

A. D. SOUTHAM.  
FORCED DRAFT GRATE.  
APPLICATION FILED NOV. 12, 1903.

2 SHEETS—SHEET 1.

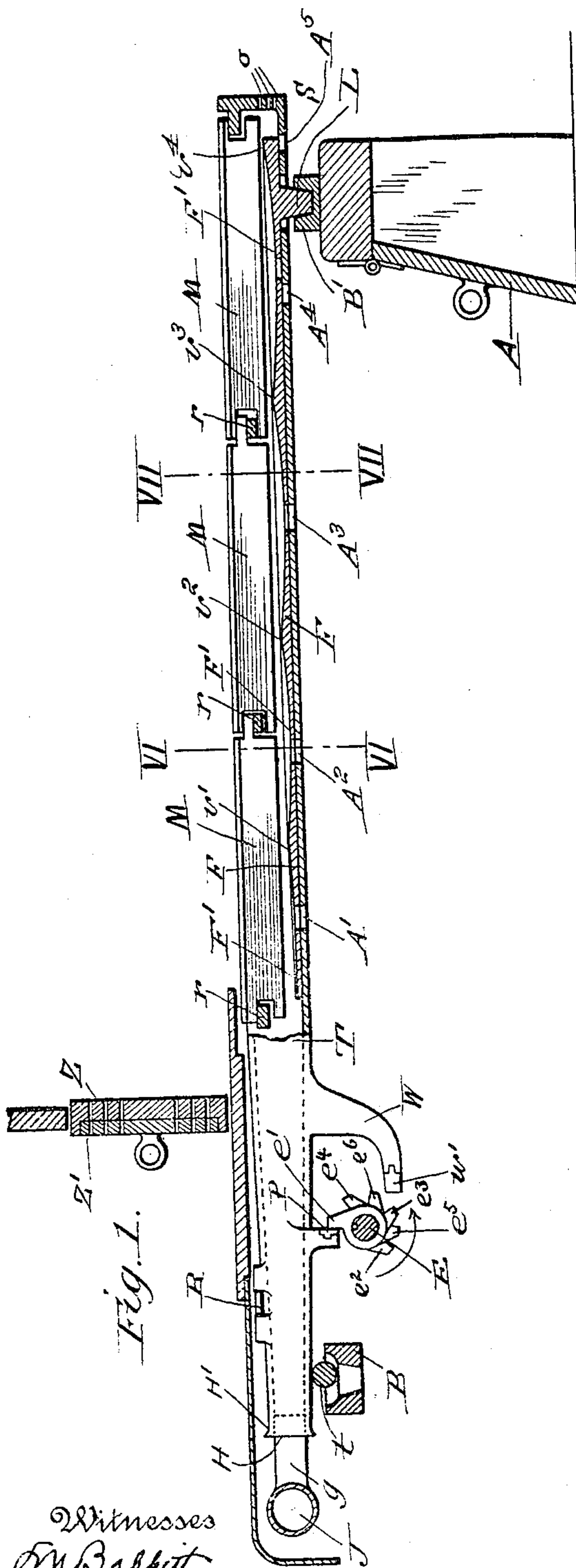


Fig. 1.

Witnesses  
M. Babbitt  
R. L. White

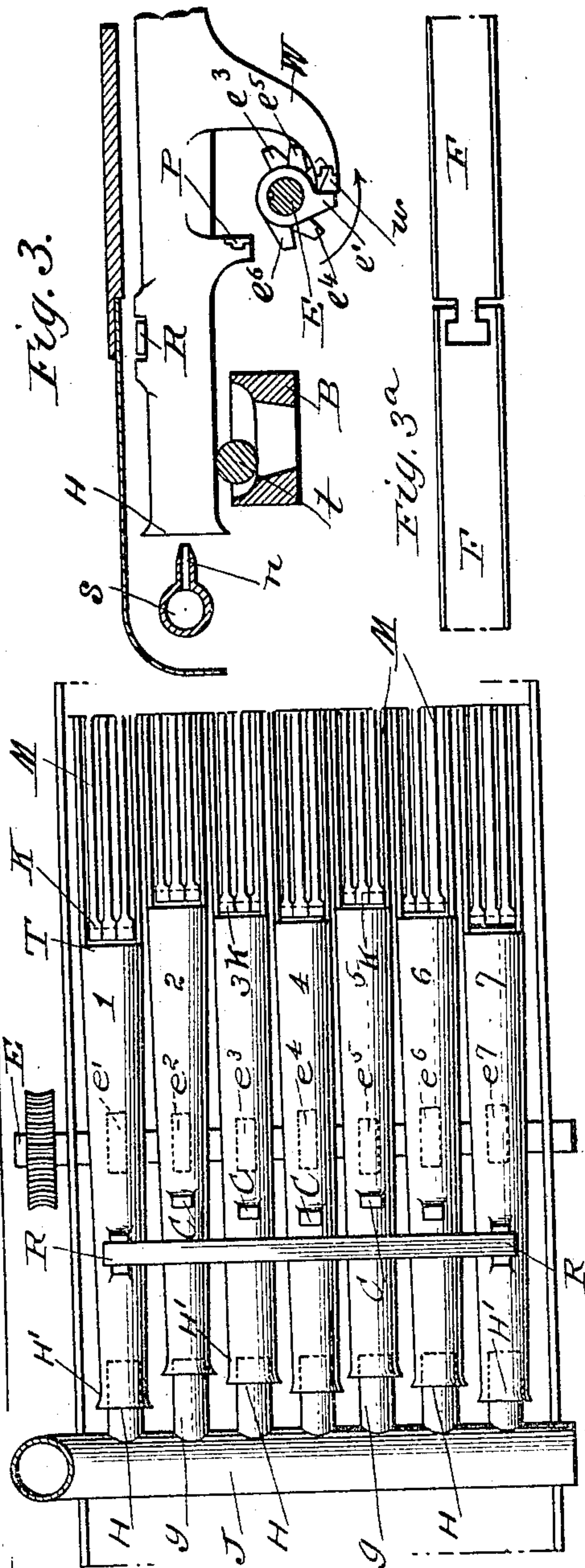


Fig. 2.

Arthur Dudley Southam  
Inventor

By his Attorney, Davis & Davis

Fig. 3.

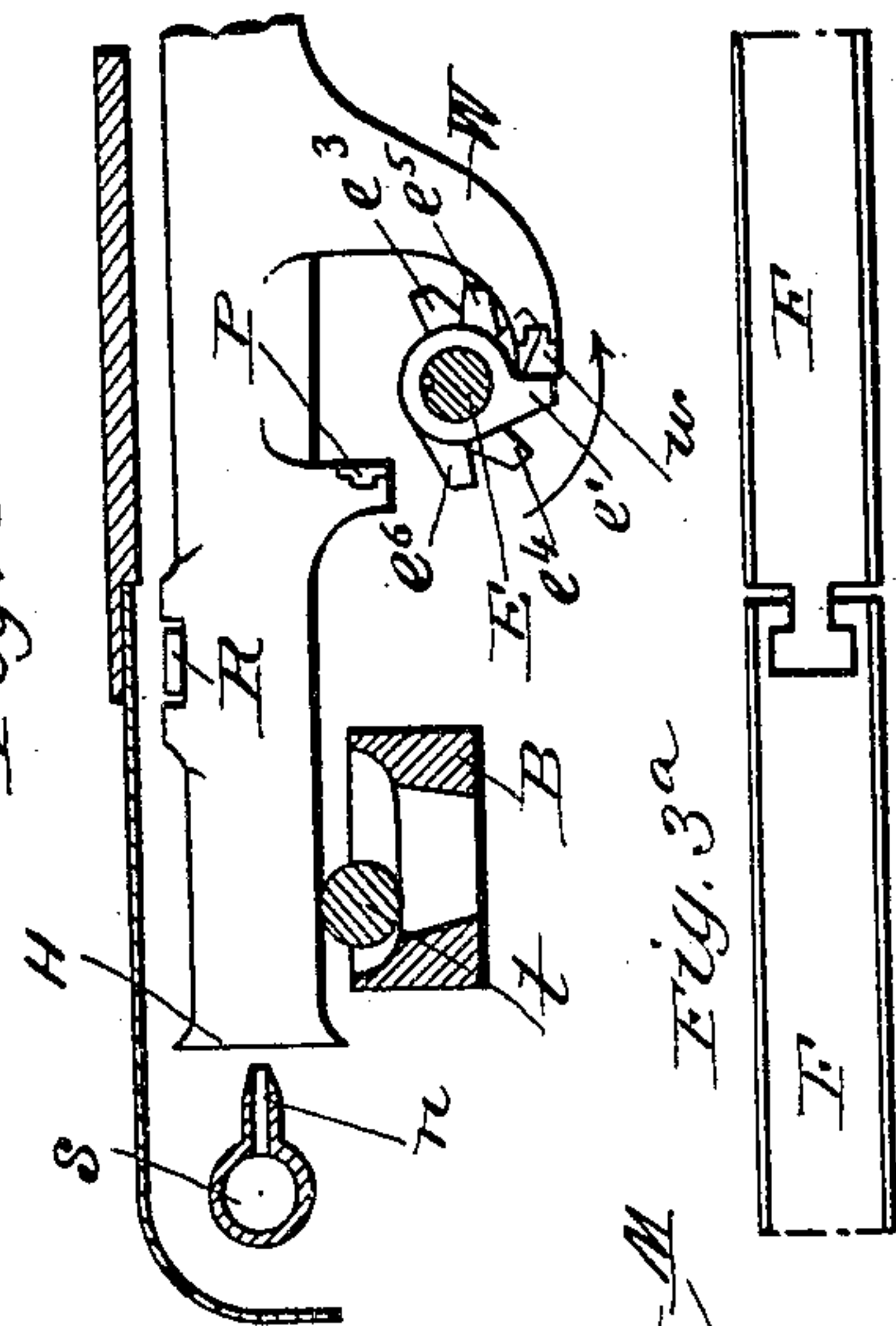


Fig. 3a

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2 SHEETS—SHEET 2.

Fig. 4.

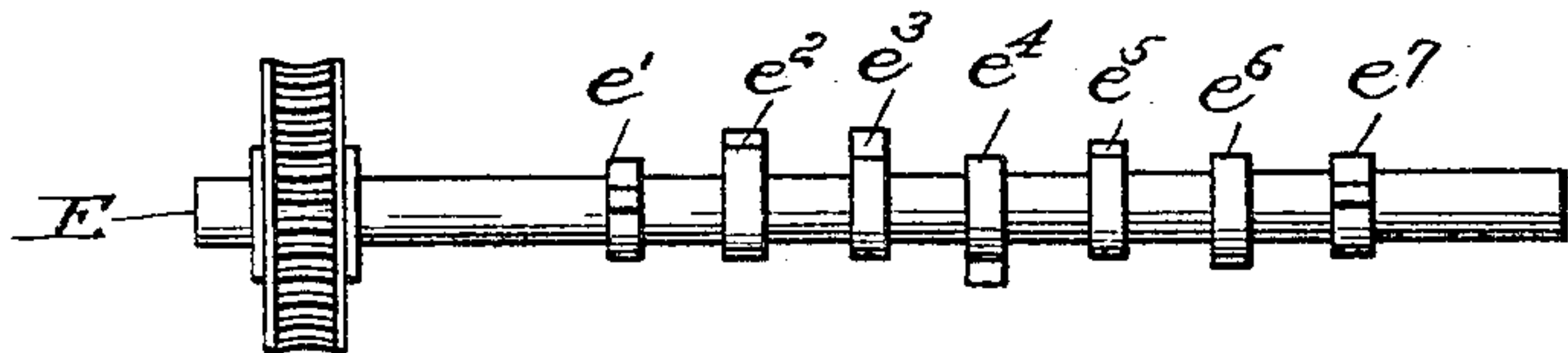


Fig. 5.

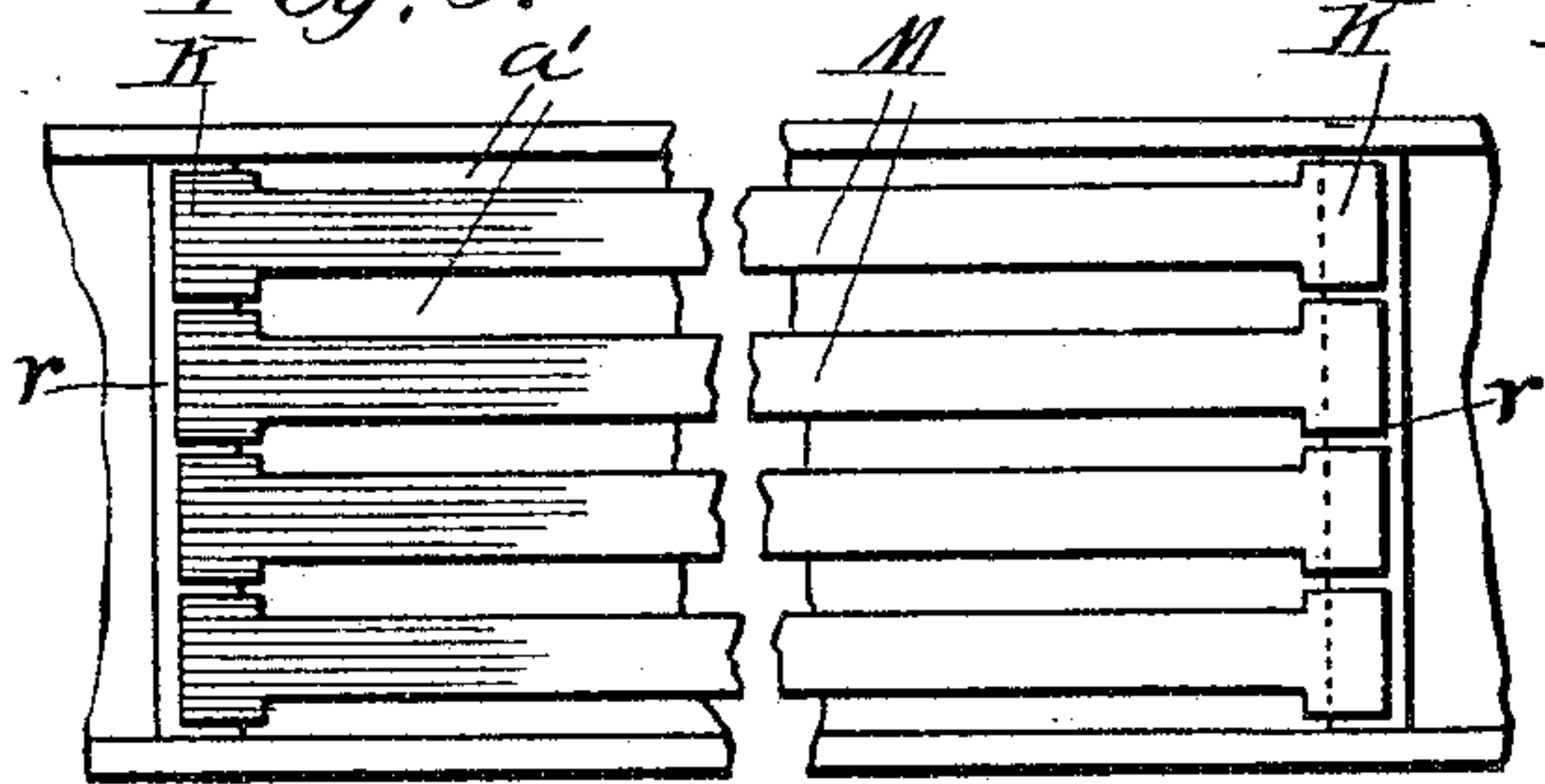


Fig. 6.

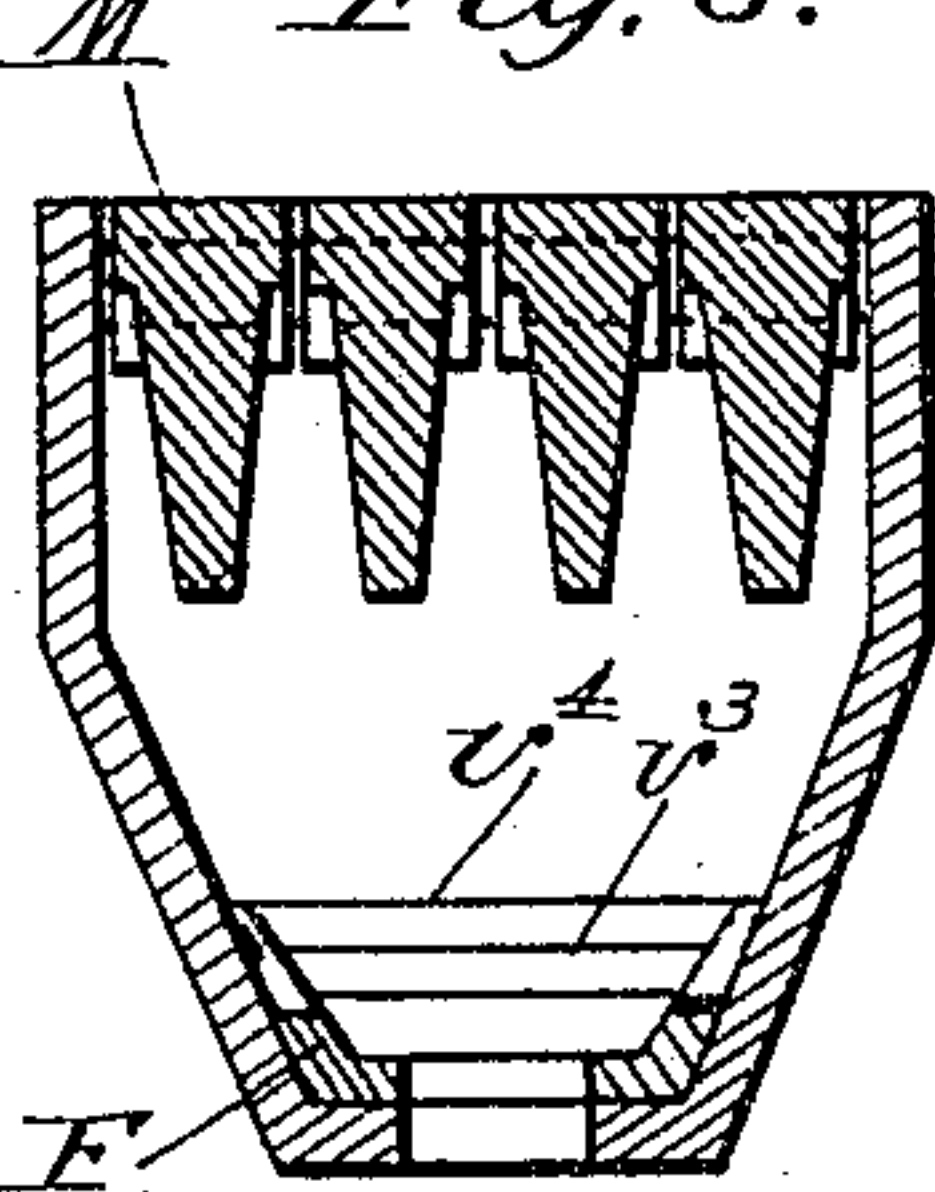


Fig. 7.

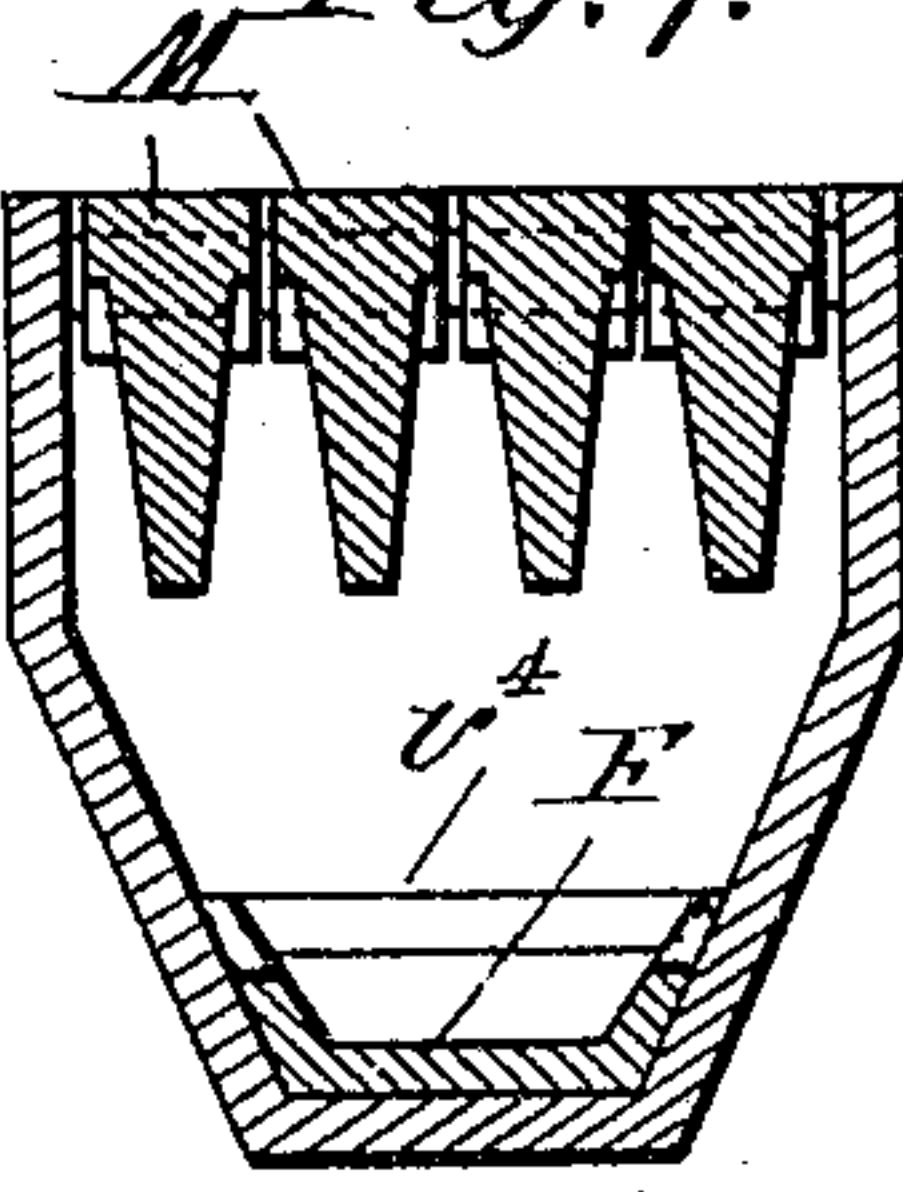


Fig. 8.

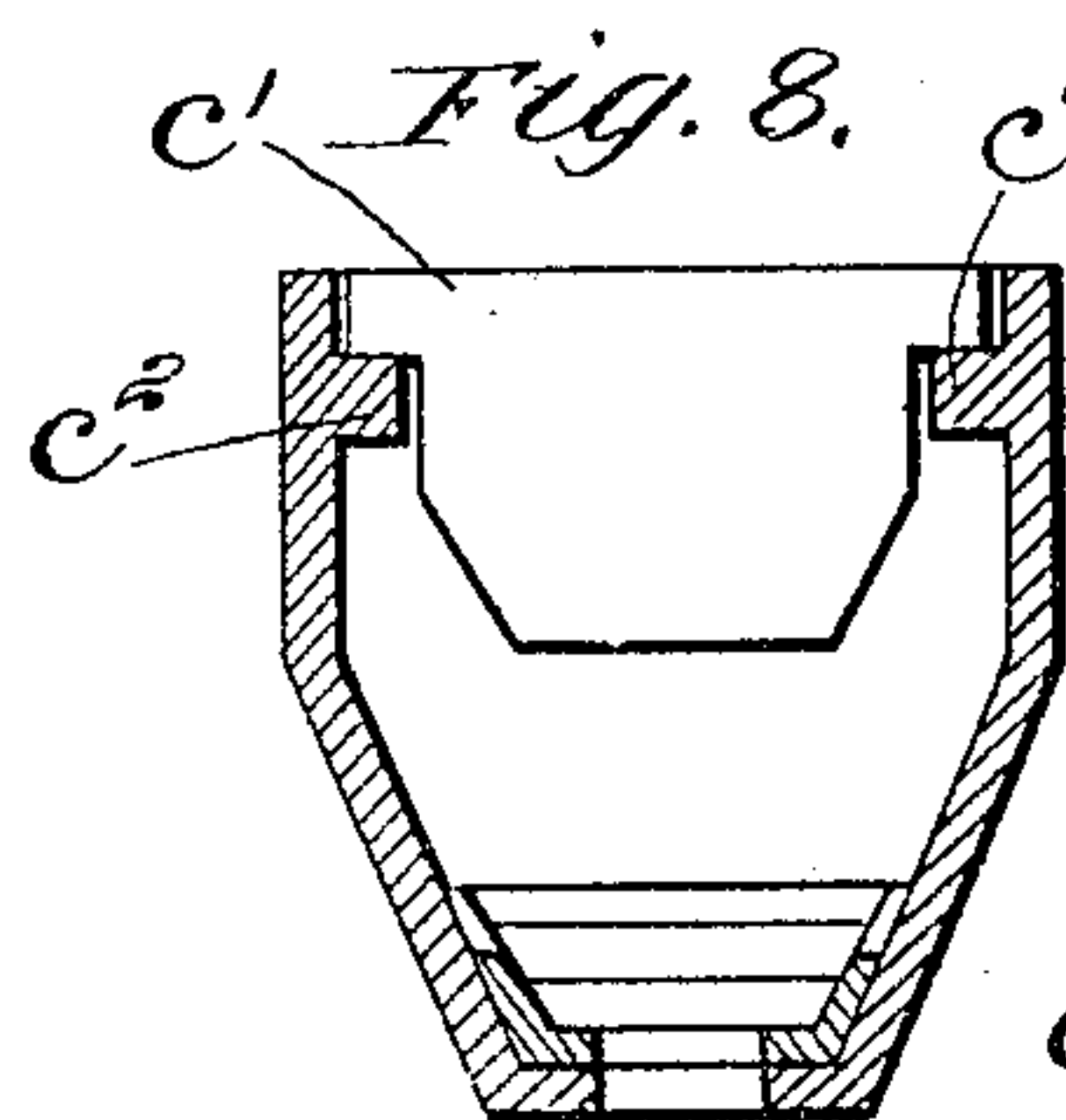


Fig. 9.

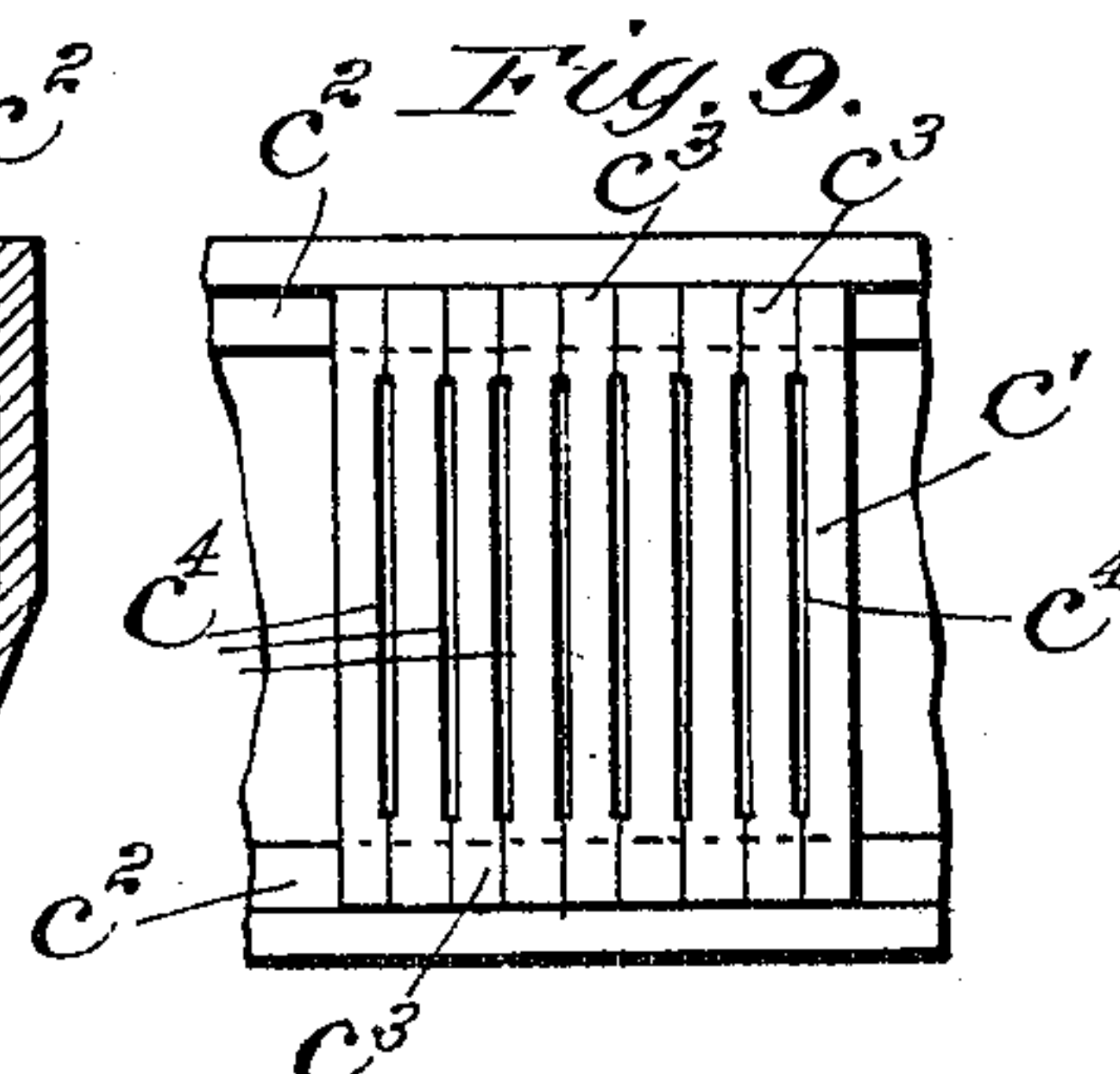


Fig. 10.

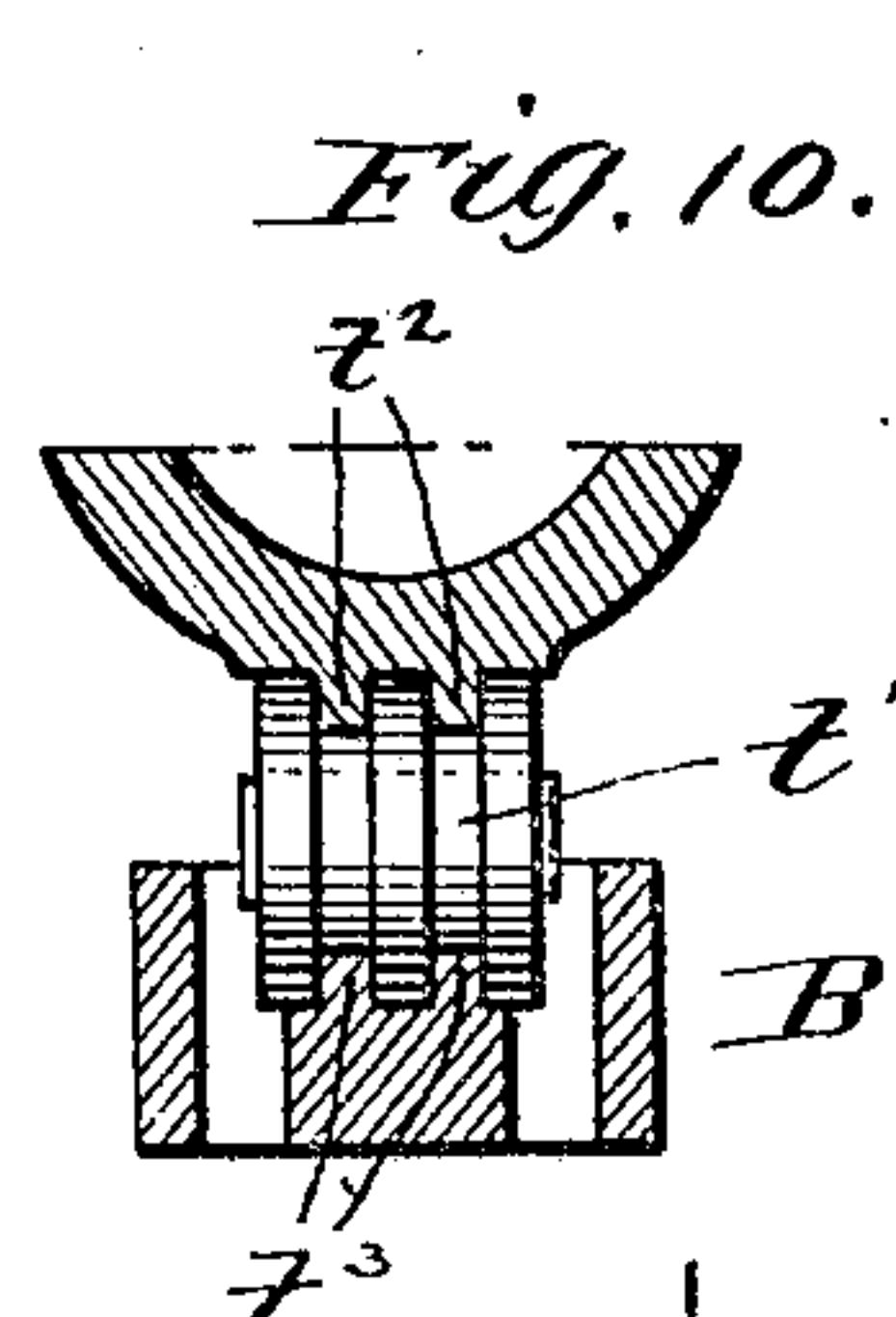
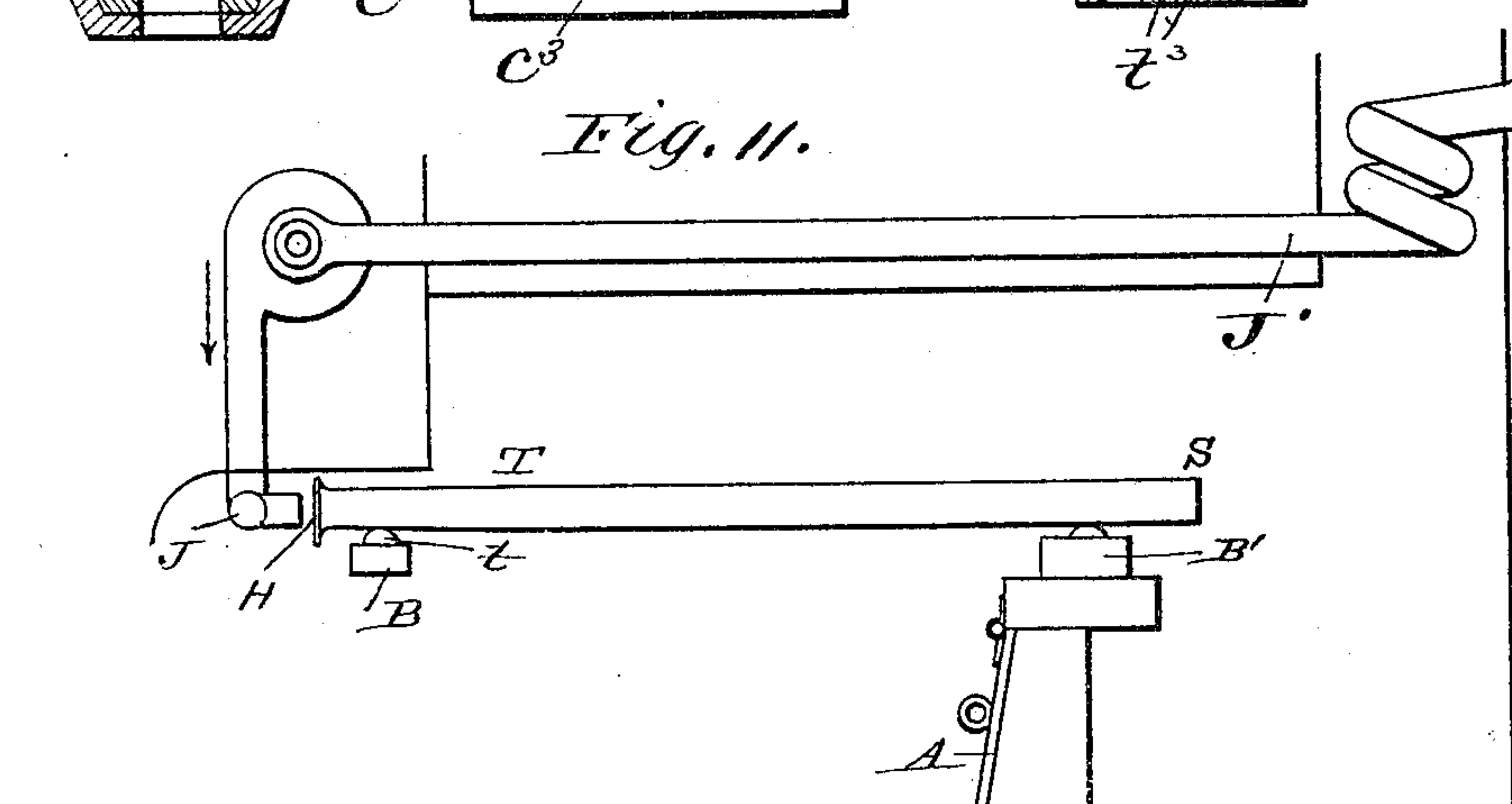


Fig. 11.



Witnesses  
M. Babbitt  
P. J. White.

Inventor  
Arthur Dudley Southam  
By his Attorneys Davis & Davis



# UNITED STATES PATENT OFFICE.

ARTHUR DUDLEY SOUTHAM, OF NEW YORK, N. Y.

## FORCED-DRAFT GRATE.

No. 808,119.

Specification of Letters Patent.

Patented Dec. 26, 1905.

Application filed November 12, 1903. Serial No. 180,812.

*To all whom it may concern:*

Be it known that I, ARTHUR DUDLEY SOUTHAM, a subject of the King of Great Britain, residing in the borough of Manhattan, city, county, and State of New York, have invented certain new and useful Improvements in Forced-Draft Grates, of which the following is a specification, reference being had therein to the accompanying drawings, in which—

Figure 1 is a longitudinal sectional view of a fire-box, a portion of one of the grate-bars being shown in vertical section; Fig. 2, a plan view of the forward ends of a series of grate-bars; Fig. 3, a detail vertical sectional view showing a portion of one of the grate-bars in side elevation; Fig. 3<sup>a</sup>, a detail plan view of a portion of the cleaner-bar; Fig. 4, a detail view of the cam-shaft and cams for moving the grate-bars; Fig. 5, a detail plan view of a portion of one of the grate-bars; Figs. 6 and 7, transverse sectional views of one of the grate-bars, taken on the lines VI VI and VII VII of Fig. 1; Fig. 8, a transverse sectional view of a grate-bar, showing a different form of fire-bar therein; Fig. 9, a plan view of the construction shown in Fig. 8; Fig. 10, a transverse sectional view of a portion of a grate-bar, showing one form of roller-bearing therefor; and Fig. 11, a diagrammatic view showing means for heating air and forcing it into the grate-bars.

The grate-bars are supported at their ends by front and back bearers or supports B and B'. On the front bearer or support is mounted a small roller for each grate-bar and on which the said bars reciprocate. If desired, these rollers may be formed with circumferential grooves *t'* and the grate-bars formed with corresponding ribs *t*<sup>2</sup> and the bearers with ribs *t*<sup>3</sup>, said ribs on the grate-bars and on the bearers engaging the grooves on the rollers, whereby the grate-bars will be held against lateral movement, as shown clearly in Fig. 10.

A portion of each grate-bar, from T to S in Fig. 1, is of a channel or U shape in cross-section and is designed to receive the fire-bars for supporting the fire. Extending across this U-shaped portion of the grate-bar at suitable intervals are horizontal bars *r*, and the bottom of the U-shaped portion of the bar is formed with the perforations A' A<sup>2</sup> A<sup>3</sup> A<sup>4</sup> A<sup>5</sup>. Each grate-bar is formed tubular from T to its forward or outer end H and contracts from the point T to the point H' near its forward end and from said point H' it expands to

its outer end, said outer end being open, whereby a conical or bell-shaped mouth is provided. The inner end wall of each bar is formed with fine holes *o* near the bottom of the bar. In the front wall of the furnace above the grate-bars is arranged a fire-door Z, which is provided with an adjustable register Z' for regulating the supply of air over the fire.

In that portion of each grate-bar which is U-shaped in cross-section and resting on the bottom thereof is a long cleaner-bar F, which is formed at suitable intervals throughout its length with upward-extending air-deflectors *v'* *v*<sup>2</sup> *v*<sup>3</sup> *v*<sup>4</sup>. The height of these deflectors gradually increases from the forward to the rear end of said cleaner-bar, each succeeding deflector being higher than the preceding one. The purpose of this is to guide or deflect upward an equal proportion of the incoming air through the grate-bar to the fire. Between the deflectors the cleaner-bar is dished or of a cup-shape, as shown at F'. At the bottom of these cup-shaped portions the bar is formed with perforations A' A<sup>2</sup> A<sup>3</sup> A<sup>4</sup>, which are adapted to register with the perforations in the grate-bar when said bar is reciprocated, as will be hereinafter described. The object of this is to permit ashes and cinders which collect on the cleaner-bar to pass through the openings in the grate-bar as the latter reciprocates. The perforations in the cleaner-bar are located at the bottom of the cups between the deflectors, so that little, if any, air will pass through them when they are in register with the openings in the grate-bar, the deflectors directing the air away and from said perforations. The cleaner-bar is preferably formed slightly trough-shaped in cross-section, as shown in Figs. 6 and 7, the sides thereof resting against the sides of the grate-bar and preventing ashes from getting under the cleaner-bar. Another advantage of this construction is that the ashes falling on the said bar will be directed toward the openings therein. It may be desirable for many reasons of convenience to form the cleaner-bar in short sections, the ends of which dovetail into each other, as shown in Fig. 3<sup>a</sup>.

Means are provided for securing a relative sliding movement between the grate-bars and the cleaner-bars therein. The purpose of this is to shift the positions of the air-deflectors with respect to the grate-bars to secure a more even distribution of the draft under the fire and also to bring the openings in



the grate-bar into register with the perforations in the cleaner-bar to permit the ashes collected on the cleaner-bar to fall through the grate-bars. This relative movement of the grate-bars and the cleaner-bars may be secured in any desired and suitable manner, but is preferably accomplished by holding the cleaner-bar stationary during the reciprocation of the grate-bar. To accomplish this, the inner end of the cleaner-bar is provided with a depending projection L, which extends through a slot in the bottom of the grate-bar and enters a recess in the back bearer B'. This projection L not only holds the cleaner-bar stationary, but serves to prevent any lateral shifting of the rear end of the grate-bar.

The back bearer is supported by a wall which extends to the floor-level and serves as the front wall of the ash-pit, a door A normally closing the entrance to the ash-pit. This door when in its closed position is at an angle, so that it will be held closed by gravity and is self-closing and air-tight to prevent air passing to the ash-pit from the front of the furnace. It may be readily raised to permit of the cleaning of the ash-pit.

A transverse horizontal shaft E is located below the grate-bars and near their forward ends. On this shaft are keyed cams  $e'$  to  $e^7$ , one for each of the grate-bars. It will of course be understood that as many of these cams are to be used as there are grate-bars. The operating-face of each cam is radial to the shaft, and said cams are arranged on different radial lines, except the two outer cams  $e'$  and  $e^7$ , these latter cams being arranged on the same radial line. Attached to or forming part of each grate-bar is a hardened downward-extending projection or lug P, against which one of the cams on the shaft E operates as said shaft is rotated to draw the bar forward or out of the fire a few inches. The cams, except the two outer ones, being arranged on different radial lines will engage the corresponding projections on the grate-bars at different intervals or periods, and thereby cause the bars to be drawn out of the fire independently and separately, except of course the two outer bars, which are drawn out simultaneously. I have found that the best results are obtained when no two adjoining bars are drawn out together. As shown in Fig. 1, the cams are set to operate in the following order: First, numbers 1 and 7 will be drawn out together, then numbers 4, 6, 3, 5, and 2 one at a time and in succession.

Two of the grate-bars, preferably the outer ones 1 and 7, are provided at a point in the rear of the cam-shaft E with downward-extending projections W, which extend to a point near the shaft E and in position to be engaged by the two cams  $e'$  and  $e^7$  when all of the grate-bars have been drawn forward

or out of the fire. The purpose of this is to provide means for simultaneously returning two of the bars rearward to their original positions under the fire. The ends of the projections W are provided with hardened and renewable projections  $w'$ . The curved arrow in Fig. 1 indicates the direction of rotation of the shaft E. To secure the simultaneous return of all the grate-bars to their original positions, the intermediate bars are provided on their upper surfaces with upward-extending lugs or projections C. The two outer bars 1 and 7 are each provided with a pair of upward-extending lugs, between which rests a cross-bar R, said bar being in such a position above the grate-bars that it will engage all of the lugs C on the intermediate bars. It will be readily understood that when the two outer bars are moved rearward this cross-bar R will contact with all of the lugs C, and thereby move all of the grate-bars rearward into the fire. The object of first withdrawing the grate-bars singly or one at a time from the fire is to break up the clinkers and at the same time draw the grate-bars outward without carrying the fire forward. It will thus be seen that the clinkers and ashes will be gradually dropped off the rear ends of the grate-bars into the ash-pit. When the bars are all moved rearward simultaneously, the fire will be carried bodily rearward.

To provide a flat surface for supporting the fire, a series of small fire-bars M is mounted in that part of each grate-bar which is U-shaped in cross-section. These fire-bars are made in short sections, and each section is provided at one of its ends with a longitudinally-extending tongue or projection, which is slightly below the upper surface of the bar and is adapted to rest upon the top of one of the transverse bars  $r$ . The other end of each fire-bar section is formed with a recess which is adapted to receive one of the bars  $r$  and the tongue of the adjoining grate-bar section, so that these fire-bars are supported by the transverse bars and are loosely interlocked. In this manner they are detachable, so that renewals may be readily effected whenever necessary. These bars are preferably of a wedge or V shape in cross-section and are provided at their ends with transverse enlargements K, whereby when they are assembled in the grate longitudinal slots or air-spaces  $a'$  are formed between them.

When using certain kinds of fuel, I prefer to use small transverse fire-bars  $c'$ . (Shown in Figs. 8 and 9.) These bars are supported in the grate-bars by a flange  $c^2$ , which extends the whole length of that portion of the grate-bar which is U-shaped in cross-section. These fire-bars are formed with end projections  $c^3$ , which support the bars and provide the air-spaces  $c^4$  between them.

The object of forming the small holes  $o$  at



the inner or rear end of each grate-bar is to permit a small proportion of air to pass through and mix with the flue-gases to render the combustion more perfect.

5 A horizontal air-supply pipe J is located near to and in front of the open forward ends of the grate-bars. This pipe is provided with a series of nozzles g, one entering the forward end of each bar and concentric therewith.  
 10 This pipe is supplied with compressed air or air under pressure from a blower or by other means. The air supplied to this pipe is preferably heated, and this may be accomplished in any suitable manner. As shown in Fig. 11,  
 15 it is heated by being circulated through pipe J', located in one of the flues and subject to the heat of the waste gases from the fire. If desired, steam preferably superheated in any suitable manner may be used instead of the  
 20 direct air-supply. When steam is used, a small pipe s is employed and the nozzles n are drawn to a fine point, as shown in Fig. 3. In this form of the apparatus the flowing jet of steam will draw into the grate-bar through  
 25 the open end thereof the amount of air necessary for combustion. It will thus be seen that a powerful draft of air or a mixture of steam and air is directed into the grate-bars through the openings at the forward ends  
 30 thereof and that air is distributed throughout the length of the fire by means of the air-deflectors on the cleaner-bars.

Having thus fully described my invention, what I claim is this—

35 1. The combination of a series of grate-bars each having an open forward end, the forward portions of said grate-bars being tubular and the rear portions thereof being substantially U-shaped in cross-section, means  
 40 for drawing said grate-bars outward away from the fire alternately, means for returning said bars simultaneously into the fire, means at the bottom of the U-shaped portions of the grate-bars for directing the air upward, said  
 45 means being relatively movable and adapted for removing the cinders and ashes therefrom.

2. The combination of a series of grate-bars tubular at their forward ends and U-  
 50 shaped in cross-section where they support the fire, the forward ends of the tubular parts being open, each of said grate-bars being provided with horizontal transverse bars across the U-shaped portion thereof, means for  
 55 slidingly supporting said grate-bars, a series of small longitudinal fire-bars supported on the transverse bars, the rear end of each grate-bar being provided with air-openings and the bottoms of said bars being provided  
 60 with discharge-openings, an air-supply pipe, nozzles connected thereto, and directing air into the forward ends of the grate-bars, a cleaner-bar in each of the grate-bars and provided with openings corresponding to the  
 65 discharge-openings in the grate-bars, upward-

extending air-directing deflectors formed on each of said cleaner-bars, and means for causing a relative movement between the cleaner-bar and the grate-bars.

3. The combination of series of grate-bars 70 tubular at their forward ends and U-shaped in cross-section where they support the fire, the forward ends of the tubular parts being open, each of said bars being provided with transverse bars at the U-shaped portion 75 thereof, means for movably supporting said grate-bars, a series of small longitudinal fire-bars supported on the transverse bars, said fire-bars being enlarged at their ends, each of said grate-bars being provided with discharge- 80 openings in its bottom and with air-outlets at its rear end, a cleaner-bar in each grate-bar provided with openings corresponding with discharge-openings in the grate-bar, a horizontal pipe in front of the grate-bars and 85 provided with nozzles to direct a blast into the grate-bars, means connected to said blast-pipe to heat the blast, a shaft below the grate-bars carrying a series of cams, depending lugs formed on the grate-bars and adapt- 90 ed to be engaged by the cams on the shaft to draw the grate-bars out from the fire, depending arms carried by the two outer bars, cams carried by the shaft and adapted to en- 95 gage said arms to return said outer bars to the fire, means connecting the two outer bars together and adapted to engage all the other bars to return them simultaneously to the fire, means for causing a relative movement 100 between the grate-bars and the cleaner-bars therein, upward-extending air-directing deflectors carried by the cleaner-bars and a self-closing air-tight damper below the grate-bars and closing the ash-pit.

4. The combination of a forced-draft fur- 105 nace-grate bar having a bell-mouth, a series of interlocking fire-bars carried by said bar, a jet in front of the bell-mouth and a series of upward-extending air-directing deflectors within the grate-bar below the fire-bars said 110 deflectors increasing in height toward the rear end of the grate-bar.

5. The combination of a movable forced-draft furnace-grate bar tubular near its forward end and trough-shaped at its inner end, 115 said bar being provided with a series of openings in the bottom of the trough-shaped portion and its outer or forward end being open, a series of fire-bars supported within the trough-shaped portion of the bar, a jet placed 120 in front of the open forward end, a perforated cleaner-bar on the bottom of the trough-shaped part of the bar and over the perforations therein, a series of upward-extending air-directing deflectors formed on said cleaner 125 bar, and means for holding the cleaner-bar stationary independently of the grate-bar.

6. The combination of a movable forced-draft furnace-grate bar tubular near its forward end and trough-shaped at its inner end, 130



said bar being provided with a series of openings in the bottom of the trough-shaped portion and its outer forward end being open, a series of fire-bars supported within the trough-shaped portion of the bar, a jet placed in front of the open forward end, a perforated cleaner-bar on the bottom of the trough-shaped bar and over the perforations therein, a series of upward-extending air-directing deflectors formed on said cleaner-bar, said deflectors gradually increasing in height to the rear end of the grate-bar, and means for holding the cleaner-bar stationary independently of the grate-bar.

7. The combination of a series of grate-bars having bell-mouths, said bars being tubular near their ends and trough-shaped where they support the fire, a series of fire-bars supported within the trough-shaped portion of the grate-bars and forming a fire-supporting surface, means for delivering steam and air into the open forward ends of the grate-bars, and a series of upward-extending air-deflectors in the bottoms of the grate-bars, said deflectors increasing in height toward the rear ends of the bars.

8. The combination of a forced-draft furnace-grate bar having an open forward end, said bar being tubular near its forward end and trough-shaped where it supports the fire, a series of fire-bars supported within the trough-shaped portion of the grate-bar to form the fire-supporting surface, means for delivering hot air into the forward open end of the grate-bar, and a series of upward-extending air-directing deflectors within the grate-bar below the fire-bars, said deflectors increasing in height toward the rear end of the grate-bar.

9. The combination of a movable forced-draft furnace-grate bar tubular near its forward end and trough-shaped at its inner end said bar being provided with a series of openings in the bottom of the trough-shaped portion and its outer end being open, a series of bars supported within the trough-shaped por-

tion of the grate-bar, means for forcing hot air into the open forward end of said bar, a perforated cleaner-bar on the bottom of the trough-shaped part of the grate-bar, a series of upward-extending air-directing deflectors formed on said cleaner-bar and means connected to said cleaner-bar and extending through an opening in the grate-bar to rigidly connect said cleaner-bar to a stationary part of the furnace, and means for moving the grate-bar, whereby the cleaner-bar will be held stationary and will prevent any lateral or sidewise movement of the grate-bar.

10. The combination of a forced-draft grate-bar open at its forward end, a series of fire-bars supported by said bar said bar being trough-shaped below said fire-bars, and provided with openings in its bottom, a trough-shaped cleaner-bar within the grate-bar and formed with perforations in its bottom, means for moving one of said bars with respect to the other to cover and uncover the openings in the grate-bar.

11. The combination of a forced-draft furnace-grate bar trough-shaped where it supports the fire and provided with openings in its bottom, the sides of said trough-shaped portion converging downwardly whereby said bar will be narrower at its bottom than at its top, a series of fire-bars within the trough-shaped part of the grate-bar and forming the fire-supporting surface, a trough-shaped cleaner-bar on the bottom of the grate-bar and having its sides resting against the sides of said bar and provided with openings in its bottom, and means for moving one of said bars to cover and uncover the openings in the bottom of the grate-bar.

In testimony whereof I hereunto affix my signature, in the presence of two witnesses, this 8th day of October, 1903.

ARTHUR DUDLEY SOUTHAM.

Witnesses:

JOHN W. THOMAS,  
ERNOLD S. MOSELEY.