

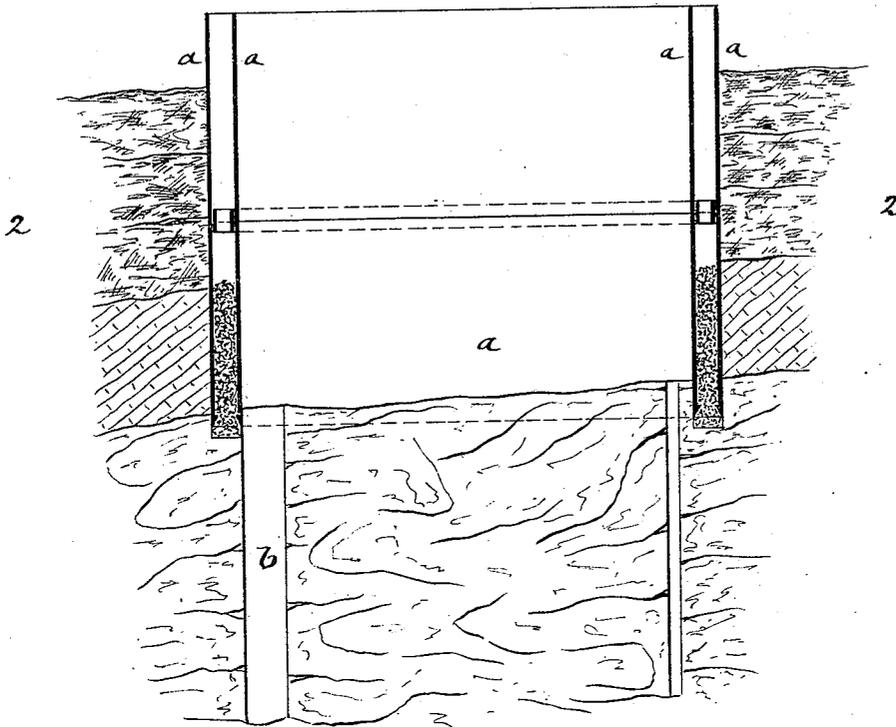
M. WOLFF.

METHOD OF DRIVING TUNNELS OR SINKING SHAFTS.

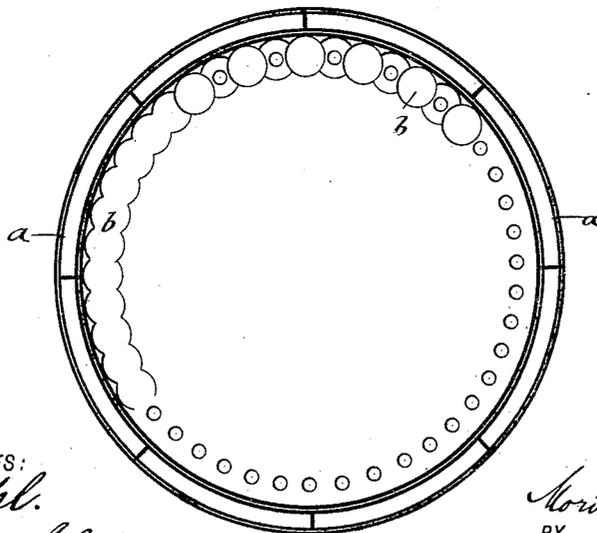
No. 460,545.

Patented Sept. 29, 1891.

*Fig: 1.*



*Fig: 2.*



WITNESSES:

*A. Seehle.*

*Charles Schroeder.*

INVENTOR:

*Moritz Wolff*

BY

*Joseph Raegner*

ATTORNEYS.

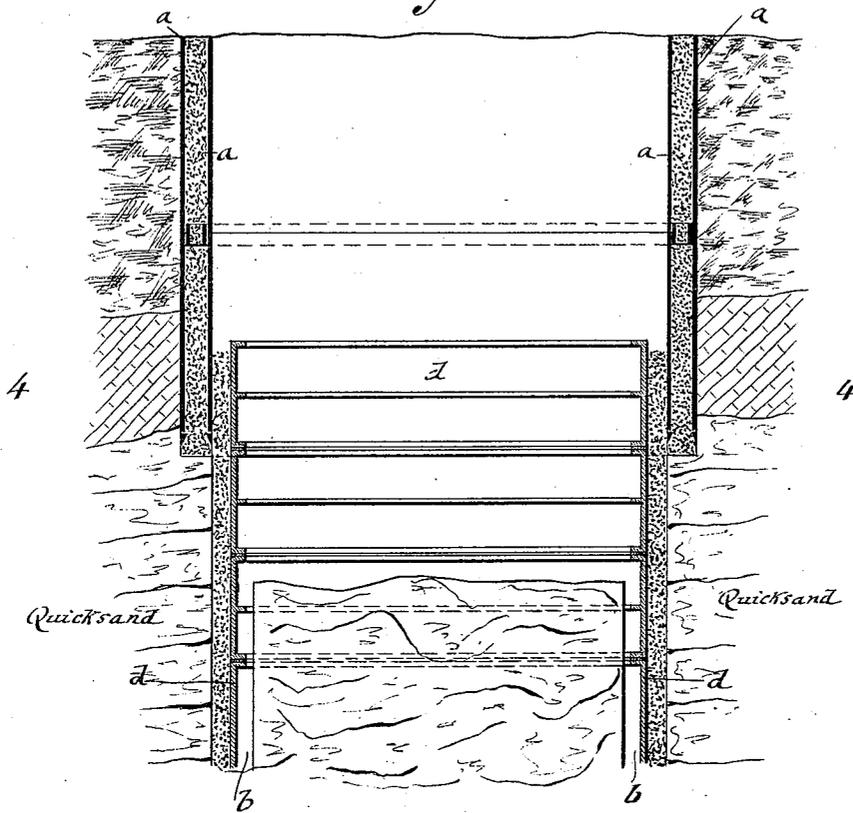
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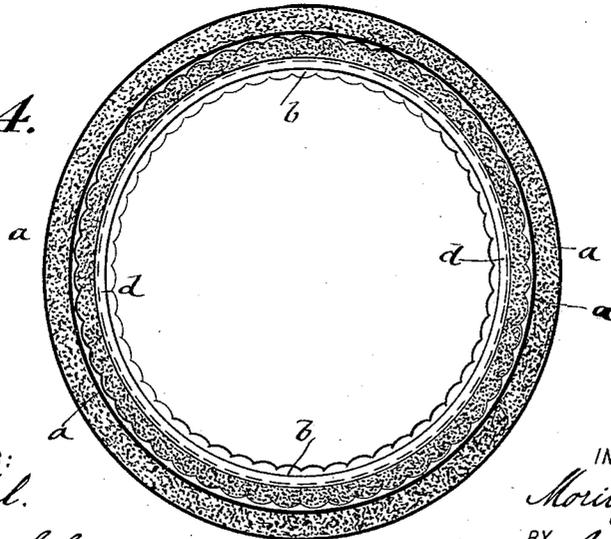
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*Fig: 3.*



*Fig: 4.*



WITNESSES:

*A. Schehl.*

*Charles Schroeder*

INVENTOR:

*Moritz Wolff*

BY

*Joseph Rayner*

ATTORNEYS

# UNITED STATES PATENT OFFICE.

MORITZ WOLFF, OF BERLIN, GERMANY.

## METHOD OF DRIVING TUNNELS OR SINKING SHAFTS.

**SPECIFICATION** forming part of Letters Patent No. 460,545, dated September 29, 1891.

Application filed December 29, 1890. Renewed September 1, 1891. Serial No. 404,408. (No model.) Patented in England October 8, 1890, No. 15,911.

*To all whom it may concern:*

Be it known that I, MORITZ WOLFF, a citizen of the German Empire, residing at Berlin, in the Kingdom of Prussia and Empire of Germany, have invented certain new and useful Improvements in Methods of Driving Tunnels or Sinking Shafts, (for which Letters Patent were granted to me in England, No. 15,911, dated October 8, 1890,) of which the following is a specification.

This invention relates to an improved method of driving tunnels or sinking shafts, wells, and foundations, said method being more especially designed for passing through water-bearing strata and below water-levels.

The invention consists of a method of driving tunnels or sinking shafts by first boring a series of small holes on the outline of the proposed tunnel or shaft, connecting said holes so as to form an annular space, inserting a casing into said annular space, and filling up the annular space outside of said casing by means of concrete, so that a solid permanent wall is formed that permits the removal of the core within the same.

In the accompanying drawings, Figures 1, 3, and 5 are vertical central sections illustrating my improved method of driving tunnels or sinking shafts, said figures illustrating the different stages of the method; and Figs. 2, 4, and 6 are horizontal sections, respectively, on the lines 2 2, Fig. 1, 4 4, Fig. 3, and 6 6, Fig. 5.

Similar letters of reference indicate corresponding parts.

In sinking shafts and tunneling in rock a series of comparatively small holes are drilled by suitable boring-tools at a short distance from each other around the outline of the proposed shaft, well, or tunnel. In the case of quicksand and similar material and in water-bearing strata an annular space is cleared by drilling or by means of hydraulic jets applied to the space between two concentric casings *a a*, which are sunk or pushed forward as the drilling proceeds, and which casings serve to exclude the water or sand. In either method of procedure a central core is left, which is then removed by the usual means. When dealing with hard material,

the series of small holes is afterward enlarged by means of tools of larger diameter, so that a continuous annular space *b* is obtained, the inner and outer contours of which are formed by short arcs or circles, as shown clearly in the horizontal sections in Figs. 2 and 4. In the annular space *b* that is thus obtained a number of rings *d* may then be inserted one after the other, so as to form a casing, which is then backed up by concrete, as shown in Figs. 3 and 4. In this manner the water from the surrounding strata may be completely shut off, so that the removal of the core within the casing may be accomplished without any difficulty. For the purpose of enlarging small holes so that their circumferences intersect and produce the annular space just described, a concentric series of chisel-pointed tools *e* is arranged in such a manner that the plane of the chisels in any two adjacent holes are at right angles to each other, as shown in Fig. 6, so that all the chisels may be simultaneously rotated at a uniform speed without their points coming in contact with each other.

In quicksand the entire interior space at the lower part of the concentric casing *d* may be filled with concrete after the removal of the core, while in bridge-foundations the whole casing may be so filled. The upper parts or rings of the concentric casing *d* may be ultimately removed for subsequent use elsewhere and replaced by less expensive brick-work. If the surrounding strata are unusually loose and dangerous, the entire annular space between the casing is filled with concrete, which thereby forms with the casing a solid permanent wall. By this method the casing may be sunk vertically with certainty, as it will not deviate from the perpendicular line in case the bottom of the casing comes in contact with inclined strata, roots of trees, rocks, or other obstacles, as these obstructions are readily broken up and removed by means of tools inserted through and operated in the annular space in the casing. In boring through a rock only a small amount of material is to be operated on by the boring-tools, as the remaining core can be removed by blasting and other simple means.

My improved method has the advantage

that there is practically no limit to the depth attainable in sinking shafts for foundations, &c., while pneumatic foundations cannot be made to much greater depth than from seventy-five to ninety feet, owing to the high atmospheric pressure required.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

10 The method herein described of driving tunnels or sinking shafts, &c., which consists in boring a series of small holes around the contour of the proposed tunnel or shaft, con-

necting said holes, so as to form an annular space, inserting a casing in said space and filling the remaining space with concrete, and finally removing the core inclosed by said casing, substantially as set forth. 15

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses. 20

MORITZ WOLFF.

Witnesses:

THEODOR WOLFF,  
OTTO KUNZE.