RESEARCH PAPER | Engineering | Volume : 4 | Issue : 1 | Jan 2014 | ISSN - 2249-555X

Plasmabit Movement - Anchoring System: Methodology of Design Concept Creation

KEYWORDS: Product development, concept, preparing concept, geothermal boring, anchoring, Plasmabit

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ABSTRACT *When providing development of new products a lot of different working methods are applied, with respect to the product technical severity, inventive steps and other specific aspects not only concerned the product alone, however concerned to its development environment, production and operational conditions as well. The paper deals with an important phase related to the product development, which follows after having completed the submission concerned to that solution, which is closely related to creation of its functional and design concept, while the product example is considered to be an anchoring system, which creates an integral part the Plasmabit subsystem. However, the subsystem creates an integral part of massive technical system applied for geothermal well boring purposes as well.*

INTRODUCTION

The device denoted as Plasmabit is applied for geothermal bores and it should be able to operate in 10 kilometers under earth surface. However, high temperature (more than 400 °C) and high pressure (more the 100 Mega-Pascal) affect the material properties and behavior of electronic devices as well. The Plasmabit device is considered to be an autonomous system having a set of appropriate elements, which provide its motional functionality. At present, no producers of those devices are known and no similar devices exist, which could be able to operate within so much drastic operational conditions. Now days, the devices applied for geothermal boring purposes are able to operate within maximum depth of five kilometers and might be found in gas and oil industry.

The Plasmabit device consists of several subsystems. Plasmatron is a subsystem having the principal functionality and provides rock or ground destruction. However, the subsystems, which provide motion and anchoring, control electronic and power systems together with systems for surface water delivery and distribution, play a role of great importance as well. This paper deals with Plasmabit anchoring subsystem concept design, which is directly interconnected to kinematics system providing the boring Plasmabit motion.

Drafting

The Plasmabit subsystem and the Plasmabit system alone are considered to be a unique system. The concept preparation phase is the principle and decisive phase and determines device further development in a great deal (Pahl 2005). The task solution is closely related to preparation of appropriate variants, while the selection of physical principles is considered to be the first one accompanied by preparation kinematics structure definition of organ structure and a preparation of construction variants is considered to be the final step in the above-mentioned activities. However, an appropriate morphological layout of possible solutions might be completed and the final solution might be designed with respect to adequate criteria denoted as a reliable functionality and acceptable implementation costs as well.

Although, there are a lot of different problems at the beginning of optimal solution finding, a set of perspective variants should be created and those variants, which are less or not suitable with respect to existing conditions should not be accepted (Ĉllík, 2001; Medvecký 2006).

Physical principles

A set of appropriate physical principles might be applied, when considering anchoring and movement mechanism:

Mechanical principles, they are suitable to be applied in the environment represented by high pressure and temperature and because of great force generation as well. An appropriate power and energy shall be delivered from earth surface, in order to assure their optimal functionality.

Hydraulic systems and principles are less suitable related to high pressure and force because of problems with temperature over 80 °C. On one hand, power or energy for functionality might be delivered from earth surface (over the boring) and transferred down with the use hydraulic principles. On the other hand electric power might be delivered from earth surface and transformed within Plasmabit system as well.

Pneumatic principles - are not suitable – a set of compression problems might be observed. As a result of that, those principles are not suitable for generation of great forces and because of changing temperature as well.

Electric principles – those principles might be applied, when mechanic or hydraulic principles are applied simultaneously. They are inevitable because of power or energy transport and performance generation, which is closely related to generation of motion and force. However, there are several problems with high temperature as well.

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Contact of anchoring system with borehole wall

There is an inevitable contact of anchoring system with boring wall because of force transfer, which is necessary for repression of the system last and for the system motion and position too. In principle forces might be transferred via friction (Fig.1) and shape (Fig.2), (Žarnay, 2011).

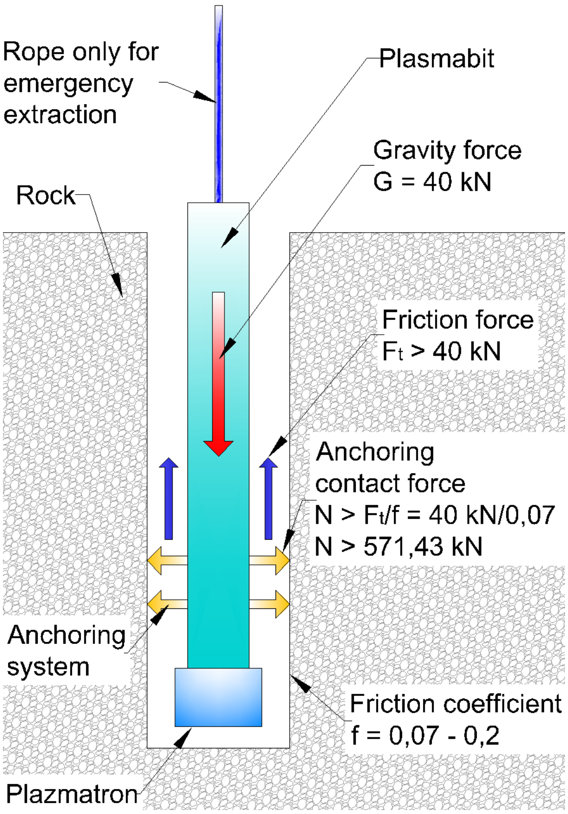


Figure 1: Friction is applied for Plasmabit last is transfer to boring walls

When providing force transfer via friction, the anchoring elements lean against smooth boring wall. When looking at Fig.1, we can postulate, the force is great.

When anchoring with the use of shape, the force is being lowered considerably, however the suitable shapes cannot be supposed in boring walls, they have to be created. The shapes might be created with the use of plasma, when boring a hole or that hole may be created with the use of anchoring system alone.

When providing force transfer via shape, the anchoring elements lean against a set of created boring wall surface bumps. As a result of that, the force is much lower, ten times less, when comparing it via friction (when a contact surface bump a = 45°). A combination of the above-mentioned principles is recommended for practical purposes because of penetrating the contact elements into boring walls, when acting force is great and they will create shapes for catching the vertical forces.

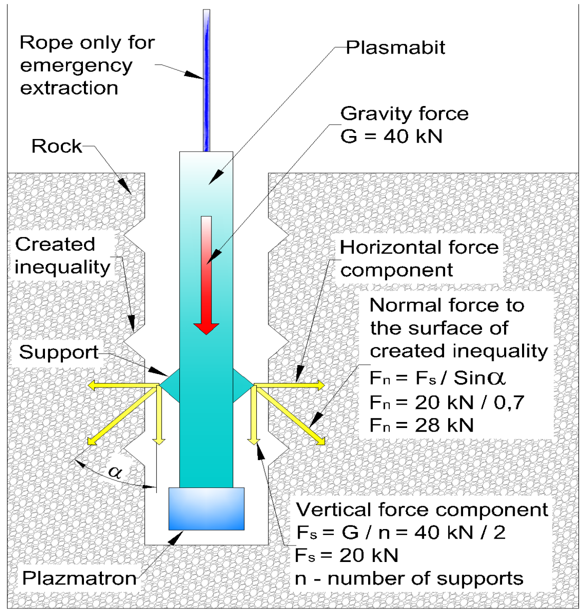
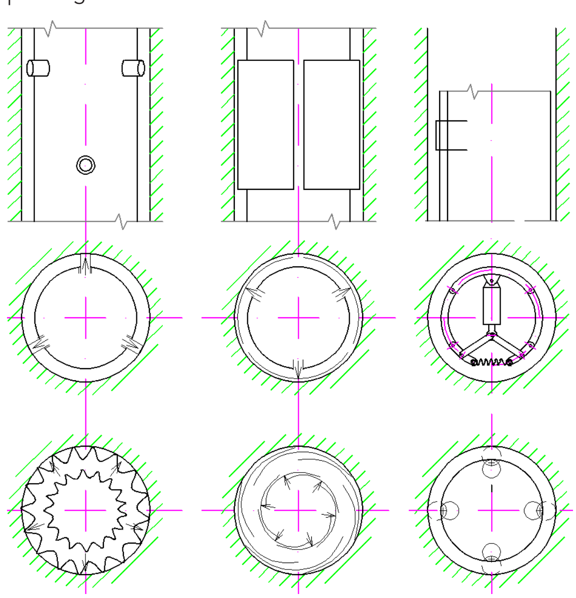


Figure 2: Plasmabit last is being transferred to bore wall via shape

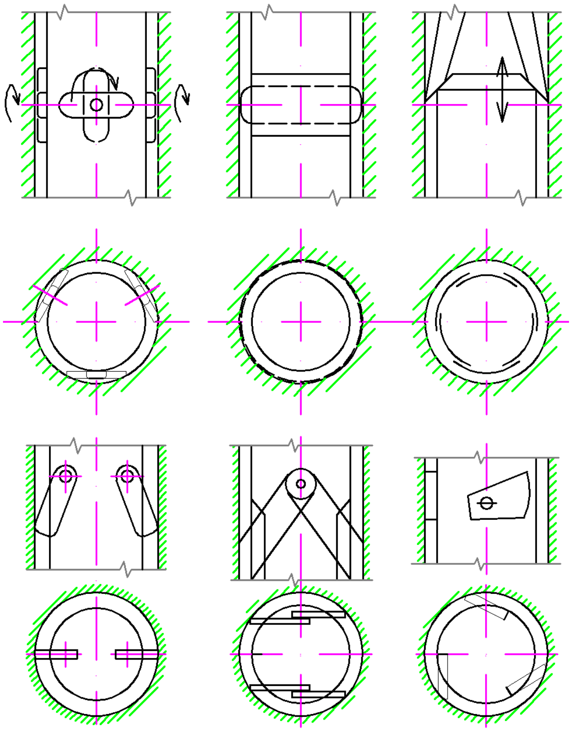
Mechanisms for contact between anchoring system and wall of the well

A lot of kinematics layouts together with different principles and anchoring mechanisms might be created based on our intuition. They have to be stored in one complete file and compared with respect to pre-defined criteria. There might be created a lot of arrangements related to the above-mentioned mechanisms (see also Fig.3). However, they may be of mechanic and hydraulic and mechanic nature as well (see also Fig.4). In principle, there is no difference between anchoring concepts based on friction and shapes too. However, the difference is in pressing force values, uplift size and solutions related to contact details only.

The up rise with the use of pins, cylindrical segments, expanding twiddle:



Rotating scent bags, deformation of material, arms leaning against the bore wall and etc.:



Other principles of mechanisms related to bore wall pressure:

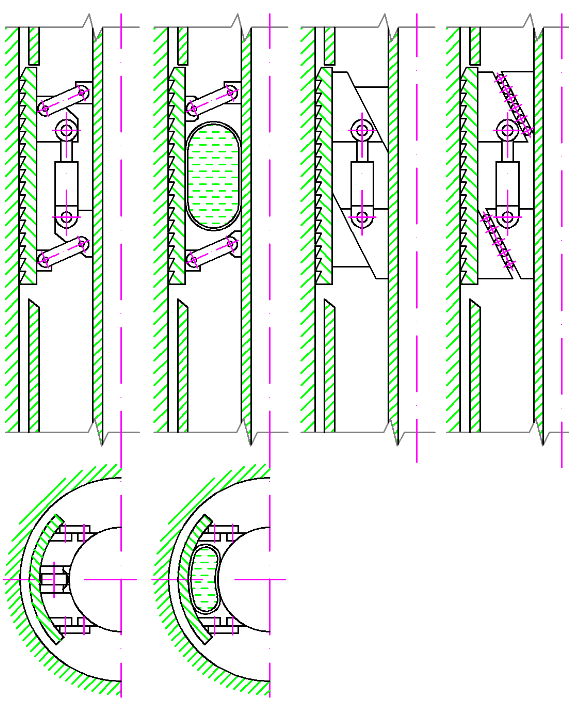
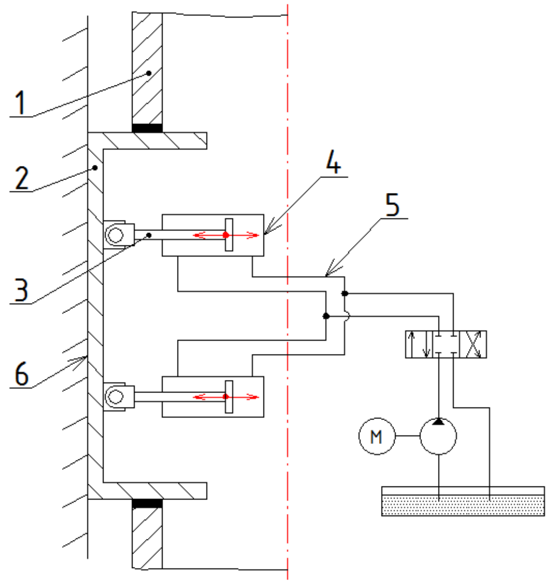


Figure 3 Drafts of different mechanic friction anchoring principles related to kinematics systems in the borehole. (Žarnay, 2011, 2013)



1 – Plasmabit coating,

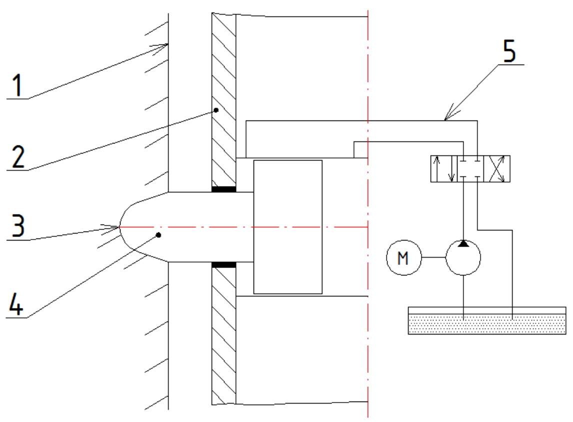
2 – Kinematics element

3 – Hydraulic piston

4 – Direct hydro motor,

5 – Hydraulic circuit,

6 – Bore wall.



1 – Bore wall,

2 – Plasmabit coating

3 – Bore wall cavity

4 – Hydraulic piston,

5 – Hydraulic circuit.

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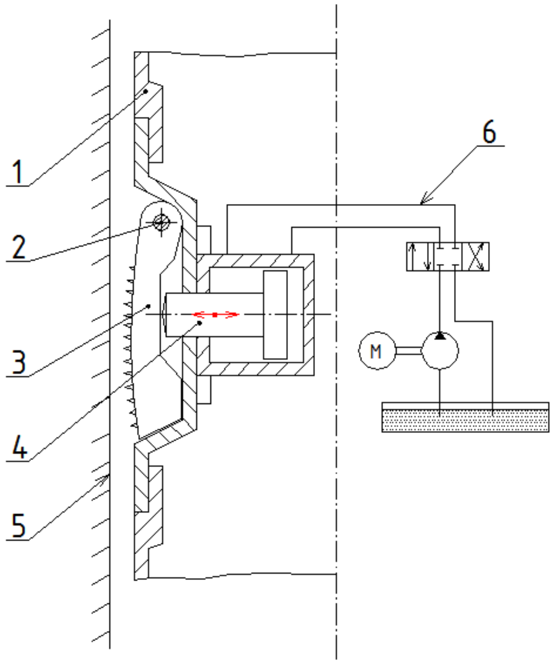

1 – Plasmabit coating,

2 – Contact element pin,

3 – Swinging contact element,

4 – Hydraulic piston,

5 – Bore wall,

6 – Hydraulic circuit.

Figure 4 Drafts of different hydraulic and mechanic anchoring principles based on friction and shape of kinematics system in the bore

Conclusion

This is not a final phase of that development task, however the system 3D model is being created. A set of calculations, evaluations, selections of proposal, function and shape optimizing, specification of standardized and normalized elements, drawing documentation preparation, production and prototype modifications represent the subsequent steps of that development task. Those aspects are standing outside the paper and might become ideas or themes for further individual and complex contributions or papers.

Acknowledgements
This publication is the result of the project implementation. The project name is „Autonomous robust mechatronic systems for ultra deep geothermal boreholes. " ITMS code 26220220139, supported by the Research & Development Operational Programme funded by the European Regional Development Fund.

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