

(No Model.)

2 Sheets—Sheet 1.

J. H. GREATHEAD.  
TUNNELING SHIELD.

No. 432,871.

Patented July 22, 1890.

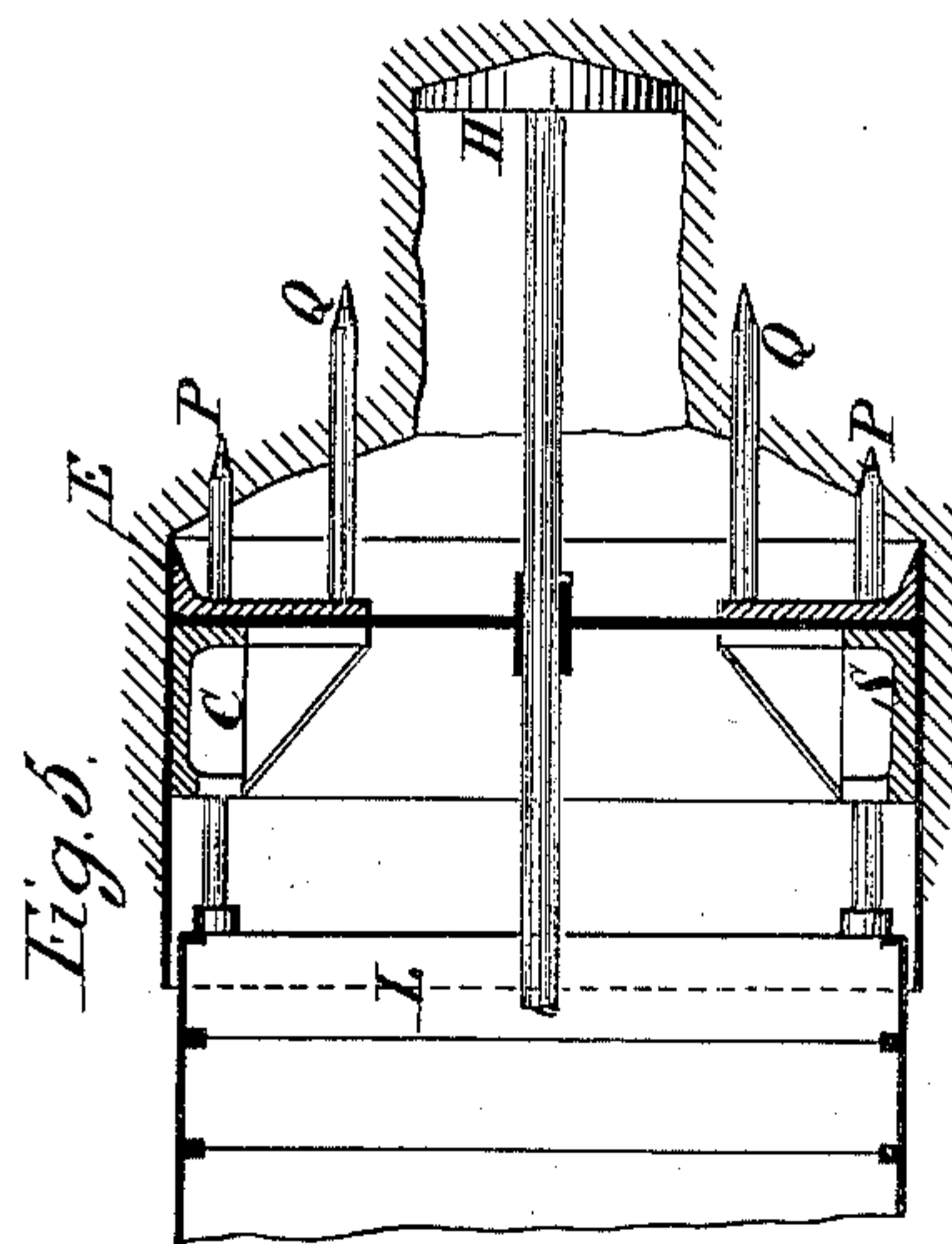
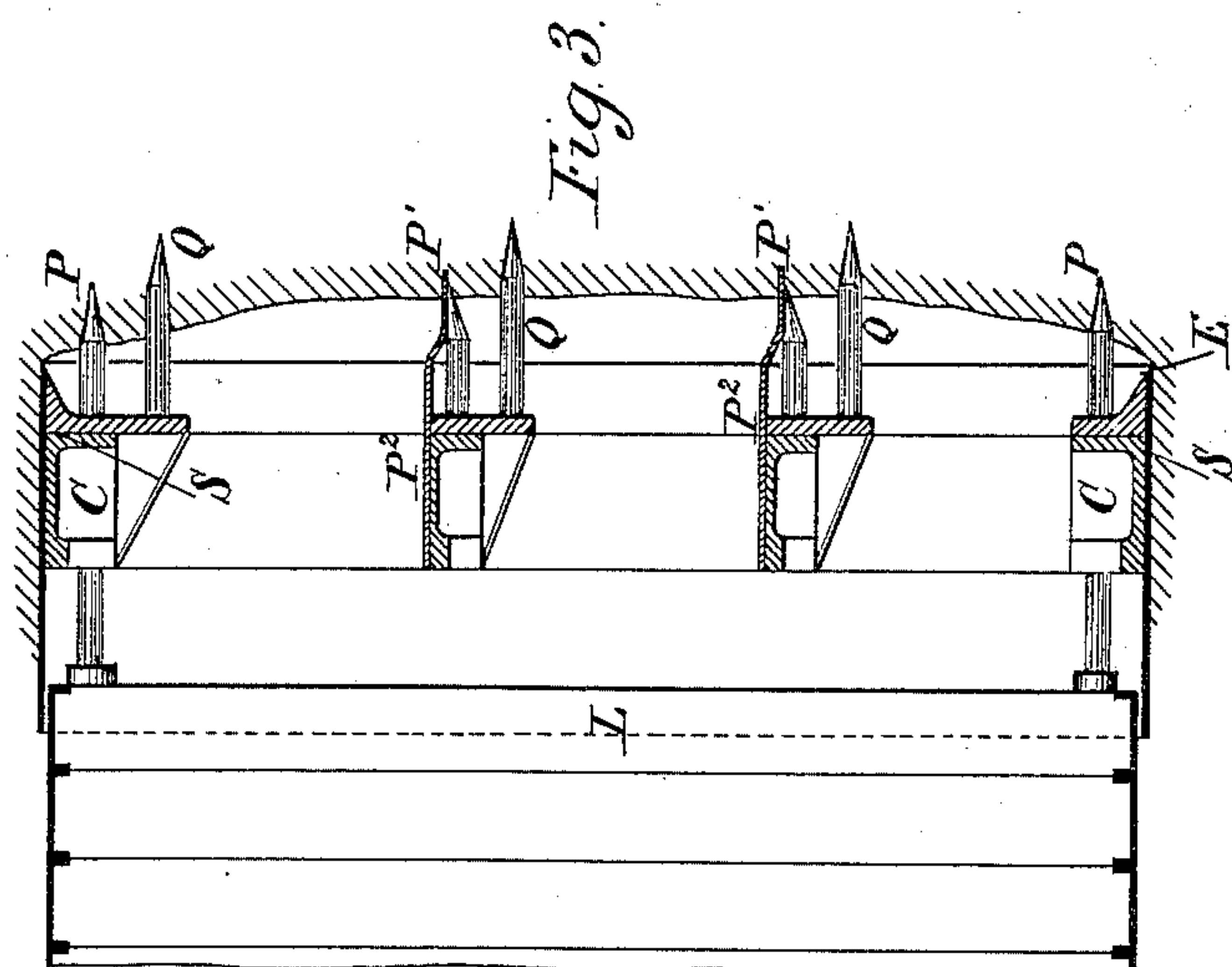


Fig. 4.

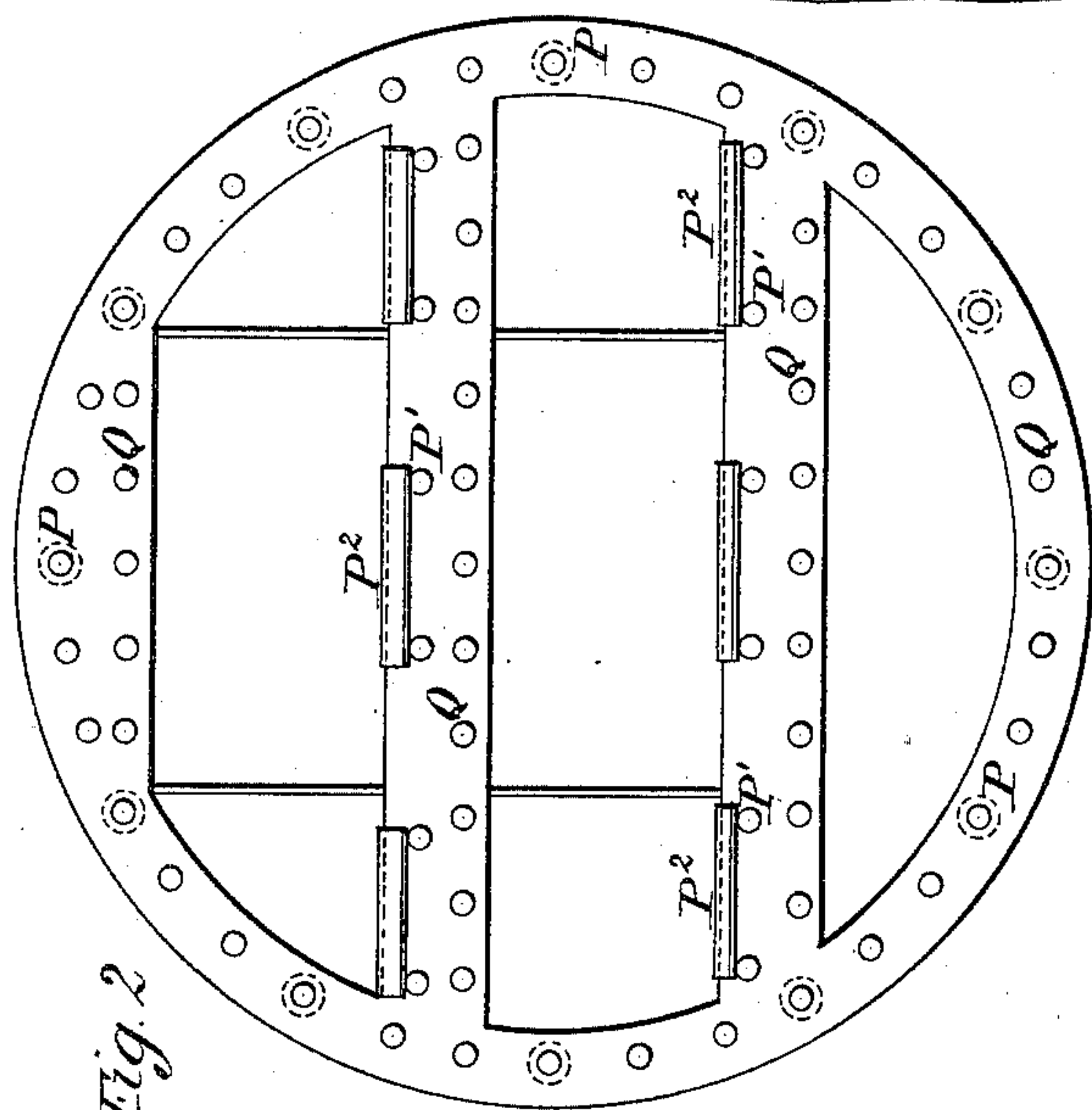
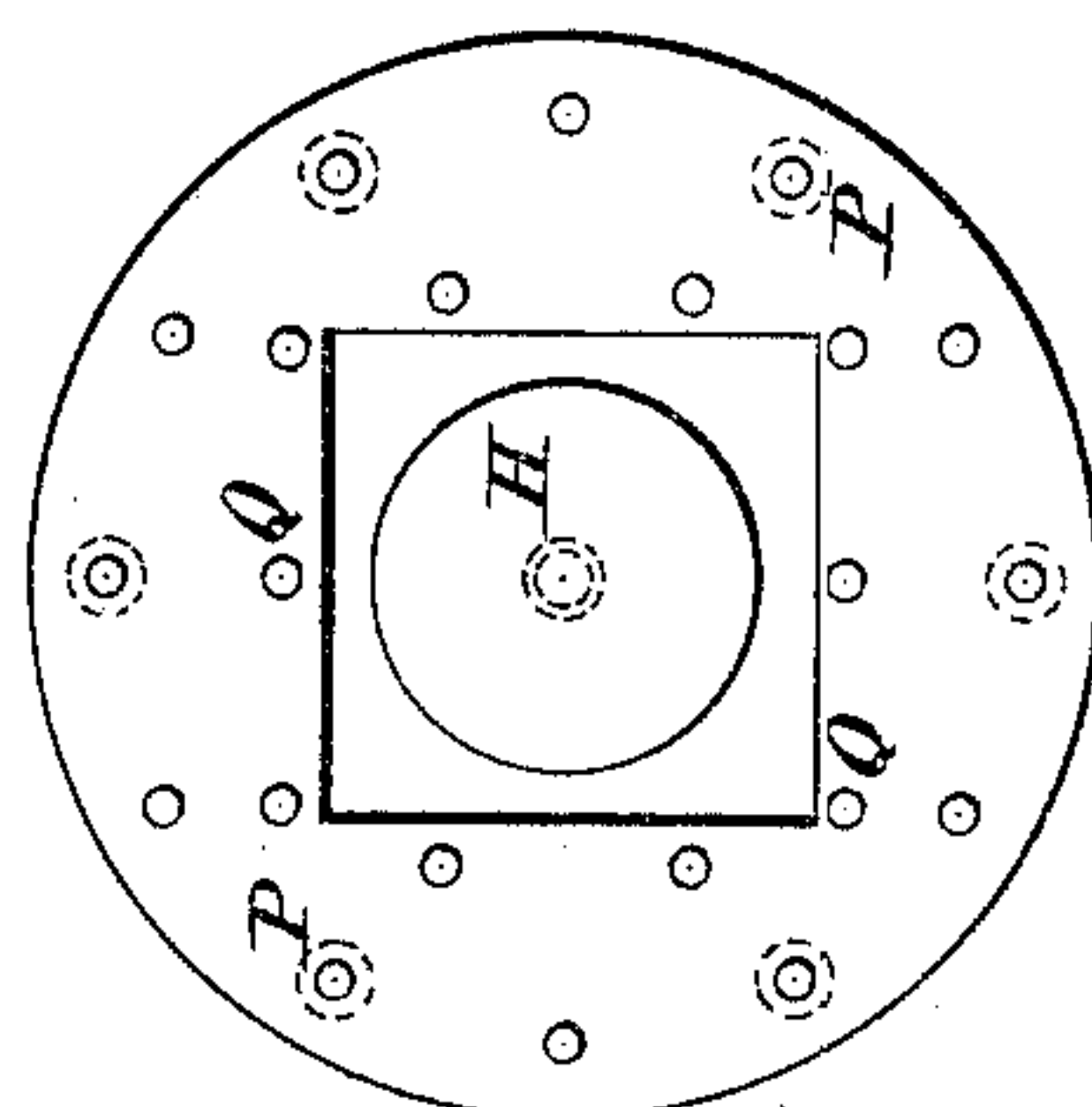
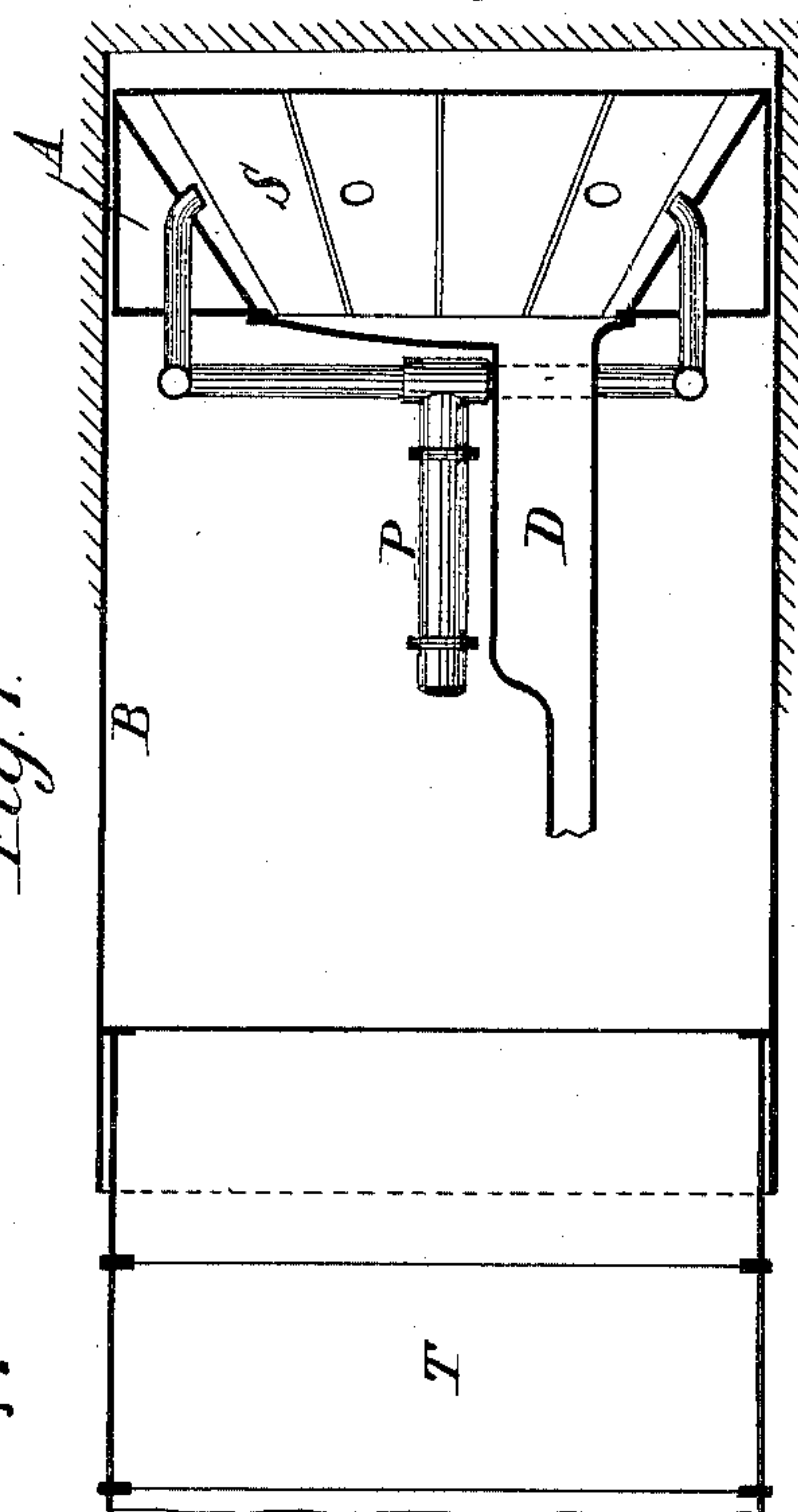


Fig. 2.

Fig. 1.



Witnesses:  
J. A. Rutherford, James Henry Greathead  
Percy B. Hills, By James L. Norris,  
Attorney.

(No Model.)

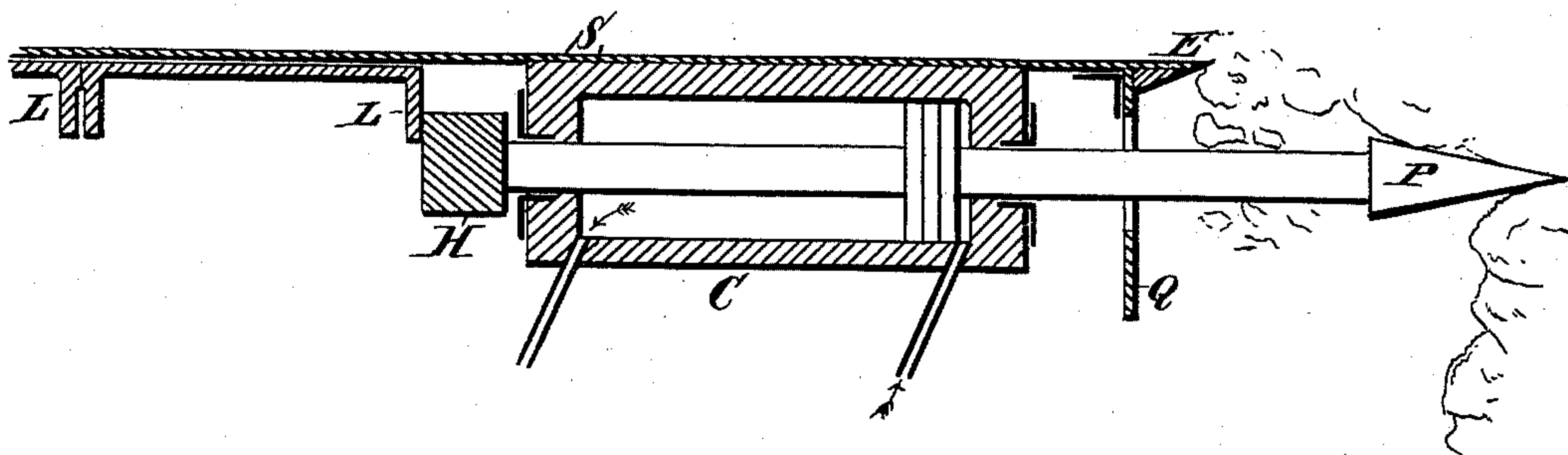
2 Sheets—Sheet 2.

J. H. GREATHEAD.  
TUNNELING SHIELD.

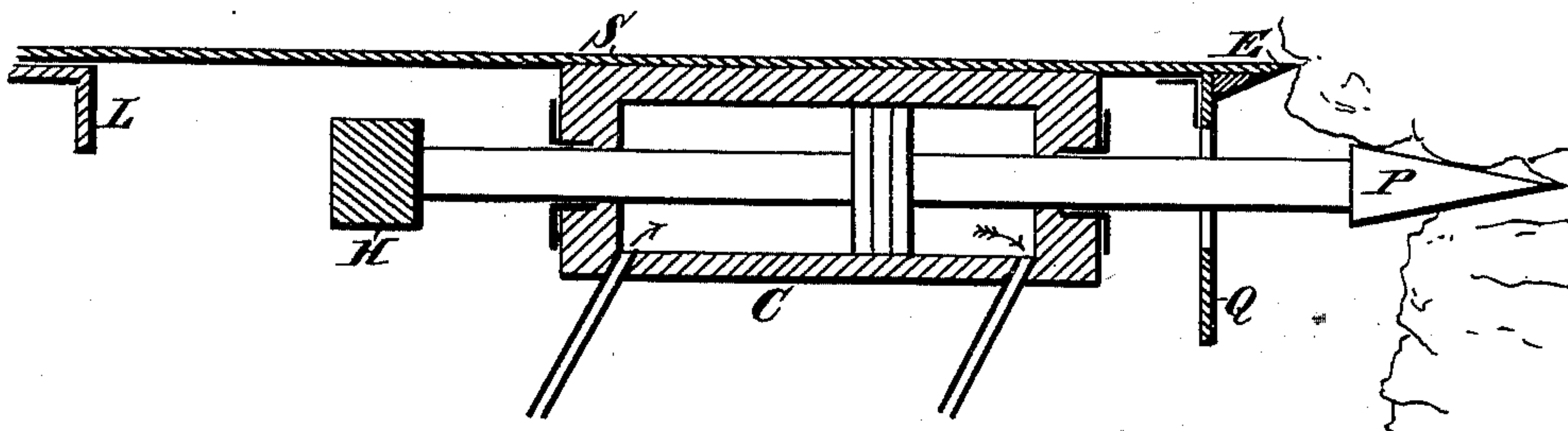
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*Fig. 6*



*Fig. 7*



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*By*

*James L. Norris.*

*att'y.*



# UNITED STATES PATENT OFFICE.

JAMES HENRY GREATHEAD, OF WESTMINSTER, ENGLAND.

## TUNNELING-SHIELD.

SPECIFICATION forming part of Letters Patent No. 432,871, dated July 22, 1890.

Application filed February 10, 1890. Serial No. 339,859. (No model.) Patented in England September 29, 1887, No. 13,215.

*To all whom it may concern:*

Be it known that I, JAMES HENRY GREAT-HEAD, a citizen of England, residing at Victoria Chambers, Westminster, in the county  
5 of Middlesex, England, have invented a new and useful Improvement in Tunneling-Shields, (for which I have obtained a patent in Great Britain, dated September 29, 1887, No. 13,215,) of which the following is a spec-  
10 ification.

My invention relates to apparatus employed for excavating a tunnel or subway, which is lined with metal segments fixed in the bore  
15 behind a shield that is advanced from time to time as the material in front of it is dislodged.

The shield employed, as is well known, consists of a head having a tubular part extending behind it, within which tubular part the metal segments are built and bolted together  
20 in successive rings, while the material in front of the head is excavated or otherwise dislodged. When there is sufficient clear space in front of the head, hydraulic presses abutting against the last ring of segments serve  
25 to push the shield forward, and thereupon fresh segments are built in front of those already fixed. Thus step by step the excavation and lining proceed until a continuous metal tube is completed. In forming a tun-  
30 nel or subway in this manner, when the shield has to penetrate water or watery or soft strata it tends to sink, owing to its greater gravity. I provide against this by forming in the shield air-chambers, or chambers filled with light  
35 material—such as cork—giving it sufficient buoyancy to prevent it from sinking; also for excavating soft material—such as clay—I fix in front of the shield a number of tapering or wedge-shaped spikes or piles, which, as the  
40 shield is pushed forward, penetrate into the material in front and so far disintegrate it as to facilitate its removal. Some of these spikes or piles, instead of being fixed to the shield, may be forced into the material by hydraulic  
45 pressure, and for this purpose some of the hydraulic presses used for pushing the shield forward may have piston-rods passing through the shield and carrying spikes or piles at their ends. When it is desired to vary somewhat

the direction of the tunnel, some of these pis- 50 ton-rods may have put on them blocks to abut against the material in front, so that on applying the hydraulic pressure the one side or the other of the shield or its upper or lower side is pushed a little backward, thus direct- 55 ing it a little obliquely. When the material is such as can be disintegrated by forcing spikes or piles into it, the disintegration and removal of the material are facilitated by driving a central heading in front of the 60 shield, which may be done by a boring-head worked from within the tunnel.

The accompanying drawings represent the appliances above described, (shown separately for the sake of distinctness;) but it is to be 65 understood that several of the appliances may be used in combination with the shield, as may best suit the nature of the material which has to be excavated.

Figure 1 is a part longitudinal section of the 70 tunnel and of the shield provided with buoyant chambers. Fig. 2 is a front view, and Fig. 3 is a longitudinal section, of the shield provided with spikes or piles. Fig. 4 is a front view, and Fig. 5 is a longitudinal section, of 75 the shield with spikes or piles and with front boring-head. Figs. 6 and 7 are detail sectional views of the shield, illustrating the piston and piston-rods for moving the shield.

As shown in Fig. 1, the shield S is made 80 with chambers A, containing either air or light material—such as cork—to give buoyancy in penetrating water bearing or soft material. At T is shown part of the segment-lining of the tunnel, which is overlapped by the tube 85 B, extending back from the front of the shield. The shield S is in this case shown provided with pipe P and branches by which water is forced in to scour out the loose material in front, causing the debris to pass away by the 90 pipe D.

As shown in Figs. 6 and 7, the shield S has fixed near its circumference the hydraulic cylinders C for advancing the shield, their rams abutting against the last ring L of the 95 metal lining. The piston-rods of the spikes P, which, while the shield is being advanced, are forced into the material. The shield is



also provided with a number of spikes P' and Q, which are forced into the material as the shield advances. The spikes P' may have on them plates P<sup>2</sup>, which can cut into the material and form stages for workmen.

As shown in Figs. 4 and 5, the shield S has spikes P and Q, as above described; but the spikes near the middle of the shield are dispensed with, a revolving boring-head H being used to cut a central heading in front of the shield.

As shown in Figs. 6 and 7, the shield S has fixed near its circumference the hydraulic cylinders C for advancing the shield, their rams abutting the last ring L of the metal lining. The piston-rods of the said cylinders terminate in spikes P. While the shield is being advanced the spikes P remain stationary, while the sharp edge E of the shield cuts into the material in front, as shown in Fig. 6. Then on withdrawing the rams from the rings and reversing the fluid-pressure, as shown in Fig. 7, the shield remains stationary, while the spikes P are advanced into the material.

Having thus described the nature of this in-

vention and the best means I know of carrying the same into practical effect, I claim—

1. A tunneling-shield having buoyant chambers and spikes or piles, substantially as and for the purposes set forth.

2. A tunneling-shield having buoyant chambers, substantially as described.

3. A tunneling-shield having in its front spikes or piles, substantially as described.

4. In combination with the hydraulic presses of a tunneling-shield, spikes or piles attached to the piston-rods of these presses in front of the shield, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 29th day of January, A. D. 1890.

JAMES HENRY GREATHEAD.

Witnesses:

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