagement member 19 and the chain 6 is broken. The chain tensioning arrangement 2 is removed from the column pipe 3 and/or out of the column pipe 3. Alternatively one or more extra retakes can be needed.

[0048] The function of the chain tensioning arrangement in connection with retake during lowering of the pump 4 is analogous with the above described procedure regarding hoisting with retake.

[0049] Thus, the pump 4 is firstly lowered as much as the crane admit except from at least the few centimeters the pump 4 is needed to be lowered when the arm 18 is displaced to the lower position by the weight of the pump 4. The chain 6 that runs centrally in the column pipe 3 is tensioned since it is loaded with the entire weight of the pump 4. The chain tensioning arrangement 2 is attached having the arm 18 pivoted to the inactive position as well as in the upper position. The arm 18 is pivoted to the active position such that the engagement member 19 may engage the chain 6. The pump 4 is lowered a few centimeters by means of the crane such that the weight of the pump is supported by the arm 18 and the chain tensioning arrangement 2 when the arm 18 abuts the cross beam 13. The crane takes a new grip higher up on the chain and lifts the pump a few centimeters such that the arm 18 is displaced to the upper position by means of the spring member 17 and then once again is pivoted to the inactive position. The pump 4 is thereafter lowered all the way down to the bottom of the column pipe 3 and the chain 6 becomes slack. Alternatively one or more extra retakes may be needed. The rest of the procedure is constituted by tensioning of the slack chain 6 as is already described in connection with figures 2a-2c.

[0050] Analogously with figures 2b and 3b, and figures 2c and 3c, respectively, the components of the chain tensioning arrangement are disclosed from the front in figure 4b and from above in figure 4c, respectively. By comparing the spring arrangement in figures 2b and 3b it is clear that the spring arrangement in figure 4b is maximally compressed. It is due to the pump 4 hanging in the chain tensioning arrangement and thus the entire weight of the pump is supported by the chain tensioning arrangement. Thus, the arm 18 that is connected to the spring member of the spring arrangement is in the lower position abutting the cross beam 13. The spring arrangement shall preferably not bottom when the arm 18 is located in the lower position.

[0051] In the following reference is made to figure 5a that is an perspective view from above of the front side of the chain tensioning arrangement according to the first embodiment as well as figure 5b that is a perspective view from above of the back side of the chain tensioning arrangement according to the first embodiment in accordance with figure 5a. Parts/functions that are like the embodiments according to figure 2-4 are not referred to in detail.

[0052] Figures 5a and 5b disclose among other things the cross beam 13 having the pins 14 arranged in the opposite ends of the cross beam. Thereto the spring arrangement 16 having three spring members 17 that are constituted by helical springs is disclosed. In the figures the helical springs are partly compressed - the chain tensioning arrangement is in the stage in which the pump is in operation and the chain tensioning arrangement stretches the chain. The arm is in the active position and is displaced in the direction from the lower position towards the upper position.

[0053] In the free end the arm 18 has the engagement member 19. The engagement member 19 has a seat configured to receive at least one link of the chain 6. A locking pin/locking screw 22 attends to secure the received chain link in the seat. In the disclosed embodiments the seat is arranged perpendicular to the direction of the main extension of the arm, however other angles are conceivable, such as parallel to the direction of the main extension of the arm.

[0054] The chain tensioning arrangement according to the first embodiment thereto comprises means for limiting to an adjustable extent the displacement of the arm 18 by means of said at least one spring member 17. In the disclosed embodiment the means is constituted by a screw 23 that can be manipulated in the axial direction and that is manipulated by means of a suitable tool. In an alternative, not disclosed, embodiment the lower end of said at least one spring member 17 may be adjustable/displaceable in the axial direction. Thereby, an alternative solution to adjust the magnitude of the load on the spring member 17 is obtained. The chain tensioning arrangement 2 can be realized without the above mentioned screw 23. According to yet another, not disclosed, embodiment the screw 23 may be exchanged by a adjustable clamp that upon activation force the arm 18 from the upper position towards the lower position.

[0055] As previously mentioned the arm 18 is pivotal about a pivot axis in a radially extending plane. An arc-shaped groove 24 is arranged in the arm 18 and the screw 23 that can be manipulated in the axial direction is located in said groove 24. Their joint action delimits the pivot angle of the arm 18.

[0056] Figure 5b also discloses a guide pin 25. The purpose of the guide pin 25 is to prevent pivoting of the arm 18 when it is located in the lower position or in a position remote from the upper position.
[0057] Herein below the second, more general, embodiment according to figures 6-9 is disclosed. Only differences in relation to the first embodiment will be described, and it shall be realized that features and functions of the first embodiment are directly applicable to the second embodiment, and vice versa, if nothing else is stated.

[0058] The most essential difference between the first embodiment and the second embodiment of the chain tensioning arrangement 2 is that the latter lacks means for limiting to an adjustable extent the displacement of the arm 18 by means of said at least one spring member, and this partly affects the function of the chain tensioning arrangement 2.

[0059] In the following and with reference to figures 6a and 6b the function of the chain tensioning arrangement 2 according to the second embodiment is described in connection with installation of the pump 4 in the column pipe 3 as well as the activation of the pump 4.

[0060] The pump 4 is lowered from ground level by means of the chain 6 and is arranged such that it is tight against the bottom flange 5 of the column pipe 3. When the pump 4 stands on the bottom flange the chain 6 is slack. The chain tensioning arrangement 2 is attached to the upper end of the column pipe 3, and it is controlled/secured that the arm 18 is in the upper position. The chain 6 is stretched/lifted by hand and is maximally tensioned. The chain link that is located at the same height as the upper side of the cross beam is observed/marked and a suitable chain link located between the observed/ marked chain link and the chain link that is at the same height as the engagement member 19 is chosen as engagement chain link. It is secured that the arm 18 is pivoted to the inactive position. The pump 4 is lifted in the chain 6 until the engagement chain link is at the same height as the engagement member 19. The arm 18 is pivoted to the active position and the engagement chain link is allowed to engage the engagement member 19. Thereafter, the pump 4 is lowered such that it once again is tight against the bottom flange 5 of the column pipe 3. The arm 18 is displaced towards the lower position and the spring member 17 is compressed due to the engagement between the arm 18 and the chain 6. The extent of the displacement is in the magnitude of 5 centimeters. It shall be made clear that the arm 18 is located at a distance from the cross beam 13 when the pump 4 stands on the bottom flange 5. Thus, the chain 6 is now stretched such that its slack is considerably less or entirely eliminated. The pump is ready for operation.

[0061] Reference is now made to figures 7a and 7b that disclose the chain tensioning arrangement 2 according to the second embodiment during hoisting or lowering of the pump 4. Thus, the pump 4 is not operating but is hoisted or lowered in the column pipe 3 by means of a suitable winch device. The chain tensioning arrangement 2 must not be removed from the walls of the column pipe 3 during hoisting/lowering. However, the engagement member 19 of the arm 18 must be unengaged from the engagement chain link, i.e. the arm 18 should preferably be set in the inactive position. This is performed, as is disclosed in figures 7a and 7b, by pivoting the arm 18.

[0062] Analogously to figures 6a and 6b the different components of the chain tensioning arrangement 2 are disclosed from the front in figure 7a and from above in figure 7b. By comparing the spring arrangement in figures 6a and 7a it is clear that the spring member 17 in figure 7a is maximally expanded. Thus, the arm 18 that is connected to the spring member 17 is located in the upper position. The spring arrangement exerts no upwardly directed force against the arm 18, which thereby can be pivoted between its active and inactive positions, respectively.

[0063] In the following and with reference to figures 7a and 7b the function of the chain tensioning arrangement is described in connection with hoisting of the pump 4 from the bottom of the column pipe 3 to the top of the column pipe 3 and/or out of the column pipe 3.

[0064] The pump 4 is lifted a few centimeters whereby the arm 18 is displaced in the direction towards the upper position under the effect of the spring member 17. When the arm 18 is located in the upper position it is pivoted from the active position to the inactive position, whereupon the engagement chain link of the chain unengaged the engagement member 19 of the arm. Thereafter the pump 4 is hoisted in conventional way be lifting in the chain 6. Before the pump is removed from the column pipe 3 the chain tensioning arrangement 2 must be removed from the upper end of the column pipe 3.

[0065] Reference is now made to figure 8 that disclose the chain tensioning arrangement 2 during so-called retake, as is described in connection with the first embodiment of the chain tensioning arrangement. During retake the chain tensioning arrangement is used to secure and remain the pump 4 at the reached height in the column pipe 3 during the retake is carried out.

[0066] In the following the function of the chain tensioning arrangement is described in connection with retake during hoisting of the pump 4. The chain 6 is not in engagement with the arm 18, and the arm 18 is pivoted to the inactive position. The pump 4 is hoisted to a height admitted by the crane, the chain is thus tensioned since the pump 4 is hanging in the chain 6 and the chain runs centrally in the column pipe 3. The arm 18 is in the upper position and is pivoted from the inactive position towards the active position and towards the chain 6 such that the engagement member 19 engage the chain link that best match the height position of the arm 18. Thereafter, the pump 4 is lowered a few centimeters by means of the crane such that the entire weight of the pump 4 is supported by the chain tensioning arrangement 2. Thus, the arm 18 is forced to the lower position in which the arm 18 abuts the cross beam 13. Thereafter, the crane takes a new grip in the chain 6 close to the chain tensioning arrangement. The pump 4 is lifted a few centimeters such that the arm 18 is displaced to the upper position. The arm 18 is thereafter pivoted to the inactive position such
that the engagement between the engagement member 19 and the chain 6 is broken. The chain tensioning arrangement 2 is removed from the column pipe 3 such that the pump 4 can be hoisted all the way up to the top of the column pipe 3 and/or out of the column pipe 3. Alternatively one or more extra retakes may be needed.

[0067] The function of the chain tensioning arrangement in connection with retake during lowering of the pump 4 is analogous to the above described procedure regarding retake during hoisting.

[0068] Thus, the pump 4 is firstly lowered as much as admitted by the crane except from at least the centimeters needed to lower the pump 4 when the arm 18 is displaced to the lower position by the weight of the pump 4. The chain 6 runs centrally in the column pipe 3 and is tensioned since it is loaded with the entire weight of the pump 4. The chain tensioning arrangement 2 is attached having the arm 18 pivoted to the inactive position as well as located in the upper position. The arm 18 is pivoted to the active position such that the engagement member 19 can engage the chain 6. The pump 4 is lowered a few centimeters by means of the crane such that the entire weight of the pump is supported by the arm 18 and the chain tensioning arrangement 2 when the arm 18 abuts the cross beam 13. The crane takes a new grip higher up on the chain and lifts the pump a few centimeters such that the arm 18 is displaced to the upper position by means of the spring member 17 and thereafter once again is pivoted to the inactive position. Thereafter, the pump 4 is lowered all the way down to the bottom of the column pipe 3 whereupon the chain 6 becomes slack. Alternatively one or more extra retakes may be needed.

The rest of the procedure is constituted by a tensioning of the slack chain 6 as is already described in connection with figures 6a and 6b.

[0069] Analogous to figures 6a and 7a the different components of the chain tensioning arrangement are disclosed from the front in figure 8. By comparing the spring arrangement in figures 6a and 7a it is clear that the spring arrangement in figure 8 is maximally compressed. This is since the pump 4 is hanging in the chain tensioning arrangement and thus the entire weight of the pump is supported by the chain tensioning arrangement. Thus, the arm 18 that is connected to the spring member of the spring arrangement is located in the lower position abutting the cross beam 13. The spring arrangement shall preferably not bottom when the arm 18 is located in the lower position.

[0070] In the following reference is made to figure 9a that is a perspective view from above of the front side of the chain tensioning arrangement according to the second embodiment as well as to figure 9b that is a perspective view from above of the back side of the chain tensioning arrangement according to the second embodiment.

[0071] Figure 9a discloses the spring arrangement 16 comprising one spring member 17 that is constituted by a helical spring. In the figures the spring member 17 is partly expanded, i.e. the chain tensioning arrangement is in the position in which the pump 4 is in operation and the chain tensioning arrangement stretches the chain 6. The arm is in the active position and located between the upper and the lower position.

[0072] In its free end the arm 18 has the engagement member 19. The engagement member 19 has a seat configured to receive at least one link of the chain 6. The seat is inclined in the direction inwards/downwards in order to secure the chain in the engagement member 19. A locking pin/locking screw 22 attends to secure the received chain link in the seat even further. In the disclosed embodiment the seat is arranged perpendicular to the direction of the main extension of the arm, however, other angles are conceivably, such as parallel to the direction of the main extension of the arm.

[0073] When the arm 18 is in the active position the guide pin 25, which is fixedly connected to the arm 18, may be displaced in the axial direction at the same time as pivoting of the arm 18 from the active position to the inactive position is prevented when the arm 18 is at a distance from the upper position. When the arm 18 is in the upper position the lower end of the guide pin 25 runs in an arc-shaped chute 31, whereupon the joint action thereof delimit the pivot angle of the arm 18. It shall be pointed out that the chute 31 is not all through and thereby the arm 18 is prevented from being displaced from the upper position towards the lower position when the arm is located in the inactive position. This feature is directly applicable to the first embodiment of the chain tensioning arrangement 2.

[0074] Reference is now made to figures 10a and 10b that are a schematic cross sectional view from the front and from the side, respectively, of an upper part of the pump station 1. Both figures contextual the preferred locations and extensions of the electric cables 9 in relation to the chain tensioning arrangement 2 and the column pipe 3. It shall be pointed out that other installations/pumps can comprise only one cable and alternatively more than two electric cables. The two disclosed electric cables 9 weigh together in the range 4-8 kilograms/meter and has a diameter in the range 20-40 millimeters. The two electric cables 9 that are disclosed are connected to the stretched chain by means of a two part electric cable holder 10 as will be described in more detail with reference to figures 11a and 11b. Thus, a stretched, essentially unmoving chain 6b open for connecting the electric cables 9 directly to the chain 6 and also removes the need for a wire such has been previously used to secure electric cables in different pump stations.

[0075] Figure 11a is a schematic perspective view from above of a first member 26 of the two part electric cable holder, which first member 26 is configured to be attached to the electric cables 9. Two opposite sets of block shaped projections 27 are arranged in a seat 28 at the front side of the first member 26. Thus, between each pair of adjacent projections there is a gap. A slit 28 extend essentially along the entire seat of the first member 26,
between said two sets of projections 27. The split 28 is configured to receive links of the chain. The first member 26 of the electric cable holder 10 can be made in any suitable polymeric material.

[0076] Figure 11b is a schematic perspective view from above of the second element 28 of the two part electric cable holder 10, which second member 29 is configured to be connected to the chain 6. More specifically the links, three whole and two half links, of the chain 6 are located in a seat of the second member 29. One whole and two half links lie flat in the seat and the other two whole links stands on its edge. This seat is designed to be able to receive and fixate the links. The chain is hereby detachably connected to the second member 29. The second member 29 comprises two opposite sets of block shaped projections 30, complementary to the gaps belonging to the two sets of opposite projections 27 of the first member 26. Also the second member 29 may be made by any suitable polymer material.

[0077] In the following the procedure to connect the electric cables 9 to the chain 6 by means of the two part electric cable holder according to figures 11a and 11b is described.

[0078] The respective end section of the first element 26 is pre attached, for instance by means of vulcanization tape, to the electric cables 9 approximately every meter, the distance between two neighboring first member 26 along the electric cables shall preferably not exceed 1.5 meters. At the same time as the pump 4 is lowered and the chain 6 is tensioned a second member 29 is attached to the links of the chain according to the above at a height corresponding to the first member 26 that is connected to the electric cables 9. The electric cables 9 are stretched by hand and the second member 29 is brought in engagement with the first member 26 by arranging the projections 30 of the second member between the projections 27 of the first member 26. The electric cables shall be kept as stretched as possible. Thereafter the first member 26 and the second member 29 of the electric cable holder are secured to each other by means of a stripe or the like.

[0079] The above procedure is performed during the lowering of the pump and the chain is tensioned. During hoisting of the pump the stripes of the respective electric cable holder 10 coming out of the column pipe are cut off and the electric cables 9 are detached from the chain 6 concurrently as the pump 4 is hoisted.

[0080] Generally the electric cable holder 10 can be defined as an electric cable holder for anchorage of at least one electric cable to a chain. The electric cable holder comprises a first member 26 configured to be connected to said at least one electric cable and a second member 29 configured to be connected to said chain, the first member 26 presenting a seat 28 in which the second member 29 is detachably received, said second member 29 being configured to in the seat optionally take one of at least two, mutually and in relation to the first member 26, axially separated positions.

Feasible modifications of the Invention

[0081] The invention is not limited only to the embodiments described above and shown in the drawings, which primarily have an illustrative and exemplifying purpose. This patent application is intended to cover all adjustments and variants of the preferred embodiments which are still according to the appended claims, because the scope of the present invention is defined by the wording of the appended claims. Thus, the equipment may be modified in all kinds of ways within the scope of the appended claims.

[0082] For instance the arm can be of fixed type, e.g. none-pivotable, and arranged perpendicular to the cross beam and rigidly connected thereto. The outer most part of the free end of the arm is then constituted by an engagement member configured to engage one of the links of the chain.

[0083] It shall also be pointed out that all information about/concerning terms such as above, under, upper, lower, etc., shall be interpreted/read having the equipment oriented according to the figures, having the drawings oriented such that the references can be properly read. Thus, such terms only indicates mutual relations in the shown embodiments, which relations may be changed if the inventive equipment is provided with another structure/design.

[0084] It shall also be pointed out that even thus it is not explicitly stated that features from a specific embodiment may be combined with features from another embodiment, the combination shall be considered obvious, if the combination is possible and if the combination still falls within the scope of the appended claims.

Claims

1. A chain tensioning arrangement (2) for an axially extending column pipe (3) which is configured to house a submersible pump (4), the chain tensioning arrangement comprising a cross beam (13) configured to extend in the radial direction in relation to the column pipe, wherein the chain tensioning arrangement (2) comprises:

- a spring arrangement (16) connected to the cross beam (13) and comprising at least one spring member (17), and
- an arm (18) that is movably connected to the cross beam (13) and that comprises an engagement member (19) configured for engaging and unengaging a chain connected to said pump, wherein the arm (18) has a main extension configured to extend in the radial direction in relation to the column pipe,

the arm (18) being displaceable in the axial direction between a lower position and an upper
position,
said at least one spring member (17) being ar-
 ranged to displace the arm (18) in the direction
from the lower position towards the upper posi-
tion.

2. The chain tensioning arrangement according to
claim 1, further comprising means for limiting to an
adjustable extent the displacement of the arm (18)
by means of said at least one spring member (17).

3. The chain tensioning arrangement according to
claim 1 or 2, wherein the arm (18) is pivotable in an
radially extending plane between an active position
and an inactive position.

4. The chain tensioning arrangement according to any
preceding claim, wherein said at least one spring member (17) is constituted by a helical spring.

5. The chain tensioning arrangement according to any
preceding claim, wherein the arm (18) is directly or
indirectly connected to the spring member (17).

6. The chain tensioning arrangement according to
claim 2, wherein the means for limiting to an adjust-
able extent the displacement of the arm (18) by
means of the spring member (17) is constituted by
a screw (23).

7. The chain tensioning arrangement according to
claim 2, wherein the means for limiting to an adjust-
able extent the displacement of the arm (18) by
means of the spring member (17) is realized by hav-
ing the position of the lower end of the at least one
spring member (17) adjustable in the axial direction.

8. The chain tensioning arrangement according to
any preceding claim, wherein said at least one spring member (17) exerts no upwardly directed force
against the arm (18) when the arm is located in the
upper position thereof.

9. The chain tensioning arrangement according to
any preceding claim, wherein the cross beam (13) in the
respective opposite ends thereof comprises at least
one pin (14) configured to be releasably connected
to the column pipe (3).

10. The chain tensioning arrangement according to
any preceding claim, wherein the engagement member
(19) of the arm (18) is constituted by a seat config-
ured to receive at least one link of the chain.

11. The chain tensioning arrangement according to
any preceding claim, further comprising an axially ex-
tending guide pin (25) configured to interact with said
arm (18).

12. A pump station comprising an axially extending col-
umn pipe (3), a submersible pump (4) arranged in
the column pipe (3), an axially extending chain (6)
connected to the pump and configured to move the
pump in the column pipe, and a chain tensioning
arrangement (2) according to claim 1.

Patentansprüche

1. Kettenspann-Anordnung (2) für ein sich axial erstre-
ckendes Kolonnenrohr (3), das für die Aufnahme ei-
er Tauchpumpe (4) ausgebildet ist, wobei die Ket-
tenspann-Anordnung einen Querträger (13) auf-
weist, der so ausgebildet ist, dass er sich in Radial-
richtung zum Kolonnenrohr erstreckt,
wobei die Kettenanspruch (2) aufweist:

- eine Federanordnung (16), die mit dem Quer-
träger (13) verbunden ist und mindestens ein
Federteil (17) aufweist, und
- einen Arm (18), der mit dem Querträger (13)
beweglich verbunden ist und ein Eingriffsteil
(19) aufweist, das zum Eingreifen in eine und
Lösen aus einer mit der Pumpe verbundenen
Kette ausgebildet ist, wobei der Arm (18) eine
Haupterstreckung hat, die so ausgebildet ist,
dass sie sich in Radialrichtung zum Kolonnen-
rohr erstreckt,

wobei der Arm (18) in Axialrichtung zwischen einer
unteren Position und einer oberen Position ver-
schiebar ist,

wobei das mindestens eine Federteil (17) zum Ver-
schieben des Armes (18) aus der unteren Position zur
oberen Position hin angeordnet ist.

2. Kettenspann-Anordnung nach Anspruch 1, ferner
mit einer Einrichtung zum Begrenzen der Verschie-
bung des Armes (18) auf ein einstellbares Maß mittels
des mindestens einen Federteils (17).

3. Kettenspann-Anordnung nach Anspruch 1 oder 2,
wobei der Arm (18) in einer sich radial erstreckenden
Ebene zwischen einer aktiven Position und einer in-
aktiven Position verschwenkbar ist.

4. Kettenspann-Anordnung nach einem der vorstehen-
den Ansprüche, wobei das mindestens eine Federtei-
(17) durch eine Spiral fed er gebildet ist.

5. Kettenspann-Anordnung nach einem der vorstehen-
den Ansprüche, wobei der Arm (18) direkt oder in-
direkt mit dem Federteil (17) verbunden ist.

6. Kettenspann-Anordnung nach Anspruch 2, wobei
die Einrichtung zum Begrenzen der Verschiebung
des Armes (18) auf ein einstellbares Maß mittels des

12. A pump station comprising an axially extending col-
umn pipe (3), a submersible pump (4) arranged in
the column pipe (3), an axially extending chain (6)
connected to the pump and configured to move the
pump in the column pipe, and a chain tensioning
arrangement (2) according to claim 1.
Federteils (17) durch eine Schraube (23) gebildet ist.


8. Kettenspann-Anordnung nach einem der vorstehenden Ansprüche, wobei das mindestens eine Federteil (17) keine nach oben gerichtete Kraft auf den Arm (18) ausübt, wenn sich der Arm in seiner oberen Position befindet.


12. Pumpstation, die aufweist: ein sich axial erstreckendes Kolonnenrohr (3), eine Tauchpumpe (4), die in dem Kolonnenrohr (3) angeordnet ist, eine sich axial erstreckende Kette (6), die mit der Pumpe verbunden und zum Bewegen der Pumpe in dem Kolonnenrohr ausgebildet ist, und eine Kettenspann-Anordnung (2) nach Anspruch 1.

Revendications

1. Tendeur de chaîne (2) pour un tube de colonne montante s’étendant de manière axiale (3) qui est configuré pour loger une pompe submersible (4), le tendeur de chaîne comprenant une poutre transversale (13) configurée pour s’étendre dans la direction radiale par rapport au tube de colonne montante, dans lequel le tendeur de chaîne (2) comprend :

un agencement de ressort (16) raccordé à la poutre transversale (13) et comprenant au moins un élément de ressort (17), et un bras (18) qui est raccordé, de manière mobile, à la poutre transversale (13) et qui comprend un élément de mise en prise (19) configuré pour mettre en prise et dégager une chaîne raccordée à ladite pompe, dans lequel le bras (18) a une extension principale configurée pour s’étendre dans la direction radiale par rapport au tube de colonne montante, le bras (18) étant déplaçable dans la direction axiale entre une position inférieure et une position supérieure, ledit au moins un élément de ressort (17) étant agencé pour déplacer le bras (18) dans la direction allant de la position inférieure à la position supérieure.

2. Tendeur de chaîne selon la revendication 1, comprenant en outre un moyen pour limiter, à une étendue ajustable, le déplacement du bras (18) au moyen dit au moins un élément de ressort (17).

3. Tendeur de chaîne selon la revendication 1 ou 2, dans lequel le bras (18) peut pivoter dans un plan s’étendant de manière radiale entre une position active et une position inactive.

4. Tendeur de chaîne selon l’une quelconque des revendications précédentes, dans lequel le ledit au moins un élément de ressort (17) est constitué par un ressort hélicoïdal.

5. Tendeur de chaîne selon l’une quelconque des revendications précédentes, dans lequel le bras (18) est directement ou indirectement raccordé à l’élément de ressort (17).

6. Tendeur de chaîne selon la revendication 2, dans lequel le moyen pour limiter, à une étendue ajustable, le déplacement du bras (18) au moyen de l’élément de ressort (17), est constitué par une vis (23).

7. Tendeur de chaîne selon la revendication 2, dans lequel le moyen pour limiter, à une étendue ajustable, le déplacement du bras (18) au moyen de l’élément de ressort (17), est réalisé en ayant la position de l’extrémité inférieure de l’au moins un élément de ressort (17) ajustable dans la direction axiale.

8. Tendeur de chaîne selon l’une quelconque des revendications précédentes, dans lequel le ledit au moins un élément de ressort (17) n’exerce aucune force dirigée vers le haut contre le bras (18) lorsque le bras est positionné dans sa position supérieure.

9. Tendeur de chaîne selon l’une quelconque des revendications précédentes, dans lequel la poutre transversale (13) dans ses extrémités opposées respectives comprend au moins une broche (14) configurée pour être raccordée de manière amovible au tube de colonne montante (3).

10. Tendeur de chaîne selon l’une quelconque des re-
vendications précédentes, dans lequel l’élément de mise en prise (19) du bras (18) est constitué par un siège configuré pour recevoir au moins un maillon de la chaîne.

11. **Tendeur de chaîne selon l’une quelconque des revendications précédentes, comprenant en outre une broche de guidage s’étendant de manière axiale (25) configurée pour interagir avec ledit bras (18).**

12. **Station de pompe comprenant un tube de colonne montante s’étendant de manière axiale (3), une pompe submersible (4) agencée dans le tube de colonne montante (3), une chaîne s’étendant de manière axiale (6) raccordée à la pompe et configurée pour déplacer la pompe dans le tube de colonne montante, et un tendeur de chaîne (2) selon la revendication 1.**
Fig. 5a
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6386487 B1 [0008]