



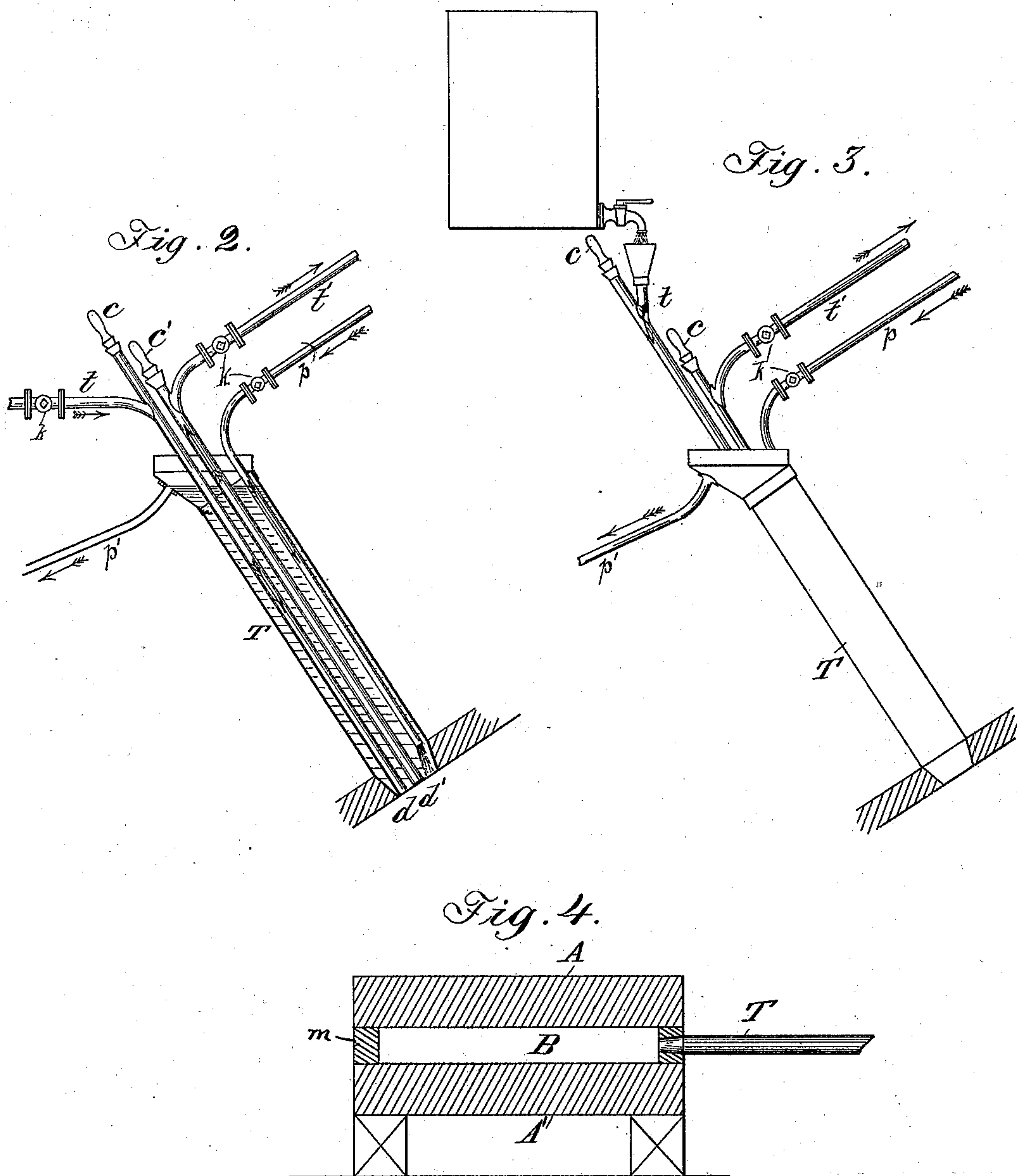
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4 Sheets—Sheet 2.

H. SCHNEIDER.  
CEMENTATION OF ARMOR PLATES.

No. 550,727.

Patented Dec. 3, 1895.



Attest.

Arthur A. Erb.  
Samuel H. Fisher.

Inventor:  
Henri Schneider  
by Alphonse Mauro  
his attorney.



(No Model.)

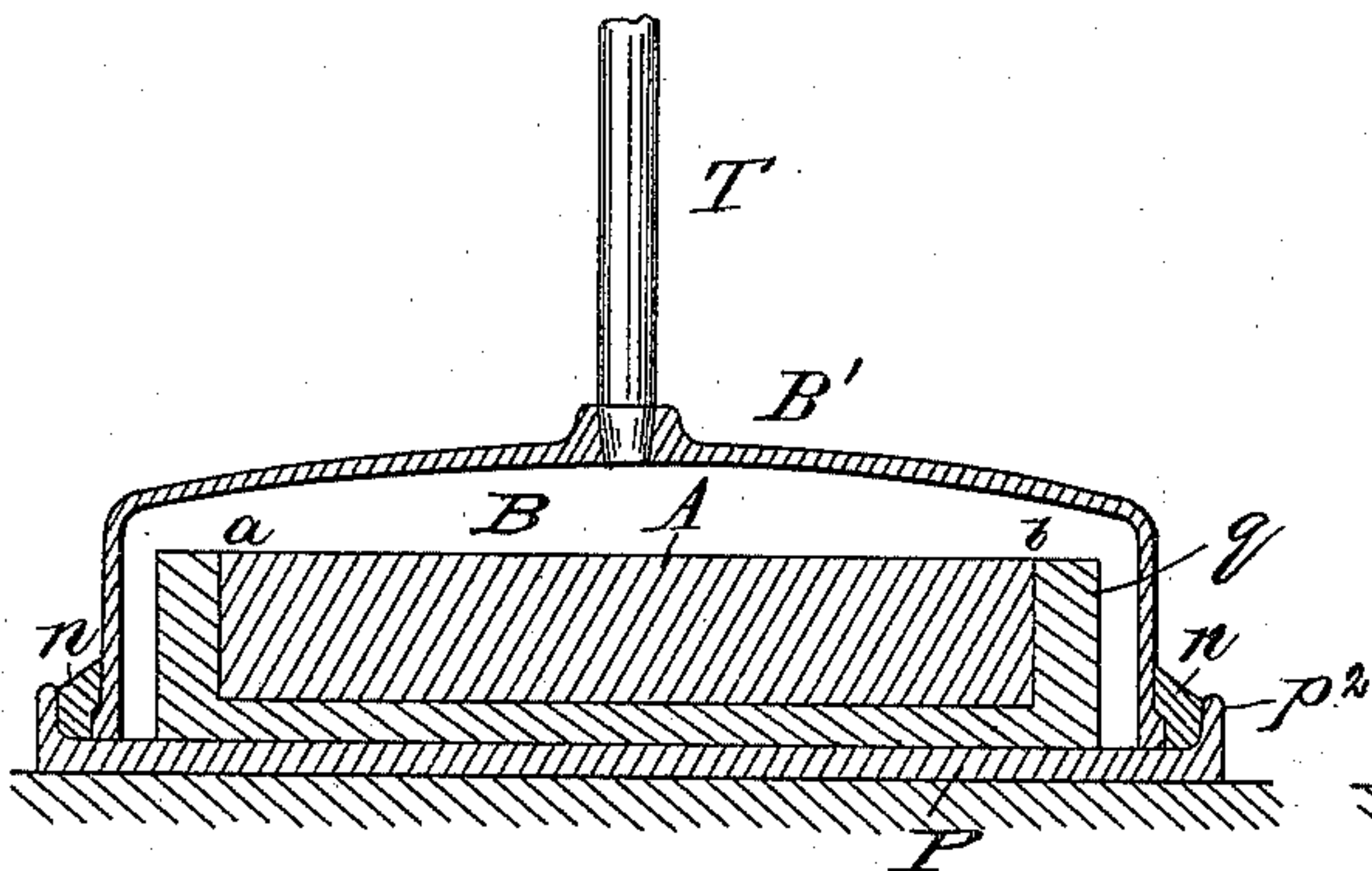
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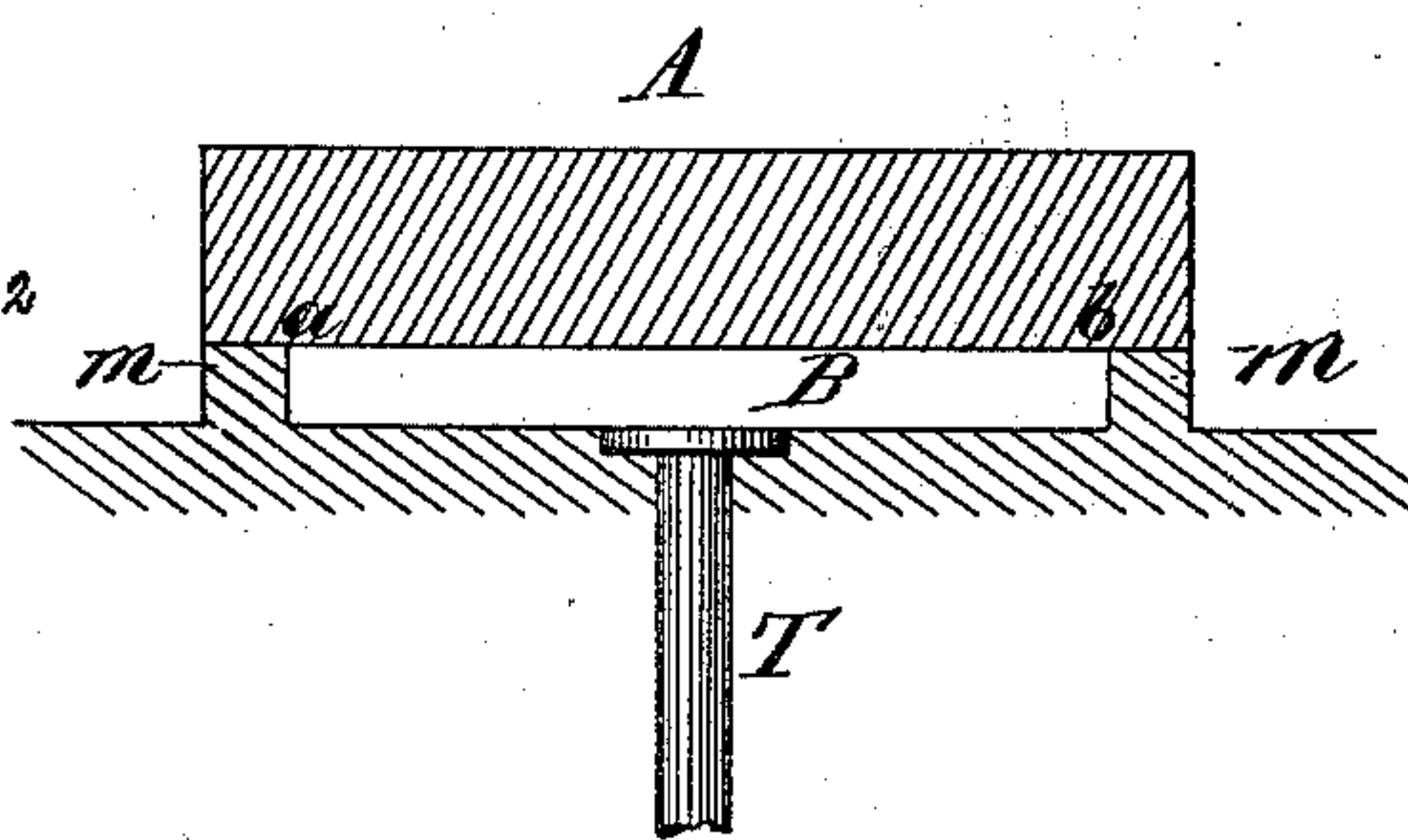
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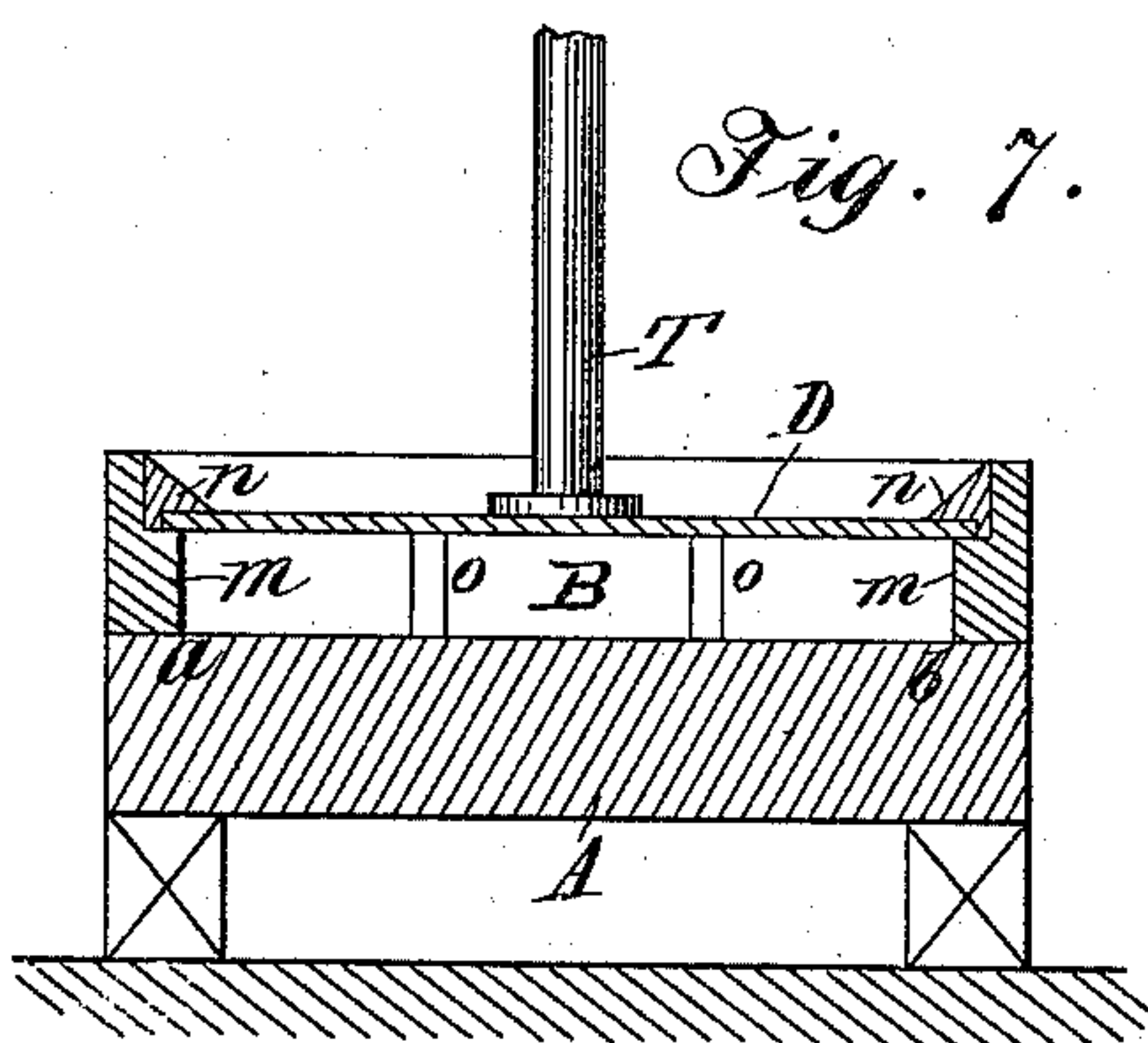
*Fig. 5.*



*Fig. 6.*



*Fig. 7.*



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*Henri Schneider*  
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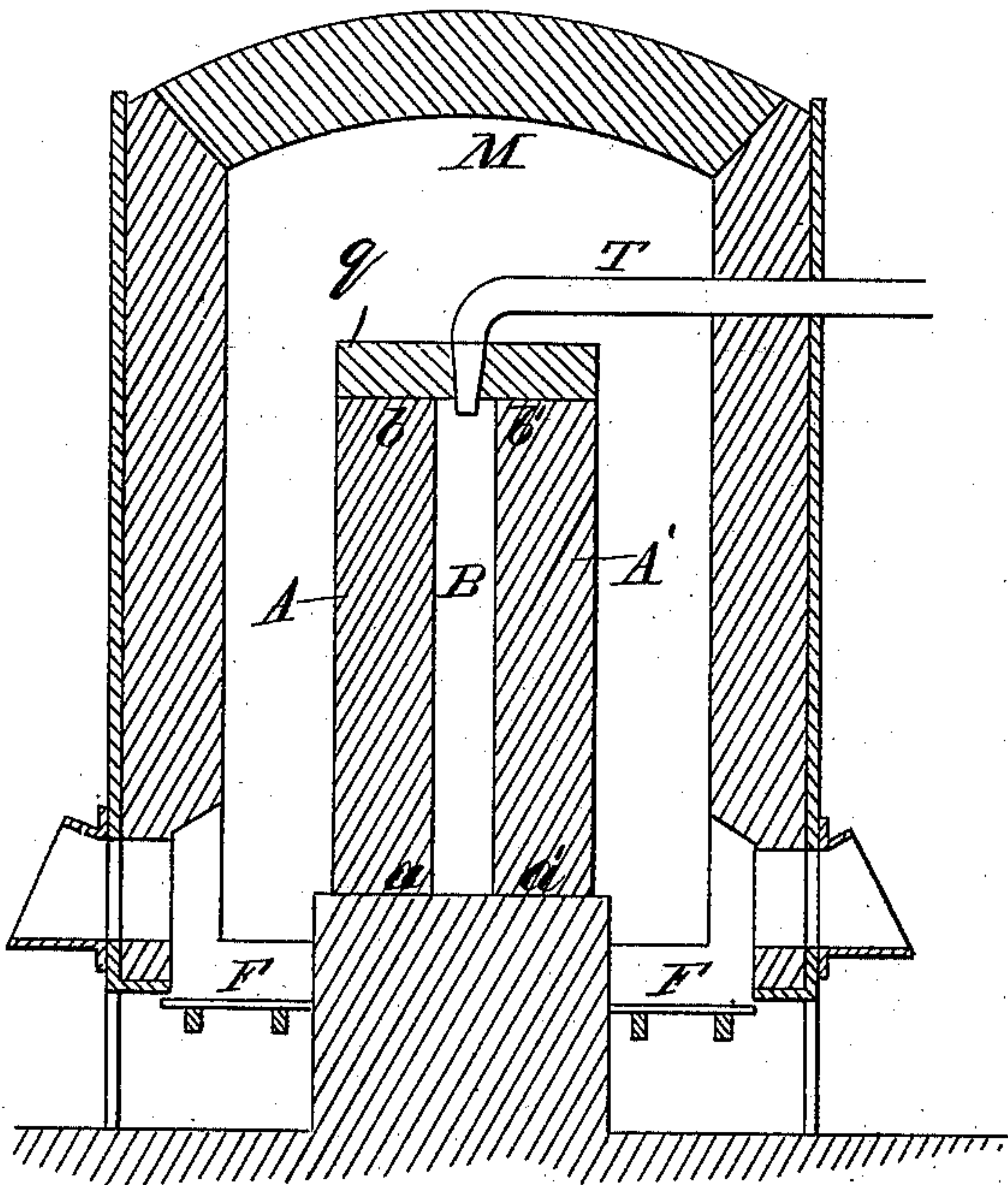
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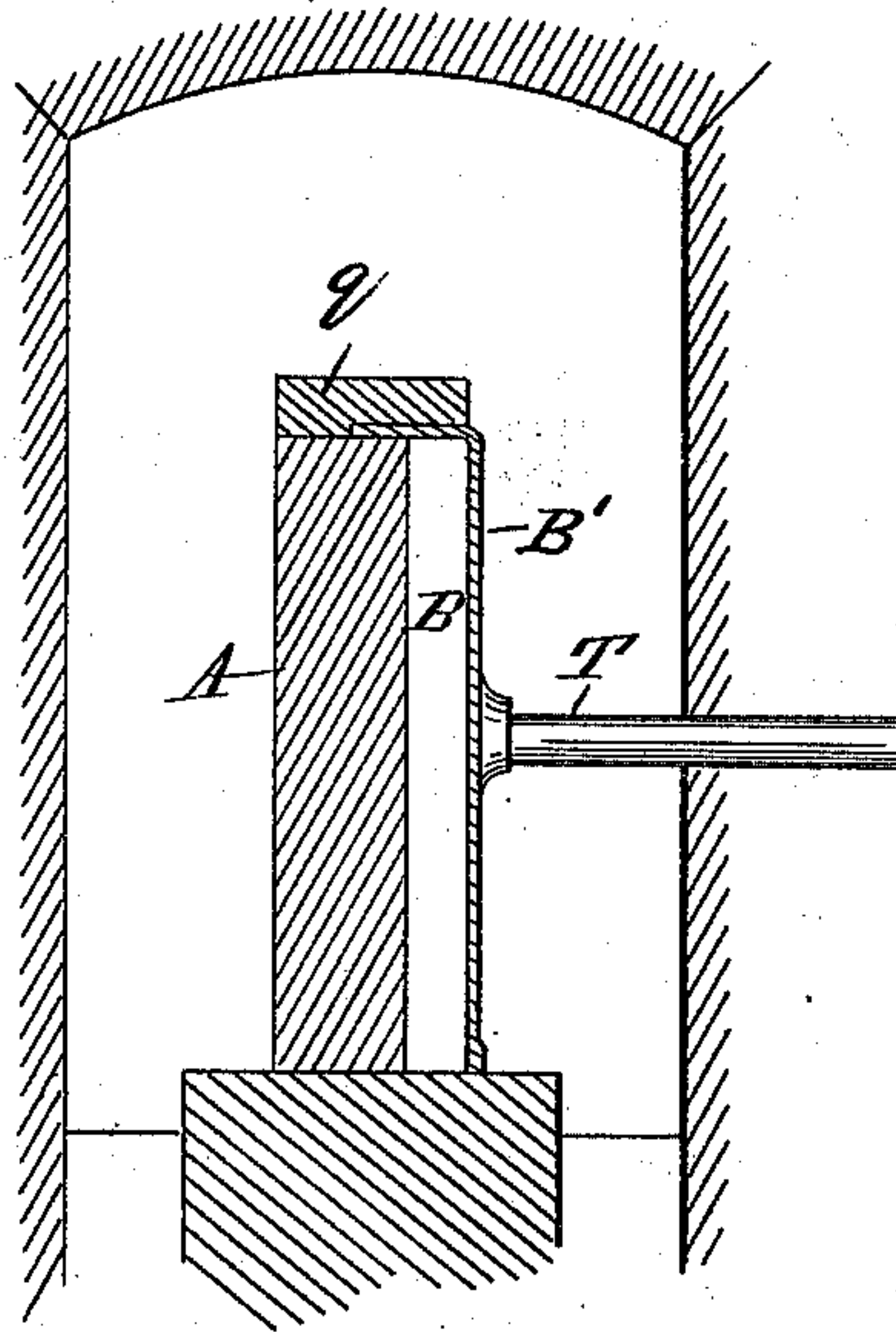
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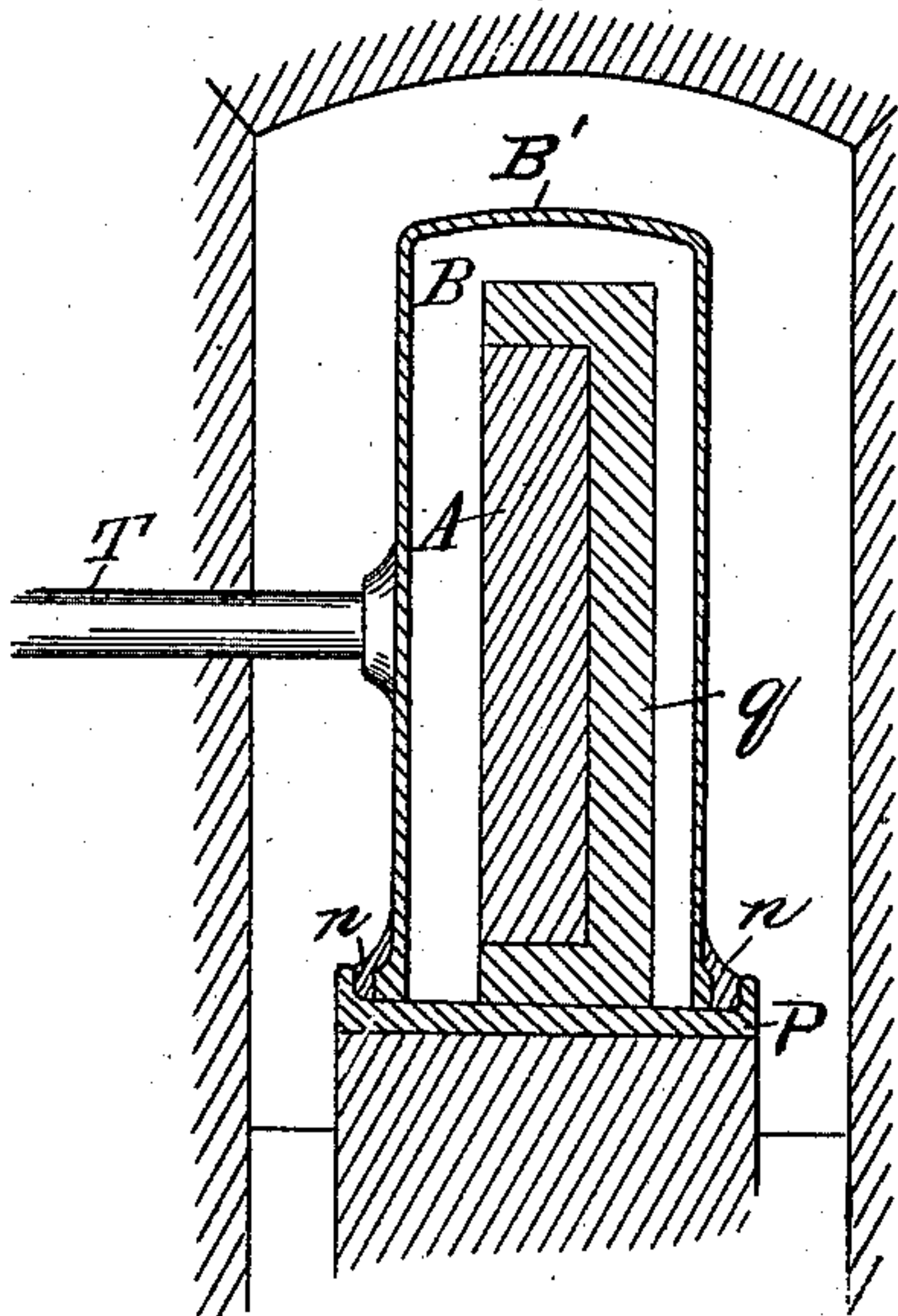
*Fig. 8.*



*Fig. 9.*



*Fig. 10.*



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# UNITED STATES PATENT OFFICE.

HENRI SCHNEIDER, OF CREUZOT, FRANCE.

## CEMENTATION OF ARMOR-PLATES.

SPECIFICATION forming part of Letters Patent No. 550,727, dated December 3, 1895.

Application filed September 4, 1893. Serial No. 484,777. (No model.) Patented in France March 15, 1893, No. 228,637.

*To all whom it may concern:*

Be it known that I, HENRI SCHNEIDER, a resident of Creuzot, Department of Saone et Loire, France, have invented a new and useful Improvement in Cementation of Armor-Plates, (for which I have obtained a French patent, No. 228,637, dated March 15, 1893,) which improvement is fully set forth in the following specification.

10 The present invention relates to a process for the cementation or supercarbonization of one of the surfaces of armor-plates, which, combined with an energetic tempering, augments the hardness of the plate and its resistance to penetration of projectiles.

15 The invention relates particularly to a process in which gaseous cementing agents are employed, whereby a more rapid cementation may be obtained at equal temperature than where solid carbonaceous materials are employed. The gaseous agents may be obtained either from distillation of coal or of mineral oils, and their action may be improved by the addition of a certain quantity of ammonia-gas. The invention has for its object to apply this gaseous cementation in a practical and efficient manner to armor-plate, which, on account of the great size of the mass, the high temperature employed, and the long duration of the treatment, requires that the operation be conducted in a special manner and under special conditions in order to obtain practical results; and the present invention is broadly distinguished from the processes heretofore proposed for converting iron into steel in closed retorts by means of hydrocarbon gases, which processes, as is well known, are rather theoretical than practical.

40 According to my invention the surface of the plate (or the surfaces of the plates, if two be treated simultaneously) forms part of the wall of the chamber or inclosure in which the cementation is carried on. The chamber is completed by walls of suitable materials, as hereinafter specified, so joined to or combined with the surface of the plate or plates to be treated as to make joints which will not be affected by the expansion and contraction of the plates under the great changes of temperature to which they are exposed. This portion of the operation is essential to the attainment of successful results, because the

existence of openings in the joints causes waste of gas and interferes with the maintenance of the proper pressure, and, chiefly, because the entrance of the flame of the furnace into the cementation-chamber would produce oxidation and defeat the object of the invention.

Means for maintaining unobstructed inlets and outlets for the gaseous cementation agents are also an essential feature of the invention. Without such means the carbon would deposit from the gas in the pipes and arrest the process. The exit-pipe is carried through the furnace and discharges outside the same. This is specially useful because its gas can be ignited as it issues from the discharge-pipe, and the appearance of the flame affords an indication whereby the progress of the operation can be determined, and from which the pressure of the gas and the duration of the treatment can be regulated.

The process may be carried on in an ordinary furnace with fixed or movable body, as may be most convenient.

The invention will be more fully explained in connection with the accompanying drawings, in which—

Figure 1 represents in vertical section a reverberatory furnace in which a plate A is in course of treatment. Figs. 2 and 3 are details in section and elevation, respectively, of the arrangement of supply and exit pipes, that shown in Fig. 3 being for use with oil. Figure 4 illustrates an arrangement for treating two plates simultaneously. Figs. 5, 6, and 7 illustrate other dispositions of the plate. Figs. 8, 9, and 10 are sectional views representing apparatus for treating the plates in a vertical position.

In Fig. 1 F represents the hearth of the furnace, V the arch, and C the chimney. The upper face *a b* of the plate A is that to be cemented, and, as shown throughout the drawings, this plate forms part of the cementation-chamber B. B' is a cover, of cast-iron, sheet-iron, cast-steel, or refractory brick, in which is conducted the carburated gas by means of the pipe T. To prevent the escape of the gas between the cover B' and the plate, a joint of sand is made all around, as indicated by *n n*, being maintained by a framework *m' m'* or simply by refractory earth. The



cover B' is so combined with the plate A that the great expansion and contraction of the latter under the changes of temperature to which it is exposed may freely take place without opening the joints, and this arrangement is maintained in all the dispositions of the plate or plates.

Fig. 2 shows in detail the arrangement of the pipes for the admission of the gas. It is known that upon making a hydrocarburet pass into a tube heated to red heat decomposition is produced, giving rise to a deposit of carbon. To avoid this deposit, which would soon obstruct the pipe *t*, the latter is protected by a circulation of water in the jacket T. The water enters by a pipe *p* and departs by pipe *p'*. To be sure that the gas is not lacking, it is introduced in slight excess, the excess being allowed to escape by a pipe *t'*. *c* and *c'* are the plugs which permit of verifying the fact that the tubes *t* and *t'* are not obstructed. *d* *d'* are the points where the gas commences to decompose and to deposit carbon. In case of necessity the tubes *t* *t'* are cleared out by means of a rod by withdrawing the stoppers *c* *c'*. The gas and water pipes are provided with suitable cocks *k*.

Fig. 3 shows a modification in which, instead of gas, mineral oil is employed, this being introduced drop by drop. On coming within the cover B', which has been brought to a red heat, the oil is decomposed and furnishes the carbonated gas serving for cementation. An acceleration of the cementation is obtained by mixing a small quantity of ammonia-gas with the hydrocarbon gas.

In Fig. 4 the two plates A A' are arranged to have their opposite faces simultaneously treated. The upper plate A rests upon a rectangular frame *m*, which may be of refractory material, such as fire-brick. The weight of the plate makes a tight joint, and, as will be observed, the disposition admits of the expansion and contraction of the plates without liability of making openings or leaks from the chamber B into the furnace. The upper plate in this instance takes the place of the movable cover.

Figs. 5, 6, and 7 represent other dispositions for obtaining an even heating. In Fig. 5 the plate A is entirely within the inclosure formed by the cover B'. The latter rests at its edge upon a flanged base-plate P, the space between the cover B' and flange *p*<sup>2</sup> being filled with sand to insure a gas-tight joint. In this case the surfaces of the plate A which are not to be cemented must be covered with refractory earth or other refractory material, as represented by *q*. In Fig. 6 the plate is placed on little walls of brick *m* *m*, which, with the body of the furnace and the surface of the plate, constitute the gas-chamber B. In Fig. 7 the chamber is formed by a plane plate D, carried on little walls *m*, of fire-brick, and on additional supports *o*, which may also be of fire-brick or other suitable material.

Figs. 8, 9, and 10 represent vertical arrange-

ments of the plates. In Fig. 9 the principal parts of the furnace are shown, F F being the hearths, and M a movable cover. The two plates A A' are arranged in a manner analogous to the arrangement shown in Fig. 4, the space between the edges of the plates being closed by refractory clay *q* or by other suitable material. In Figs. 9 and 10 a single plate is treated, use being made of a metallic cover B' to complete the chamber B, whereof the surface of the plate A forms one of the walls. In Fig. 10 the cover rests on a flanged base-plate P, as in Fig. 5.

Whichever one of the apparatus may be adopted, the operation will be conducted in the same manner. The plate will be maintained at red heat in contact with the gaseous cementing agents for a longer or shorter time, according to the thickness of the cementation which it is desired to obtain. In each case it will be of advantage to employ a temperature as high as possible, but it will be limited to the temperature at which the metal of the plate would be altered. For soft steel this temperature will be the clear yellow. For hard steel of about 0.60 percent. of carbon the clear cherry should not be exceeded. The intermediary steels will be heated to the intermediary colors. As an instance we will say that a plate of thirty centimeters of thickness in steel of medium hardness (C. 0.45) ought to be maintained at yellow oxidation during seventy-two hours to obtain a decreasing cementation of about twenty millimeters of thickness. Once the desired degree of cementation is obtained, the plate may be left to cool in the furnace either completely or only to the color suitable for tempering. The gas will be left in contact with the cemented face until the temperature descends to a dull red. The plate might be also withdrawn from the furnace and left to cool, taking care to preserve the cemented part *a* *b* from contact with the air until it cools to a somber red heat.

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

1. The described process of cementation of plates to be carbonized on one side only, said process consisting in forming in a furnace a gas-tight chamber or inclosure having the surface or surfaces to be cemented for part of the wall thereof, the chamber being completed by means which admit of expansion of the plates without forming openings from the chamber to the furnace, heating the plate or plates, and admitting to said chamber gaseous cementing agents, substantially as set forth.

2. The combination with a furnace for cementation of armor plates, of a removable cover applied to the side of the plate to be treated and forming with the surface of said plate a closed gas-tight chamber, and pipes for conveying gaseous cementing agents to and from said chamber, substantially as described.

3. The combination with the cementation furnace, and with the cover or device form-



ing part of a gas-tight cementation chamber in said furnace, of supply and exit pipes communicating with said cementation chamber and provided with means for regulating the  
5 supply and pressure, and with means for preventing deposits of carbon in said pipes, substantially as described.

4. The combination with the cover or device adapted to form part of a cementation chamber, of gas inlet and outlet pipes connected  
10 with said cover or device, and a tube or water

jacket surrounding said pipes and provided with water inlets and outlets, substantially as described.

In testimony whereof I have signed this  
specification in the presence of two subscribing witnesses.

HENRI SCHNEIDER.

Witnesses:

CHARLES LAUREAU,  
HIPPOLYTE OLIVIER.