

No. 629,094.

Patented July 18, 1899.

F. L. SLOCUM.  
STEAM SUPERHEATING FURNACE.

(Application filed Apr. 14, 1897.)

(No Model.)

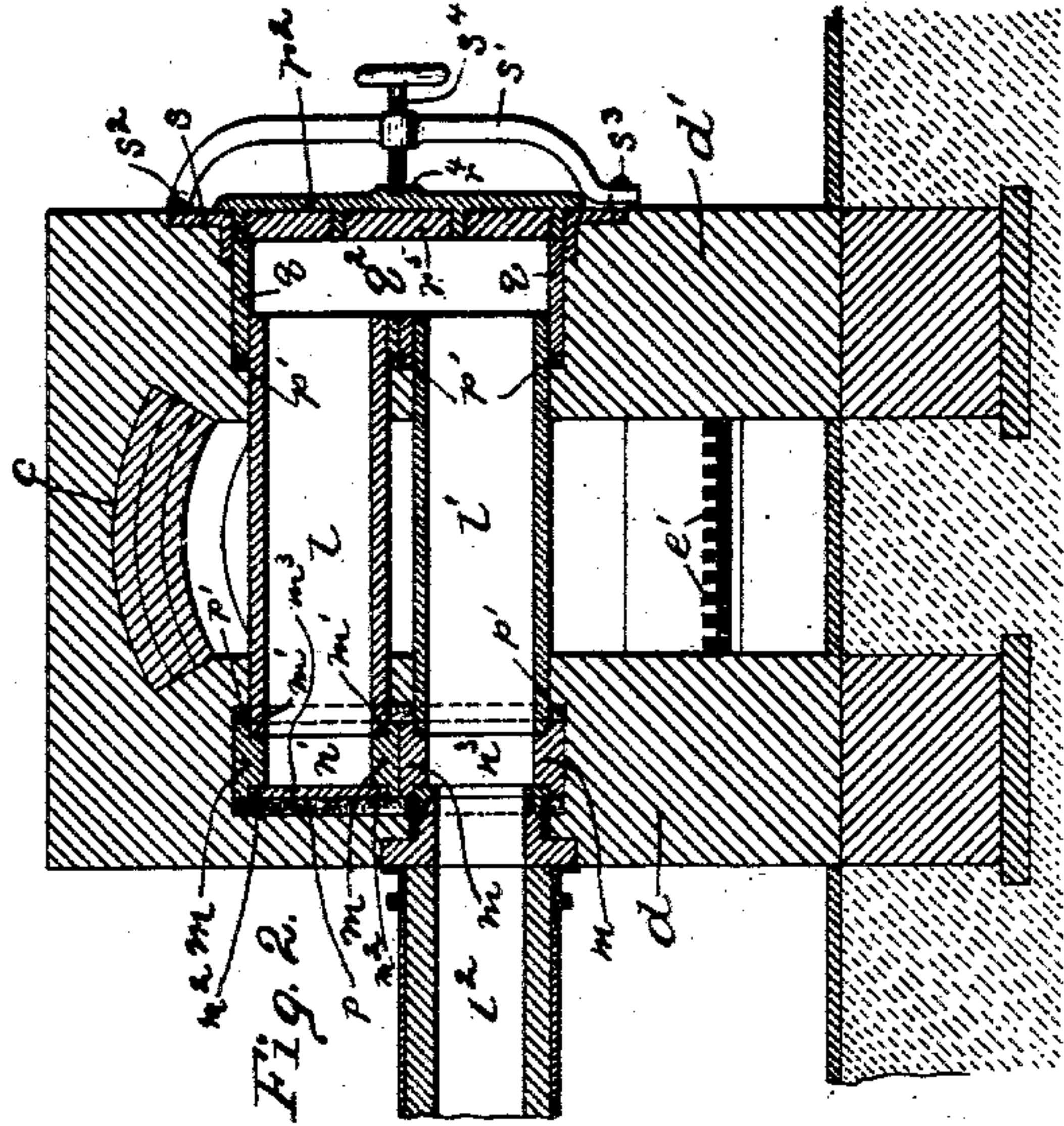


Fig. 1.

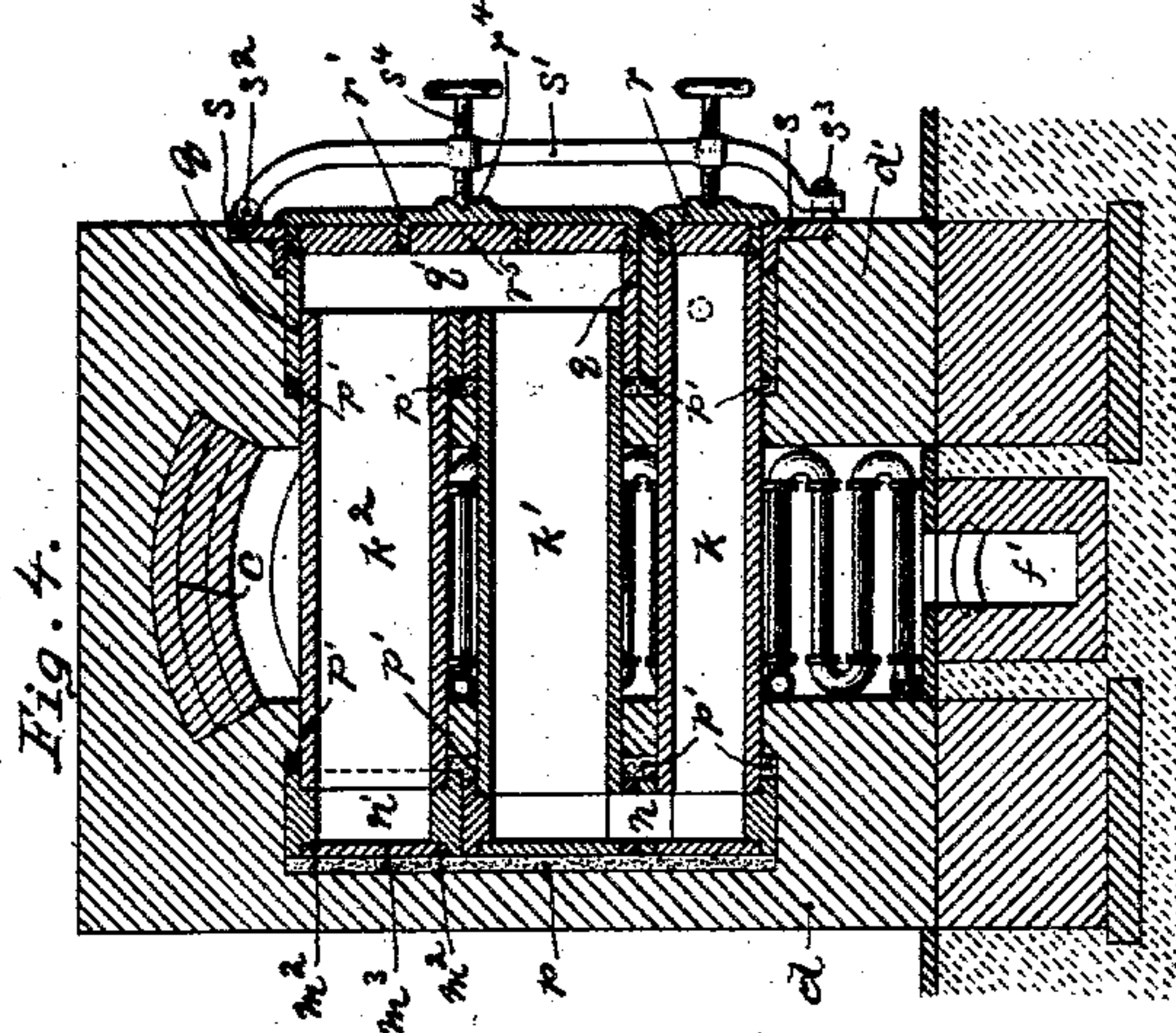


Fig. 2.

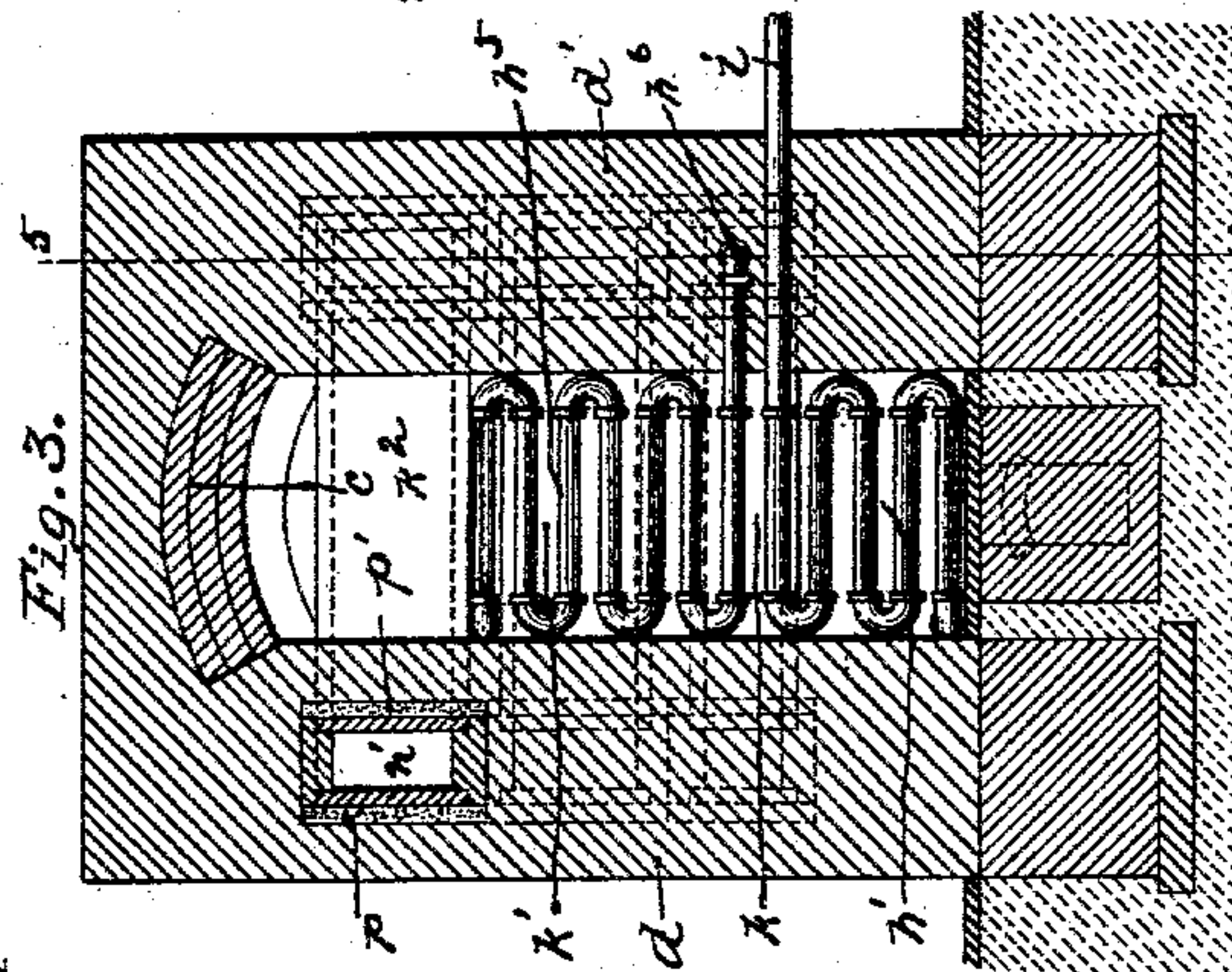


Fig. 3.

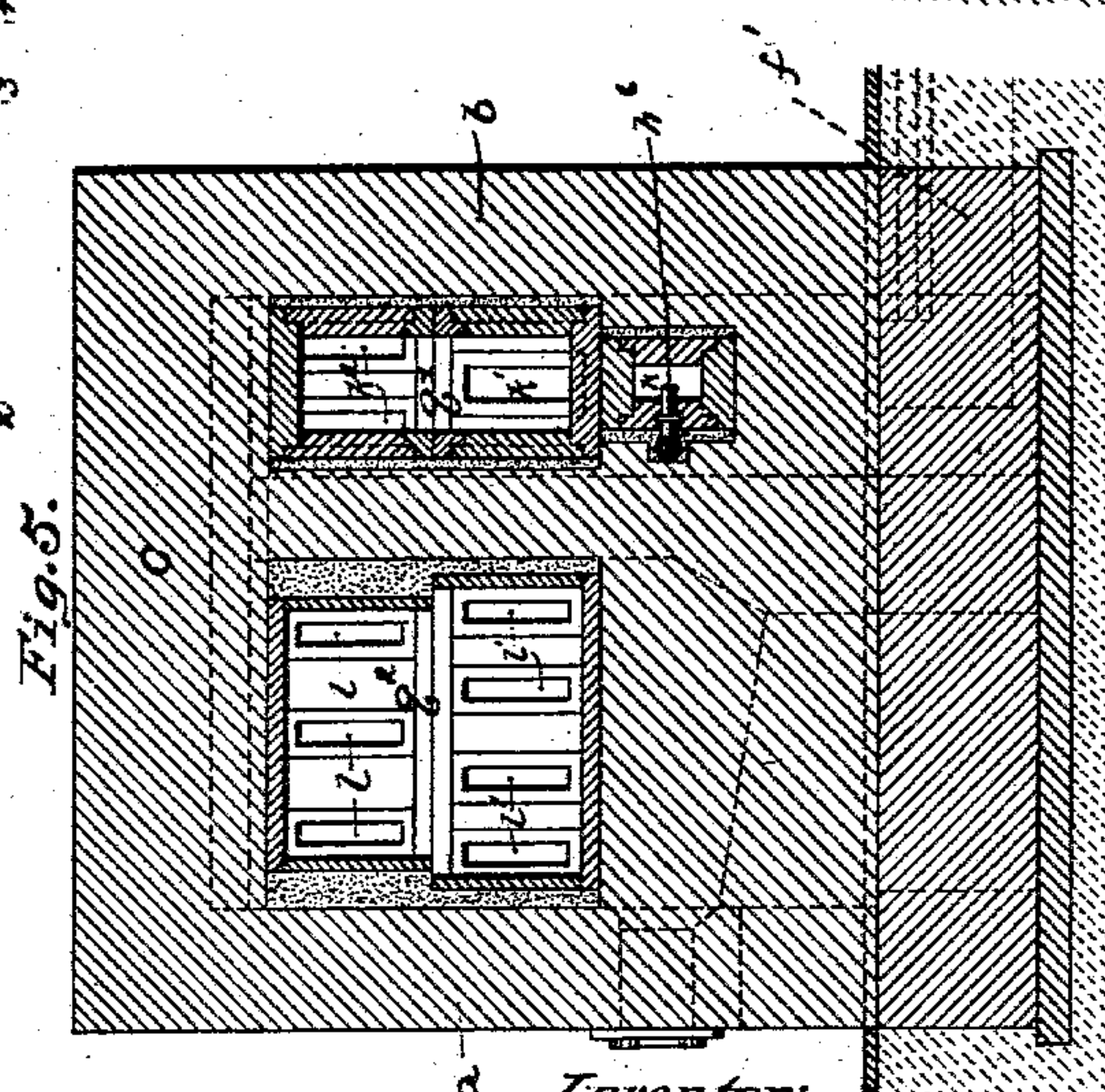


Fig. 4.

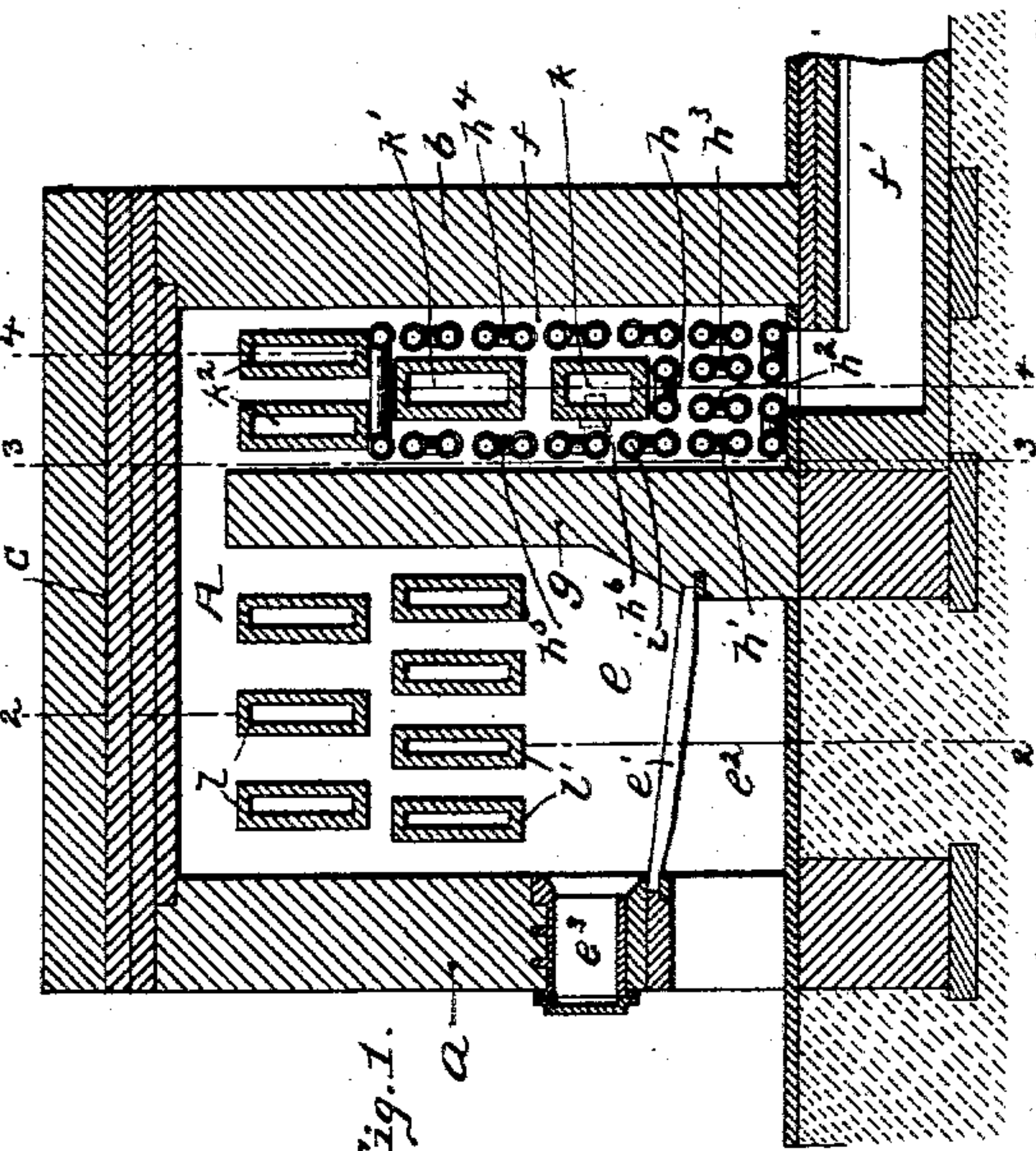


Fig. 5.

Witnesses:

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# UNITED STATES PATENT OFFICE.

FRANK L. SLOCUM, OF PITTSBURG, PENNSYLVANIA.

## STEAM-SUPERHEATING FURNACE.

SPECIFICATION forming part of Letters Patent No. 629,094, dated July 18, 1899.

Application filed April 14, 1897. Serial No. 632,108. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK L. SLOCUM, a resident of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Steam-Superheating Furnaces; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to steam-superheating furnaces; and it consists in certain improvements in furnaces for raising the steam to an exceedingly high heat, the special purpose of superheating the steam being to raise it to a sufficient heat for making gas by a continuous process in which the heat of the steam is sufficient both to cause its breaking up and combination with the carbon or other elements of the coal and to maintain the coal by the heat of the steam at proper temperatures for gas-making, as described in a separate application of even date herewith, Serial No. 632,109.

In the furnace forming the subject-matter of this application I employ a furnace-chamber preferably divided into two compartments, a fire-chamber and a downtake-chamber, and within these I arrange a series of return steam-superheating pipes and horizontal tubular flues, so located that the steam is gradually brought into the hottest part of the furnace, while the flues are so arranged that they increase by size or number in cross-sectional area from the steam-inlet to the steam-discharge, whereby as the steam is raised to a higher and higher temperature, and thereby expanded, space for holding the same without material increase of pressure is provided and leakage in the furnace prevented.

The particular points of invention desired to be covered will be hereinafter more particularly set forth and claimed.

To enable others skilled in the art to construct and use my invention, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a longitudinal central section of the furnace. Fig. 2 is a vertical cross-section on the line 2 2, Fig. 1. Fig. 3 is a vertical cross-section on the line 3 3, Fig. 1. Fig. 4 is a vertical cross-section on the line 4 4, Fig. 1; and Fig. 5 is a longitudinal section on the line 5 5, Fig. 3.

Like letters indicate like parts in each of the figures.

The furnace is inclosed within the front wall *a*, rear wall *b*, top wall *c*, and side walls *d d'*. It has a heating-chamber *A*, in which are located the different steam-superheating pipes and flues and which is preferably arranged as shown, being divided into the main fire-chamber *e* and the downtake-chamber *f* back of the same, the two being divided by the bridge-wall *g*. At the base of the downtake-chamber *f* is the escape-flue *f'*, which leads either to a chimney or, as preferred by me, to the boiler, where the heat not utilized in the furnace can be utilized for the generation of steam.

The furnace can be heated by any suitable fuel, being shown as having the grate *e'* and ash-pit *e''*, having also the feeding-opening *e'''* for feeding coal or like fuel to the grate. Located within the downtake-chamber *f* are the return steam-superheating pipes *h*, with which the steam-inlet *i* leads from the boiler. As more clearly shown in Fig. 3, the return-bend steam-superheating pipes are arranged so that their entire surfaces are exposed to direct contact with the flame and heated products. These pipes are located in such a way as to fill the space of the downtake-chamber not occupied by the superheating-flues *k k'* and *k<sup>2</sup> k<sup>2</sup>'*. The arrangement shown, which is considered very desirable, is as follows: The inlet-pipe *i* communicates with the vertical series of return-pipes *h<sup>1</sup>*, which communicates with the vertical series *h<sup>2</sup>* and *h<sup>3</sup>* under the lower flue *k*, the series *h<sup>3</sup>* communicating with the vertical series *h<sup>4</sup>*, which leads up to the base of the chamber beside the flues *k k'* to the base of the flues *k<sup>2</sup> k<sup>2</sup>'* and then extends over and communicates with the vertical series *h<sup>5</sup>*, which extends downwardly and communicates finally with the tile flue *k* at *h<sup>6</sup>*.

The first point to notice in connection with the return tile flues *k k' k<sup>2</sup> k<sup>2</sup>'* and also with the tile flues in the main or fire chamber *e*, the upper series of which is marked *l* and the lower series *l'*, is that the cross-sectional area of the flues through which the steam passes successively increases from the inlet-point, where the pipe *h<sup>6</sup>* opens into the flue *k* through the several flues *k' k<sup>2</sup> l l'* to the discharge-opening *l<sup>2</sup>*, so that the space is provided for the



expansion of the steam under the exceedingly high heat to which it is raised. This is either accomplished by employing tile of increasing sectional area, such as shown by the tiles  $k k'$ , respectively, or employing an increased number of tile in each series, the series  $k^2$  having two tile, the series  $l$  having three, and the series  $l'$  having four. The invention is intended to cover the construction whether the increased sectional area is obtained by increase in size or number.

As the tile are subjected to exceedingly high heats and as such heats might lead to cracking of the tile, I prefer to arrange them in the way hereinafter described both for supporting the tile and to provide for quick removal and change in case of breakage. It will be noticed that rectangular tile are used and that they extend into the side walls  $d d'$ , and, further, that separate tile, such as might be termed "seat-tile," are built within the walls, as shown at  $m$ , these seat-tile having angular seats  $m'$  to receive the ends of the tile. These seat-tile are provided with such angular recesses at the ends where access is not required to the flues, and, as shown in Figs. 2 and 4, they serve the extra function of providing the passage within the side walls from one flue to another. They are preferably formed of flat plates having the seats  $m'$  along the sides, so as to provide for building up for any construction or shape of opening, either for a vertical opening, as at  $n$ , to connect the flues  $k k'$  or for the side passage, as at  $n'$ , which connects the flues  $k^2$  with the flues  $l$ . The opposite spaces of said seat-tiles  $m$  are also preferably provided with angular seats  $m^2$ , into which tile plates  $m^3$  fit, so as to close the inner ends of the ports forming connection between the flues. In order to brace these several flues and hold the parts to place, I may also employ metal plates  $p$ , resting against the seat-tiles and tile plates, and like plates  $p'$  on the other side of the seat-tiles fitting around the tile flues, so as to give support thereto.

In order to obtain access to the several flues, so that they may be cleaned, if necessary, or where one of the flues is cracked or worn out to remove the same, I provide the brick-lined doors  $r r' r^2$ , the door  $r$  giving access to the flue  $k$ , the door  $r'$  giving access to the flues  $k'$  and  $k^2$ , and the door  $r^2$  giving access to the flues  $l$  and  $l'$ , these doors of course being made of sufficient size to provide for the withdrawal of the flue or flues through the same. These doors also close the outer ends of the ports or passages connecting the flues where necessary. For example, it will be seen that the flues  $k'$  and  $k^2$  extend within the side wall  $d'$ , being supported therein by the plates  $p'$ , similar to those used at the other ends and their ends resting in seat-tiles  $q$ , which do not extend over the ends of the flues and so leave them free to be withdrawn, these seat-tiles  $q$  being secured in place in any desired way. This leaves a vertical chamber

or space  $q'$  between the ends of the tiles and the door  $r$ , which forms the uptake passage or port between the flues  $k'$  and the flues  $k^2$ . The same construction is employed to form connection between the flues  $l$  and  $l'$ , forming the uptake-passage  $q^2$ . To close these passages, the doors  $r' r^2$ , above referred to, are employed, said doors fitting within the door-frames  $s$ , and to which the clamp-arms  $s'$  are hinged at  $s^2$ , said clamp-arms engaging with lugs  $s^3$  and carrying hand-screws  $s^4$ , which engage with seats  $r^4$  on the outer faces of the door, so that after the door is luted with clay by means of said clamp-arms and hand-screw it may be securely locked to form a steam-tight joint. The inner faces of the door are lined with brick or tiling, as at  $r^5$ , to protect them from the heat.

When the said furnace is in use, the high heat necessary for superheating the steam is generated within the furnace, and where solid fuel is used this is accomplished by building the fire upon the grate  $e'$  within the fire-chamber  $e$ , the flame and heated products from the same rising around the series  $l'$  of steam-superheating flues, then passing around the series  $l$ , then passing over the bridge-wall  $g$  and around the series  $k^2$ , and thence passing downwardly through the chamber  $f$ , around the flues  $k'$  and  $k$ , and circulating around the return steam-superheating pipes  $h$  and escaping through the flue  $f'$  to the chimney or boiler. Meanwhile steam enters through the inlet-pipe  $i'$  and circulates through the return superheating-pipes  $h$ , passing through the series  $h'$ ,  $h^2$ ,  $h^3$ ,  $h^4$ , and  $h^5$ , above described, and eventually entering the smallest of the horizontal steam-superheating flues. The steam then passes along the flue  $k$  through the uptake-passage  $n$  into the flue  $k$  and along said flue into the uptake-passage  $q'$ , and thence into the flues  $k^2$ , whence it passes by the horizontal passage  $n'$  across to the flues  $l'$ , forming the upper series in the main fire-chamber, passing along these flues, and thence by the downtake-passage  $q^2$  into the flues  $l$ , from which it enters the passage  $n^3$  and flows into the outlet-pipe  $l^2$ . It will thus be seen that the steam is passing in opposite course to the heated products, and therefore is being brought into a hotter part of the furnace as it passes through one horizontal set of flues to another, and is therefore gradually raised to a very high heat, and that at the same time that the steam is thus expanded provision is made to receive the expanded steam on account of the increased cross-sectional area of the horizontal superheating-flues. Such construction provides for the bringing of the steam to an exceedingly high heat—indeed to such temperature that it is capable of heating and maintaining the coal in the gas-generator at proper heat for gas-making, and also provides the necessary heat for causing its own decomposition in the presence of the coal, as above set forth. As it is thus heated and expanded on account of the increased space to



receive the expanded steam the pressure is not materially increased, and therefore the liability of leakage is much decreased, an important point in the heating of the steam in tile flues and under extremely high temperatures where it would be practically impossible to hold it if under high pressure. In case of breakage or wearing out of any of the flues they may be quickly changed, access to the same being provided through the doors  $r$ ,  $r'$ , or  $r''$ , above described, while the flues are properly centered and supported within the side walls.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. A steam-superheating furnace having a fire-chamber containing a series of horizontal tubular tile flues mounted in the side walls, said flues increasing in cross-sectional area from the steam-inlet to the steam-discharge, substantially as set forth.

2. A steam-superheating furnace having a fire-chamber and a downtake-chamber, separated therefrom by a bridge-wall and having an outlet-flue at its base, said chambers each containing a series of tubular tile flues mounted in the side walls and extending across the same, substantially as set forth.

3. A steam-superheating furnace having a fire-chamber and a downtake-chamber, separated therefrom by a bridge-wall and having an outlet-flue at its base, said chambers each containing a series of tubular tile flues mounted in the side walls and extending across the same, said flues increasing in cross-sectional area from the steam-inlet to the steam-discharge, substantially as set forth.

4. A steam-superheating furnace having therein a series of return-bend steam-superheating pipes with which the steam-inlet pipe communicates and a series of horizontal tile flues with the first of which said return-bend pipes communicate, said flues communicating with each other and with the outlet-pipe, substantially as set forth.

5. A steam-superheating furnace having a fire-chamber and a downtake-chamber separated therefrom by a bridge-wall and having an outlet-flue at its base, said chambers each containing a series of tile flues mounted in the side walls and extending across the same, and a series of return-bend steam-superheating pipes arranged within said downtake-chamber and communicating with one of said tile flues, substantially as set forth.

6. A steam-superheating furnace having a series of horizontal tile flues extending across the same and seated in the side walls thereof, and passages formed within the side walls forming communication between said flues, the inner ends of said flues resting in seat-tiles having angular recesses to receive them, substantially as set forth.

7. A steam-superheating furnace having a series of horizontal tile flues extending across the same and seated in the side walls thereof, and passages formed within the side walls forming communication between said flues, the inner ends of said flues resting in seat-tiles having angular recesses to receive them, and the opposite faces of said tiles having like angular recesses for receiving the tile plates to close the passages, substantially as set forth.

8. A steam-superheating furnace having a series of tile flues extending across the same and supported in the side walls, a chamber or passage of as great diameter as the outer diameter of the flue, into which one end of the tile flue enters, and said passage being closed by a door, substantially as and for the purposes set forth.

In testimony whereof I, the said FRANK L. SLOCUM, have hereunto set my hand.

FRANK L. SLOCUM.

Witnesses:

JAMES I. KAY,  
ROBERT C. TOTTEN.