

D. C. HASKIN.
Art of Tunneling.

No. 147,055.

Patented Feb. 3, 1874.

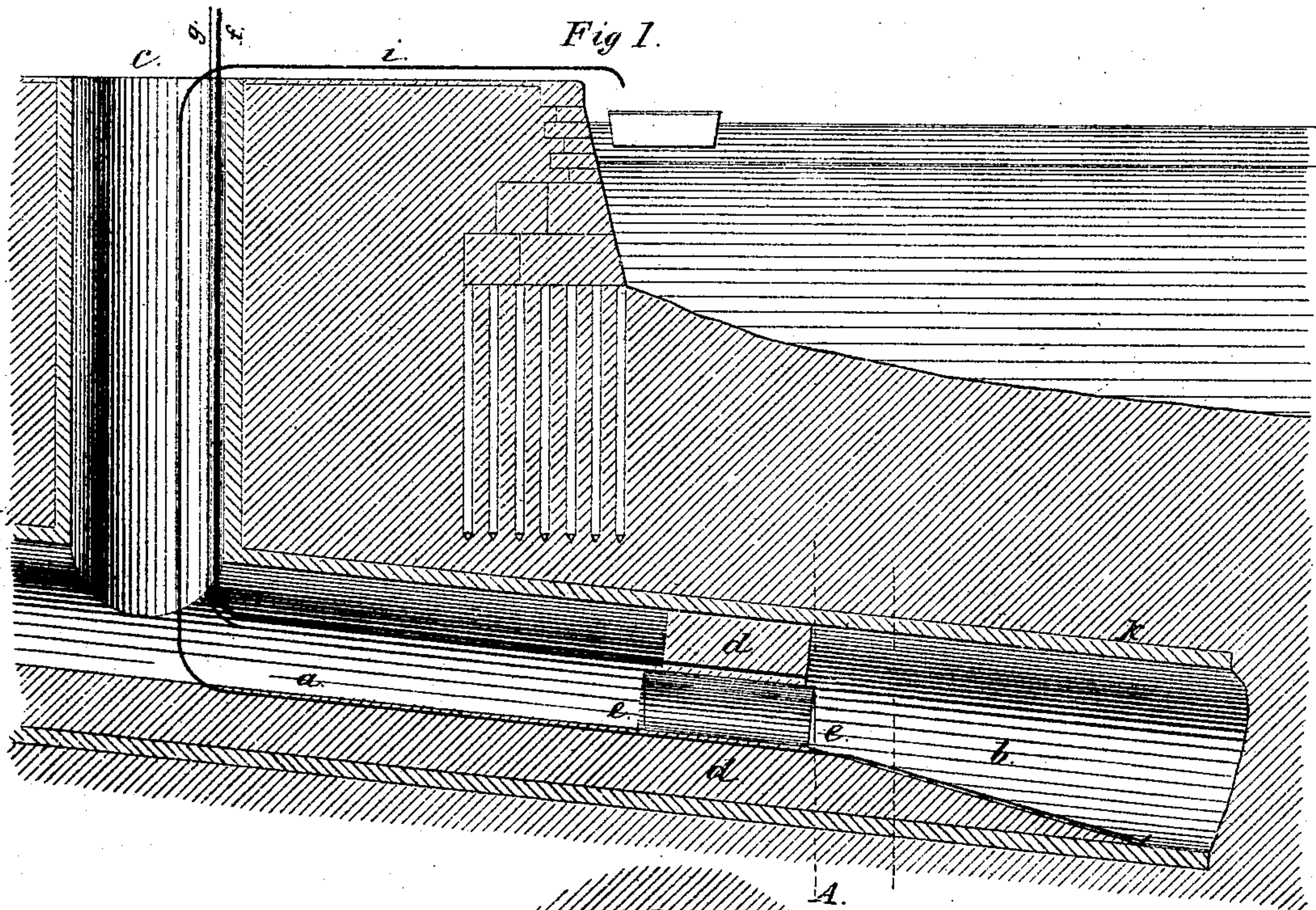
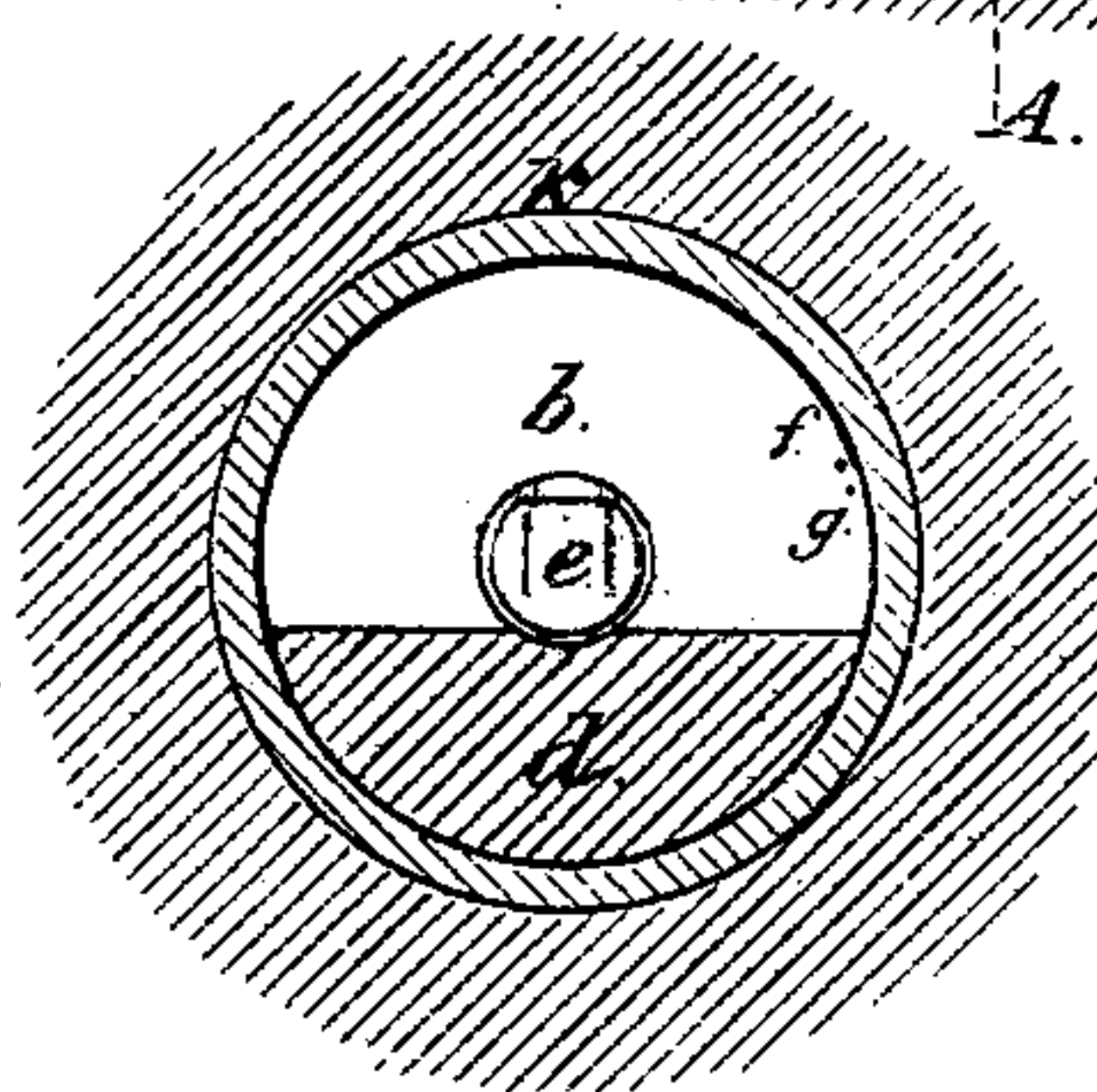


Fig 2.



Section at A.

Fig 3.



Witnesses.
Baltis & Long.
E. Davidson,

Inventor.
De Witt C. Haskin
by his attorney
Wm. D. Baldwin

UNITED STATES PATENT OFFICE.

DE WITT C. HASKIN, OF VALLEJO, CALIFORNIA.

IMPROVEMENT IN THE ART OF TUNNELING.

Specification forming part of Letters Patent No. **147,055**, dated February 3, 1874; application filed December 9, 1873.

To all whom it may concern:

Be it known that I, DE WITT CLINTON HASKIN, of Vallejo, in the county of Solano and State of California, have invented a new and useful Improvement in the Art of Tunneling, of which the following is a specification:

My invention relates more especially to the construction of tunnels through sands, wet earths under water-courses, and under such like conditions where the caving in of the walls of the excavation or the infiltration or irruption of water is to be apprehended. Its object is effectually to prevent such incidents in a cheap and simple way, to which end my improvement consists in filling the excavation with compressed air of a density sufficient to resist the inward pressure during the construction of the shell or wall of the tunnel.

The mechanical appliances for carrying out my invention are well known to engineers, and obviously may be varied in many ways in the details of their construction and application to meet the varying conditions under which the operations are to be performed, such application, however, involving nothing more than engineering skill or that of the constructor.

The accompanying drawings represent the best way of carrying out the details of my invention now known to me.

Figure 1 represents a vertical longitudinal central section through a tunnel in process of construction by my improved plan; Fig. 2, a vertical transverse section therethrough on the line A of Fig. 1. Fig. 3 represents a side elevation, partly in section, through the air-lock.

In this instance the tunnel is shown as partially completed. A working-shaft, *a*, leads into the tunnel *b*, which is divided into two or more compartments by an air-tight diaphragm, bulk-head, or air-lock, *d*. This air-lock is constructed so as to be movable at pleasure, and is, by preference, kept up as close to the tunnel-head as convenience will permit. The compartment or portion of the tunnel in advance of the air-lock forms a working-chamber or compressed-air chamber, *b*. Compressed air is forced into this chamber by means of a pipe, *g*, communicating with a suitable pump, and passing through the air-lock. This pipe is made flexible and extensible in order to ac-

commodate the adjustments of the air-lock. The air-pump may be located in the working-chamber, if preferred. A gas-pipe, *f*, may also be introduced through the air-lock. An exit-pipe, or waste-pipe, *i*, leading from the compressed-air chamber to the surface, may be used for ventilation or to carry off waste water, sand, &c. The air-lock is supplied with valves or doors *h* to retain the air, while permitting ingress and egress to the working-chamber.

I make no claim to the special construction of the devices above described, as they are well known to engineers.

In working by my improved system, the air-lock is adjusted in position, the air compressed in the chamber *b*, and the excavation proceeds in the ordinary way beyond the masonry-work *K*. The distinguishing feature of my system, however, is, that instead of using temporary facings of timber or other rigid material, I rely upon the air-pressure to resist the caving in of the wall or the infiltration of water until the masonry wall is completed. This pressure is, of course, to be regulated by the exigencies of the occasion, and may be varied from anything above that of the atmosphere to fifty pounds to the square inch, which is about as much as the human system will bear with safety. The effect of such pressure has been found to be to drive water in from the surface of the excavation, so that the sand becomes dry. In case a jet-seam or small stream of water is encountered, I supply a temporary shield of canvas, leather, or other light flexible integument to the wall, against which the pressure instantly forces it and seals the leak. This device is also very efficacious in preventing the escape of the compressed air through leaks in the sides or walls of the excavation. After completing the masonry walls of large tunnels, I allow the débris *d* to accumulate in the bottom, as shown in Fig. 1, until the tunnel is completed, leaving an opening only large enough for working purposes. By this means the area of the air-lock, the surface exposed to pressure, and the consequent liability to leaks are materially diminished.

These three features constitute the leading characteristics of my invention, namely: First, the use of compressed air acting directly upon the excavation walls to prevent leakage or cav-

ing; second, the use of temporary flexible integuments to stop leaks; third, the partial refilling of the completed tunnel to diminish the area of the surface exposed to the action of the compressed air.

I claim as my invention—

1. The improvement in the art of tunneling herein set forth, the same consisting in excavating in a working-chamber, of which the tunnel-head forms a portion, under an air-pressure acting directly upon the surface being excavated, and sufficient to prevent the caving or leakage of said surface during the construction of the masonry walls.

2. The method herein set forth of preventing leakage in the excavation surface of the working-chamber, by the application thereto of a flexible integument held in position by atmospheric pressure.

3. The method herein set forth of partially refilling the completed tunnel in advance of the air-lock, to diminish the air-surface thereof.

In testimony whereof I have hereunto subscribed my name.

D. C. HASKIN.

Witnesses:

E. C. DAVIDSON,
B. H. MORSE.