No. 667,399. Patented Feb. 5, 1901.

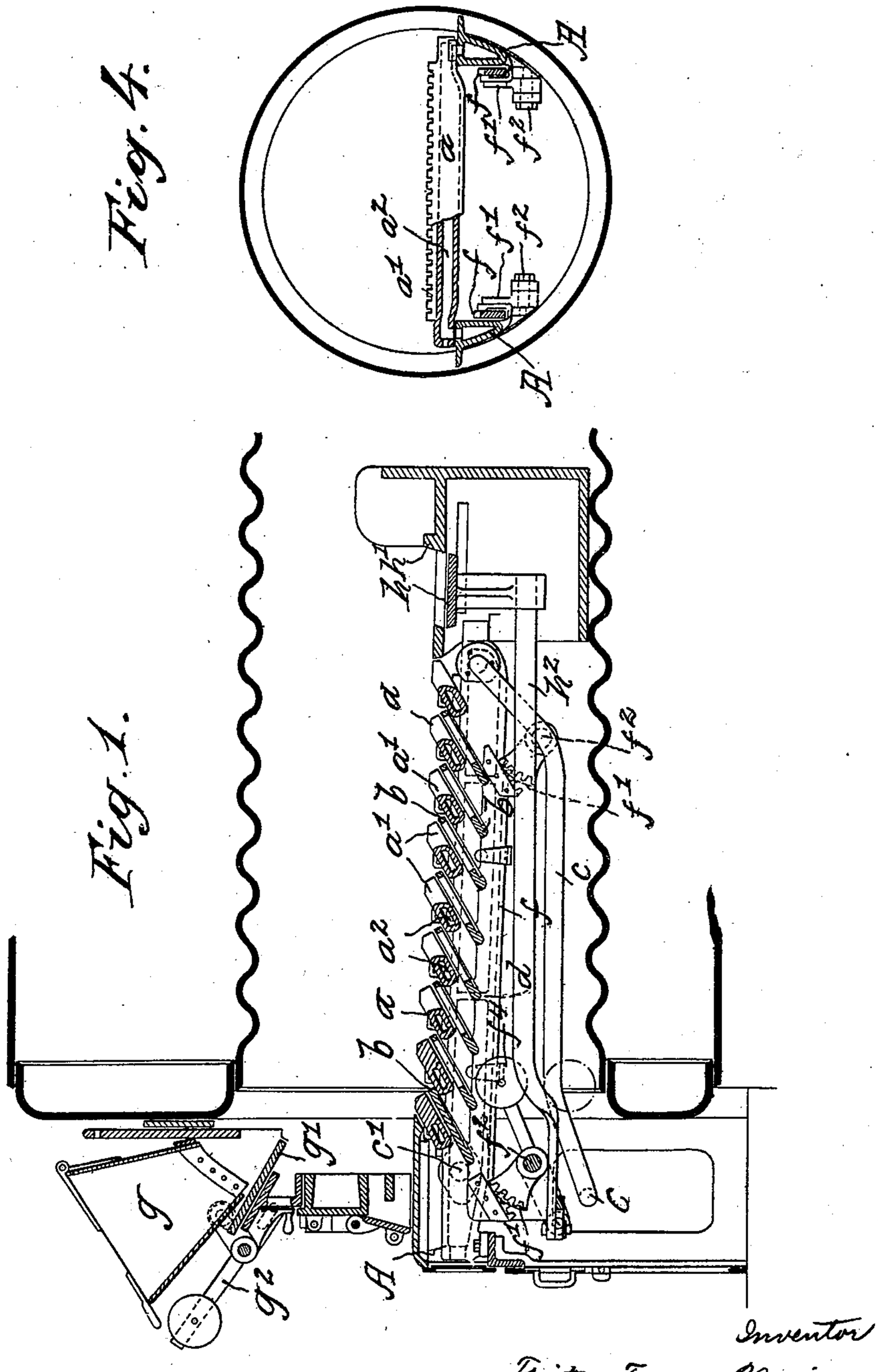
F. F. MAIER.

FURNACE GRATE.

(Application filed Aug. 23, 1897.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 4 Sheets—Sheet 2.

Fig. 5.

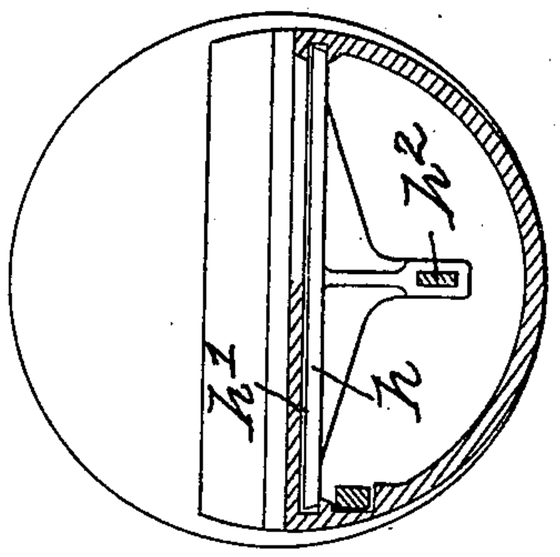


Fig. 1a.

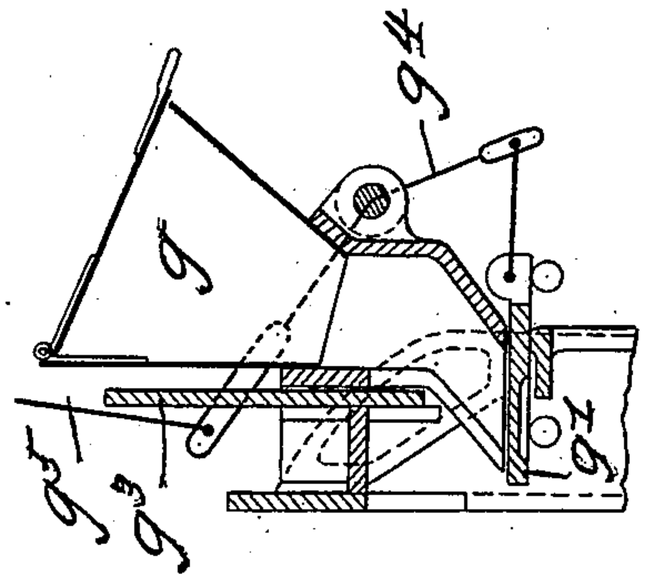


Fig. 2.

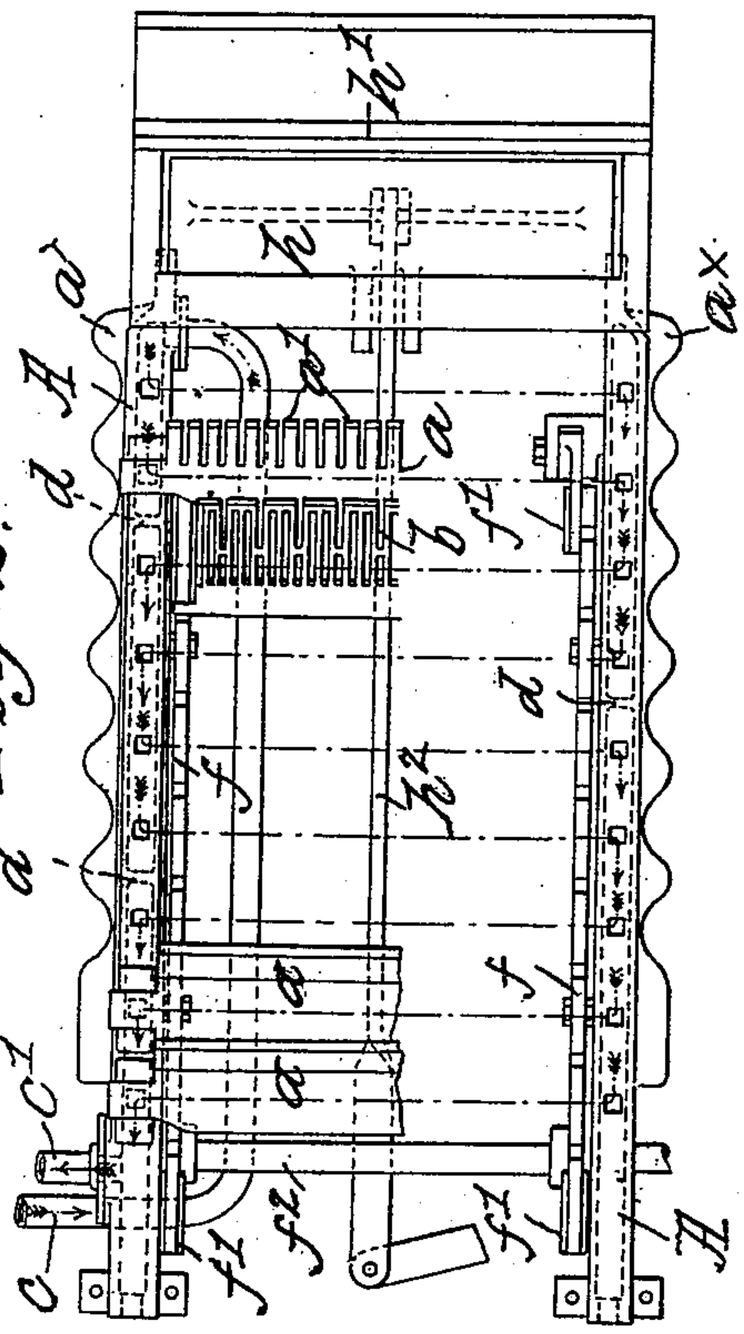
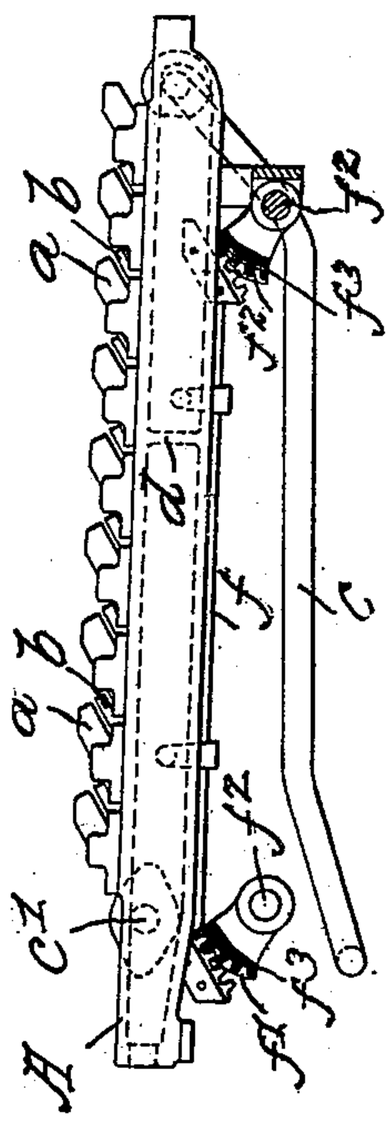


Fig. 3.



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FURNACE GRATE.

(Application filed Aug. 23, 1897.)

(No Model.) 4 Sheets—Sheet 3.

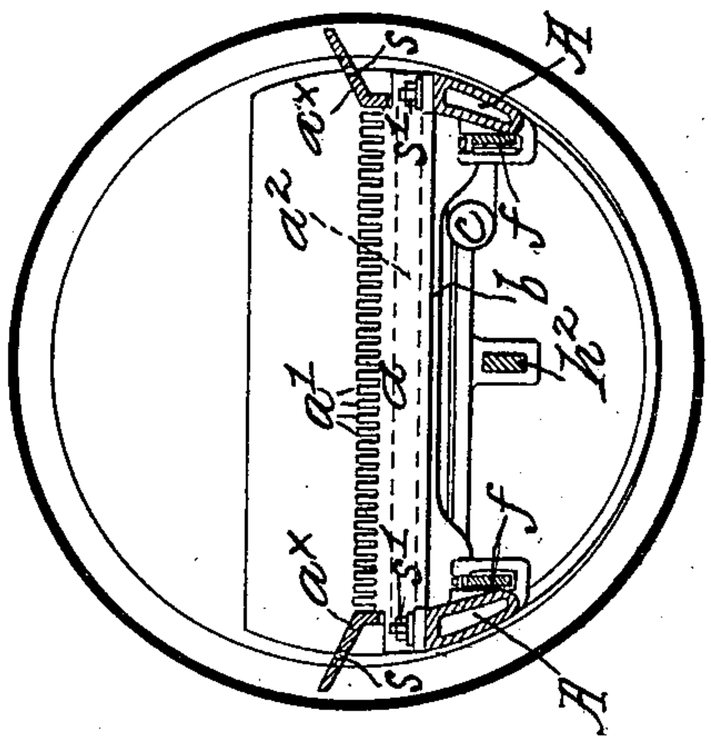

Fig. 7.

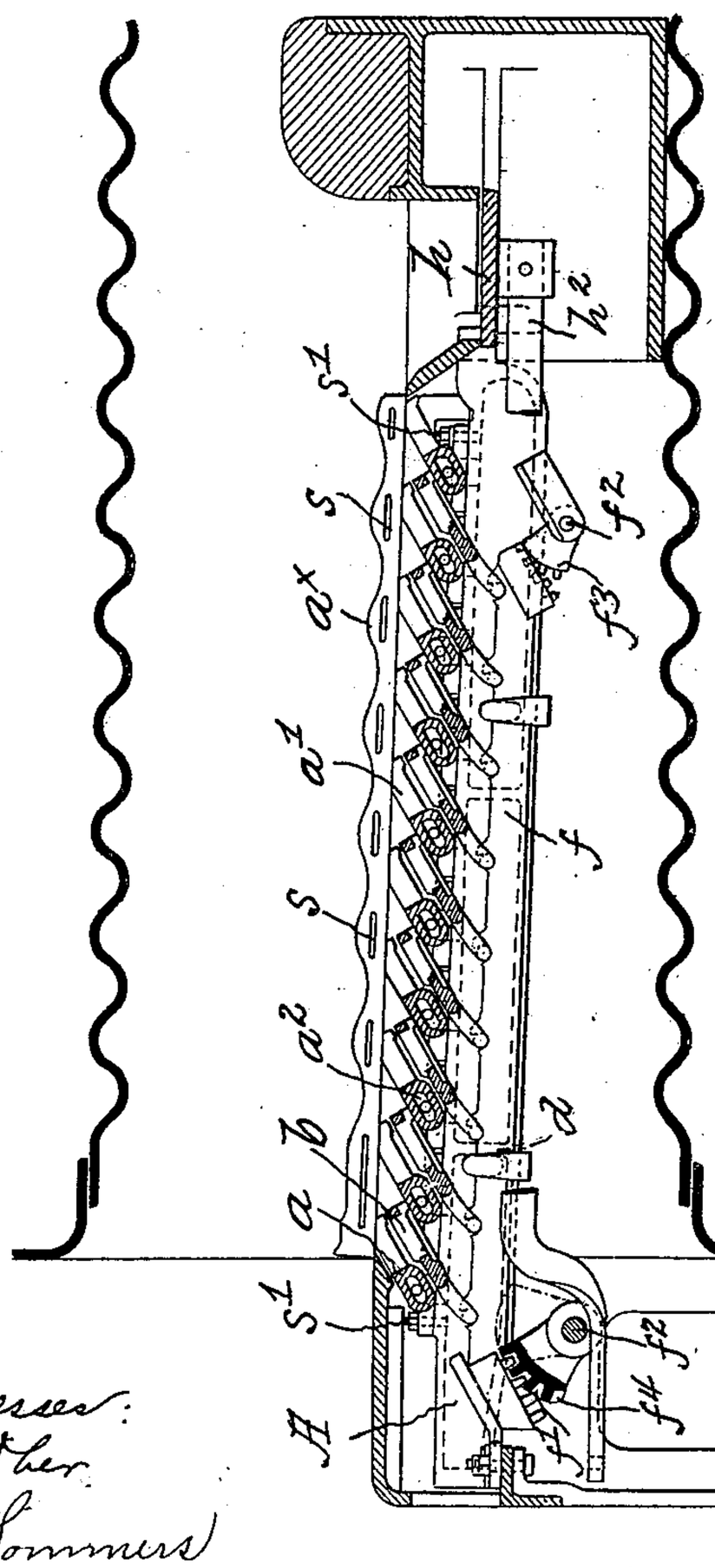

Fig. 6.

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(Application filed Aug. 23, 1897.)

(No Model.) 4 Sheets—Sheet 4.

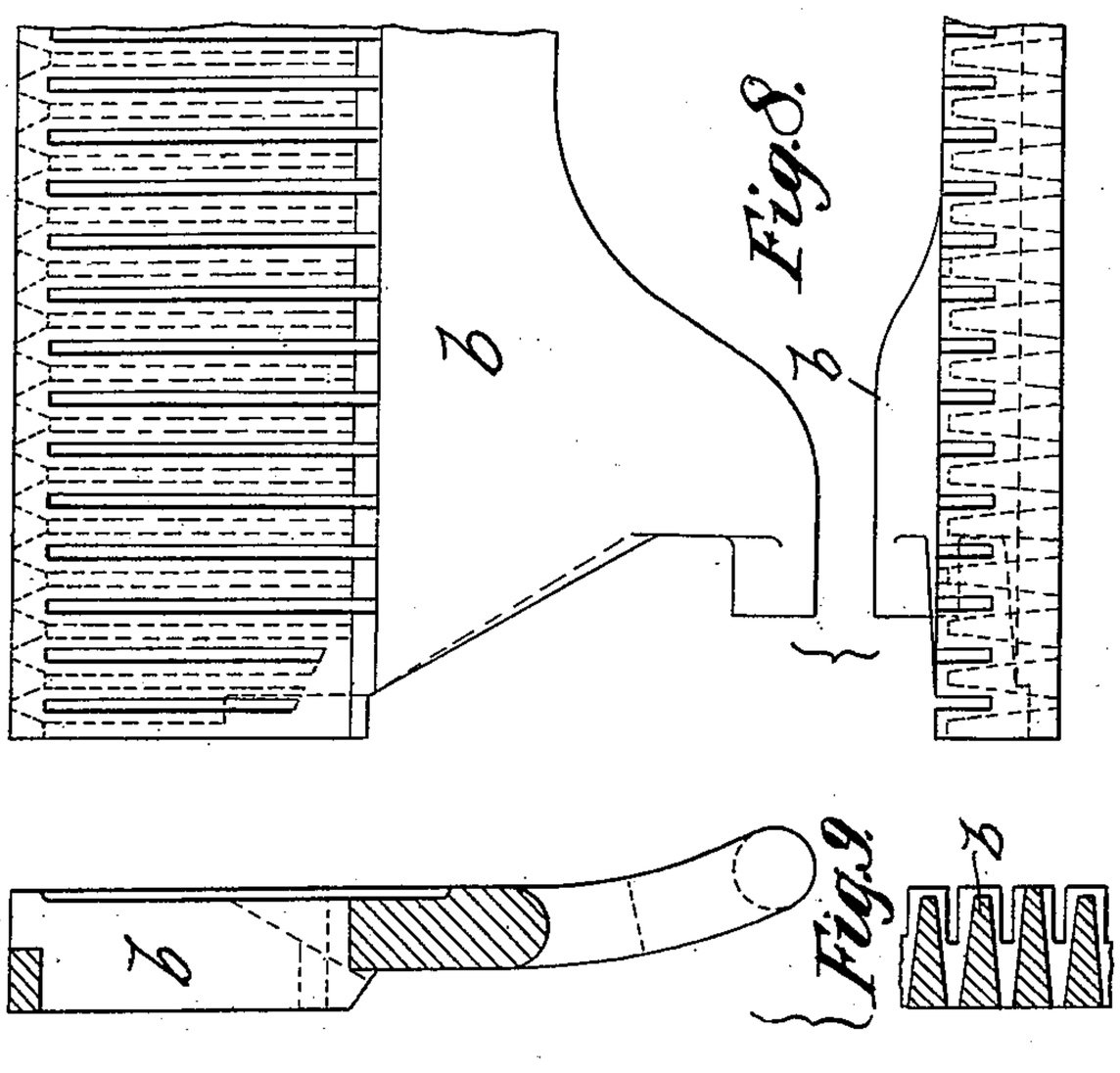

Fig. 8.

Fig. 9.

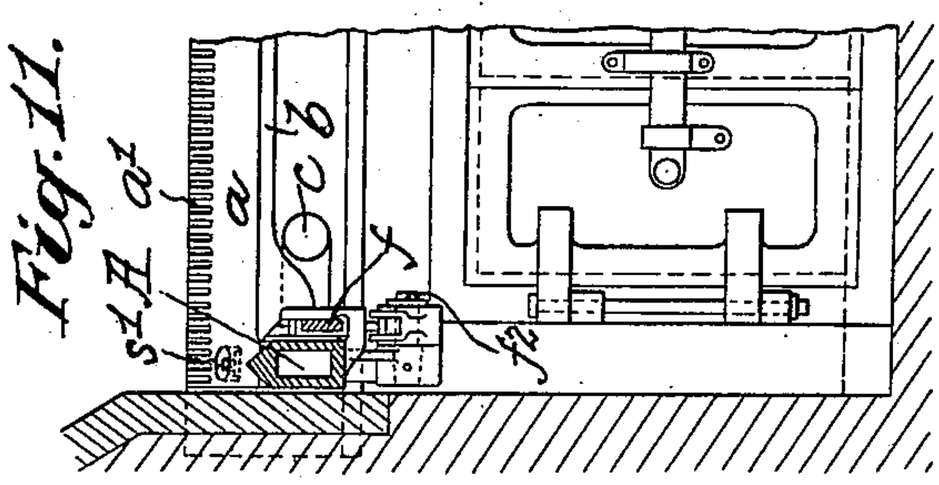

Fig. 11.

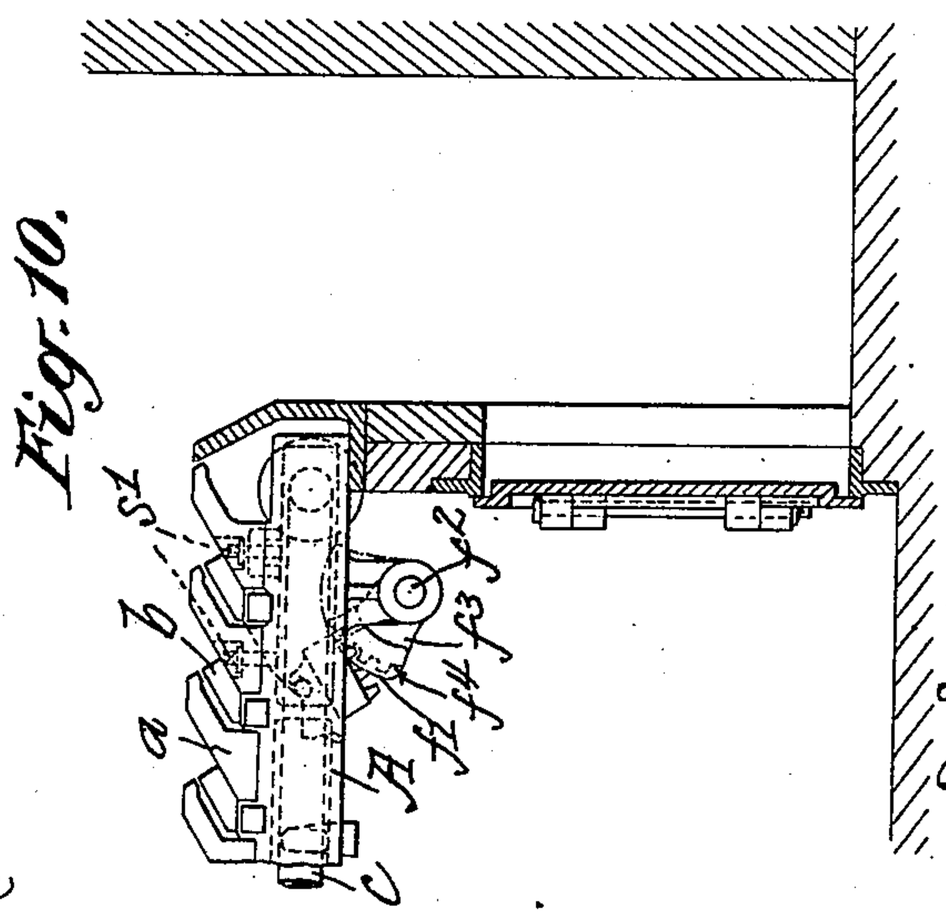

Fig. 10.

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UNITED STATES PATENT OFFICE.

FRITZ FRANZ MAIER, OF VIENNA, AUSTRIA-HUNGARY, ASSIGNOR OF ONE-HALF TO SIGMUND KANITZ, OF SAME PLACE.

FURNACE-GRATE.

SPECIFICATION forming part of Letters Patent No. 667,399, dated February 5, 1901.

Application filed August 23, 1897. Serial No. 649,271. (No model.)

To all whom it may concern:

Be it known that I, FRITZ FRANZ MAIER, a subject of the Emperor of Austria-Hungary, residing at Vienna, in the Province of Lower Austria, in the Empire of Austria-Hungary, have invented certain new and useful Improvements in Furnace-Grates, (for which Letters Patent have been obtained in Austria, dated May 28, 1897, registered Vol. 47, Fol. 1986;) and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in that type of furnace in which the feeding forward of the fuel, the clearing of the fire-grate, and the removal of clinkers and ashes therefrom are effected by means of a movable sliding grate in conjunction with a fixed step-grate provided with cooling means. These furnaces have many and serious defects which interfere with their good working and which form disturbing elements generally. The defects consist, mainly, in that the fixed step-grate bars are so constructed that all the grate-openings are closed by the rising of the sliding grate, and thus prevent the entry of air, that the cooling-passages are too far removed from the surfaces to be cooled, and thus through the unfavorable circulation of the cooling medium cause a defective system of cooling. Further, in consequence of the great quantity of material required in the construction of the parts of these furnaces such construction is rendered difficult, while at the same time the total area of the openings of the fire-grate is disadvantageously reduced, and the increased heat-conducting surface greatly interferes with the air-currents passing through the open spaces of the grate.

The improvements for obviating the above defects and for rendering such furnaces really smokeless must therefore aim (*a*) at an arrangement of the step-grate and its supporting-frame relatively to the sliding grate, in which the air-passages between the bars of the step-grate possess in any position of the sliding grate a relatively larger cross-sectional area, (*b*) at rendering the action of the cooling medium in the frame most effective, and (*c*) at arranging the cooling-passages in the step-grate as near as possible to the surface of combustion.

Improvements have also been introduced in the device for moving the sliding grate, in the feeding device, and in the means for obtaining a uniform combustion of the fuel throughout the entire width of the fire-grate, and, finally, for enabling the parts of both the step and the sliding grates to be easily removed and exchanged.

The accompanying drawings illustrate several furnaces provided with the above improvements.

Figure 1 is a vertical longitudinal section of a furnace constructed according to this invention and provided with the improved charging device. Fig. 1ª is a modification of the charging device. Fig. 2 is a plan of the furnace. Fig. 3 is a side elevation of the grate, and Figs. 4 and 5 are two cross-sections taken on different vertical planes. Fig. 6 is a vertical longitudinal section of a modified construction of furnace. Fig. 7 is a vertical cross-section of the same. Figs. 8 and 9 represent one of the sliding bars of the movable grate in two external views and in two cross-sections. Figs. 10 and 11 show a longitudinal and a cross section, respectively, of a furnace built of bricks or masonry.

a are the hollow bars of the fixed or step grate.

b are the sliding bars of the movable grate, which are arranged between the former in such a manner as to effect at one and the same time the feeding forward of the fuel as well as the clearing of the grate and the removal therefrom of the ashes and clinkers.

The main support of the fire-grate possesses the form of a frame having in both its longitudinal branches A passages serving as inlet and outlet to the cooling medium, which latter may be water, air, or air mixed with atomized water. These two longitudinal branches are connected together by the hollow step-bars *a*. The latter are provided with ribs *a'* and with an asbestos packing-ring at each end and are secured to the branches A in

such manner as to enable each single bar to be taken out when required for renewal without having to take the whole grate out or even without having to dismount any other parts whatever.

The hollow step-bars *a* are of comparatively small cross-section, so as to leave large openings between them for the passage of air from the ash-pit for combustion. Further, these bars are arranged parallel with the bars or slides *b* of the movable grate and so that said slides, even in their most outward position, only reach with their recessed portions into the spaces between the hollow bars, and thus never block out the air. This arrangement enables the section of the iron in the grate to be reduced to a minimum, so that the cooling of the same will be more easily effected, inasmuch as at a constant combustion-surface a favorable relation between the cooling area and the iron mass to be cooled is realized, while at the same time it becomes possible to provide cooling-passages a^2 in the grate-bars, and therefore nearer to the fire. In consequence of this arrangement the sliding bars *b* are now protected against excessive heating by being cooled from below by the cold air and at the upper parts by the artificial cooling means of the step-bars, which latter are also efficaciously cooled by the air passing unhindered through the recesses of the sliding bars *b*.

The cooling medium, which may be water or air or air mixed with atomized water, is conducted through a pipe *c* into the rear and lowest end of one of the longitudinal branches A of the frame. These hollow longitudinal branches are provided with cross-partitions *d*, so as to cause the cooling medium to pass from the one longitudinal branch through the passage a^2 of one of the step-bars (or, if desired, through several bars) into the opposite longitudinal branch A, from here again through the next following group of step-bars back into the first longitudinal branch, and thus pass in the same zigzag current through the whole frame and out through the pipe *c'* back into the reservoir from which it had been drawn off The cooling medium is caused to flow in a direction opposite to the draft in the furnace, and thus the coolest portion of it is brought into contact with the hottest part of the grate, which it naturally cools, more or less, according to the difference in temperature in the two. With the absorption of heat and consequent dilatation of the cooling medium the rising tendency of the latter is increased, which causes a rapid passage of the cooling medium from the reservoir through all the parts of the fire-grate, and thereby cools effectually even the less-heated front bars of the grate.

The supporting-bars *f* of the movable grate having a to-and-fro sliding motion and at the same time an up-and-down motion are guided between guide-bars on the longitudinal branches A and are supported by quadrants *f'*, mounted on shafts f^2 and provided at their sides with toothed sectors f^3, adapted to engage with the teeth of the bars *f*, and thus cause the motions of the grate *b*. When the sliding grate is in its lowest position, it will be balanced by a counterweight f^4, whereby but little power is required to move the sliding bars.

The hollow longitudinal branches A of the frame are adapted to fit, with their exterior walls, the circular form of the furnace-walls, where such exist, as shown at Figs. 4 and 7. For boilers with vertical furnace-walls (see Figs. 10 and 11) the longitudinal branches A are of rectangular section.

In corrugated furnace-tubes, Figs. 4 and 7, the spaces between the corrugated walls and the branches A require to be filled in, so as not to impair the effectual working of the furnace. These spaces are closed by side flanges $a^\times$, which are entirely of solid material, and may be arranged on a level with the upper surface of the longitudinal branches A, Figs. 1 and 4. It is, however, more advantageous to arrange these flanges at an incline and so as to surpass in height the upper edges of the step-bars *a* and of the sliding bars *b*, as shown in Fig. 7. These flanges may, as shown at Figs. 6 and 7, be provided with openings, so as to cause an even combustion over the whole width of the grate.

The step-bars *a* in the arrangement represented at Figs. 1 to 7 are connected to the side branches A by two screw-bolts *s'*, (see Figs. 6 and 7,) while only one such screw-bolt *s'* is required in the arrangement represented at Figs. 10 and 11. These screws are easily removed when required for the purpose of removing and renewing one of the step-bars.

The quadrant-pieces *f'* at the front and rear, or in some instances those at the front only, are rounded at the front part f^4, Figs. 9 and 10, so as to enable them to be moved from the position shown in full lines to that shown in dotted lines, and thus enabling the sliding bars to be removed and also the screws *s'* to be loosened by a suitable spanner.

The sliding bars *b* of the movable grate in the furnace (shown at Figs. 1 and 2) are provided with rectangular openings as well as with recesses at the front edge. In some instances, however, they may only have the first-mentioned openings, and the edges surrounding these openings be of an increased height, (see Fig. 2,) so as to prevent the sliding bars from becoming warped by the heat.

The fuel is supplied to the furnace from a hopper *g*, arranged in front of the boiler above the grate. According to the arrangement shown in Fig. 1 this hopper is provided with bottom *g'*, inclined toward the rear. This bottom is adjustable by means of a weighted arm g^2. A balanced vertical plate g^3 at the rear of the hopper, together with the bottom *g'*, enables the supply of combustible material to be regulated according to the ad-

vancing movement of the same on the furnace-grate. The movable and adjustable bottom g' of the hopper g can also be arranged horizontally, as shown in Fig. 1ª. In this case instead of the weighted lever an oscillating slitted lever g^4 is provided, connected on one side with the bottom g' and on the other side with the adjusting-lever g^5. The displacement of the lever g^5 has for consequence also a displacement of the bottom g', whereby the feeding-aperture, and consequently also the supply of the fuel, is regulated in any desired manner.

The described manner of adjustment of the feeding-aperture within very large limits enables all sorts of solid fuel to be employed, such as wood-shavings, wood-dust, and cuttings, coal in its different forms—viz., dust, rubble, nuts, and cobbles, as well as coke and peat.

The ashes and clinkers are removed and thrown into the ash-pit by means of a sliding plate h, adapted to be moved by a lever h^2 against the inclined edge h' at the lower part of the fire-bridge, where the accumulated ashes are caused to fall down into the pit by simply sliding the plate h inward.

I claim—

1. In a horizontal water-bar grate, the combination with side bars and serrated, rearwardly-inclined connecting-bars water-cooled, of a series of similarly-inclined pusher members, one between each pair of water-bars, each of said members provided with perforations of sufficient length to never cut off draft through the grate, substantially as described.

2. In a horizontal water-bar grate, the combination with stationary side and stationary rearwardly-inclined, serrated water-bars; of a series of similarly-inclined balanced pusher-bars coöperating therewith and organized to produce a movement of the fuel from front to rear of the grate, each pusher-bar provided with slots of a length greater than the length of movement of said bars, substantially as and for the purpose set forth.

3. The combination with a fixed step-grate having inclined hollow grate-bars provided with a toothed or comb-like web, and a sliding grate having grate-bars sliding between those of the fixed grate, the faces of said sliding grate-bars being at all points parallel with the corresponding faces of the fixed grate-bars, said sliding bars having slots in line with the interspaces in the comb-like web of the fixed bars, said slots of such length as to prevent the movable bars, whatever their position relatively to the fixed bars, from covering the web interspaces of the latter, for the purpose set forth.

4. In a horizontal water-bar grate, the combination with stationary side and serrated, rearwardly-inclined, connecting water-bars, means for causing a cooling medium to circulate from the rear to the forward portion of said grate zigzag through the series of connecting water-bars, a series of balanced pusher-bars coöperating with the connecting water-bars, similarly inclined and organized to move fuel from front to rear of said grate, a fire-bridge and a dumping member between said fire bridge and grate organized to deliver ash into the pit, substantially as set forth.

5. In a furnace, a horizontal water-bar grate, serrated, rearwardly-inclined, water-cooled grate-bars, a series of similarly-inclined pusher-bars coöperating therewith, and a fuel feed-hopper and a pair of slides angular to one another, and independently adjustable to regulate the fuel-feed, substantially as described.

6. In a furnace, a horizontal water-bar grate, comprising serrated, rearwardly-inclined, water-cooled grate-bars, a series of similarly-inclined slotted pusher-bars coöperating therewith, organized to progressively move fuel from front to rear of the grate, each pusher-bar provided with slots longer than the length of its motion; in combination with a fire-bridge and a sliding plate between said fire bridge and grate organized to drop ash into the pit, substantially as described.

7. In a furnace, a horizontal grate, comprising a pair of longitudinal, and a series of rearwardly-inclined, serrated, connecting water-bars, means for circulating a cooling medium through the series of bars, a series of slotted pusher-bars coöperating with the water-bars, and similarly inclined, each of said pusher-bars having slots longer than the length of its motion, a lateral lug on each pusher-bar below the grate and an actuating member engaging said lugs and common to all the pusher-bars, substantially as described.

8. In furnaces having a fixed step-grate and a movable grate, the combination of the toothed sectors f' gearing with corresponding racks on the movable grate-frame f, the shafts f^2 mounted in hangers from the fixed grate-frame A whose bars are bolted thereto, whereby the sliding grate-bars may be removed from between the fixed grate-bars to afford ready access to the bolts and facilitate the removal of any one of the fixed grate-bars, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

FRITZ FRANZ MAIER.

Witnesses:
HARRY BELMONT,
DAVID ALRIN.