

Preface

“... I have discovered methods for tunnels and engulfed secret ways, which are excavated without any noise, in order to reach predetermined locations, even if they have to be dug under ditches or under a river.”

“... I have noiseless methods to dig tunnels and winding secret catacombs in order to reach a pre-planned place, even if they have to be built underneath ditches and rivers.”

(Leonardo da Vinci, 1452–1519)

Leonardo da Vinci is considered to be one of the greatest inventors of all times. His revolutionary and futuristic construction plans e. g. in aviation and in the construction of canals and bridges were ridiculed during his time. Many of his discoveries were later ‘re-invented’ at times when they were actually necessary.

A horizontal drilling machine cannot be found among Leonardo’s known and published sketches, but he elaborated extensively about their usage and advantages in the construction of shafts. In his writings one can find descriptions of the method of drilling horizontal or vertical shafts, which means that he had already plans for useful applications in this field before Agricola, Brunel and all the following patent holders.

The drilling of tunnels has a long history. First patents were already distributed in the beginning of the 19th Century, but it took almost another century until a similar machine had drilled a longer distance through mountains. There were several reasons for this delay. Among them were ineffective mining tools, which were too soft, but above all it was the lack of sufficient energy sources at the workplace. In those days movable steam engines, even hydraulic devices for blasting rock formations were in use, but those techniques were not effective enough to dig a tunnel through an entire mountain.

Nowadays TBM tunnelling gains more and more significance in hard rock formations even with larger diameters. The number of substantially longer tunnels as well in road and rail traffic, as in the areas of supply and waste are constantly on the rise; not only are those projects worth mentioning like the Alpine tunnels that are in process or in developmental stages, but also those subterranean tunnels underneath straits, which will be realized in the future. Those procedures are still considered as spectacular. Bernard Kellermann wrote about a similar project in his utopian best seller ‘The Tunnel’ (published in 1921), describing the construction of a railway tunnel connecting Europe with the North American continent by means of four drills.

The varying usage of open tunnel drills with grippers will be extended from that for smaller or medium diameters to larger, which will be effective also under mixed geological circumstances. Those mixed geological circumstances have already led to an enormous push in the development of the shield machines and prefabricated tunnel linings. Open hard rock machinery has no or only a short protective shield and as a result, its usage is rather limited under difficult geological circumstances. Currently there is a

development of open hard rock machinery on the way, with the main focus on securing the area behind the drill head and advanced safety. The safety systems, with shotcrete, anchors and plates, which were developed for the traditional construction of tunnels are not of much use for continuous boring with Gripper-TBMs. Still, one cannot foresee if there are modifications of existing procedures possible or if one has to find completely new ways of dealing with these problems. In addition there is further demand for refining the use of tunnel bore machines in high altitude with high pressure.

The goal of the authors, Maidl, Schmid, Ritz and Herrenknecht was to accumulate existing knowledge and experience, to define requirements of use and to present as well as to encourage potential developments. This endeavour requires an interaction of Science and Practice at the highest level.

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