5 Sheets—Sheet 1.

T. VICARS, Sr. T. VICARS, Jr. & J. SMITH.

BOILER FURNACE.

No. 110,313. Patented Dec. 20, 1870.

Fig 1

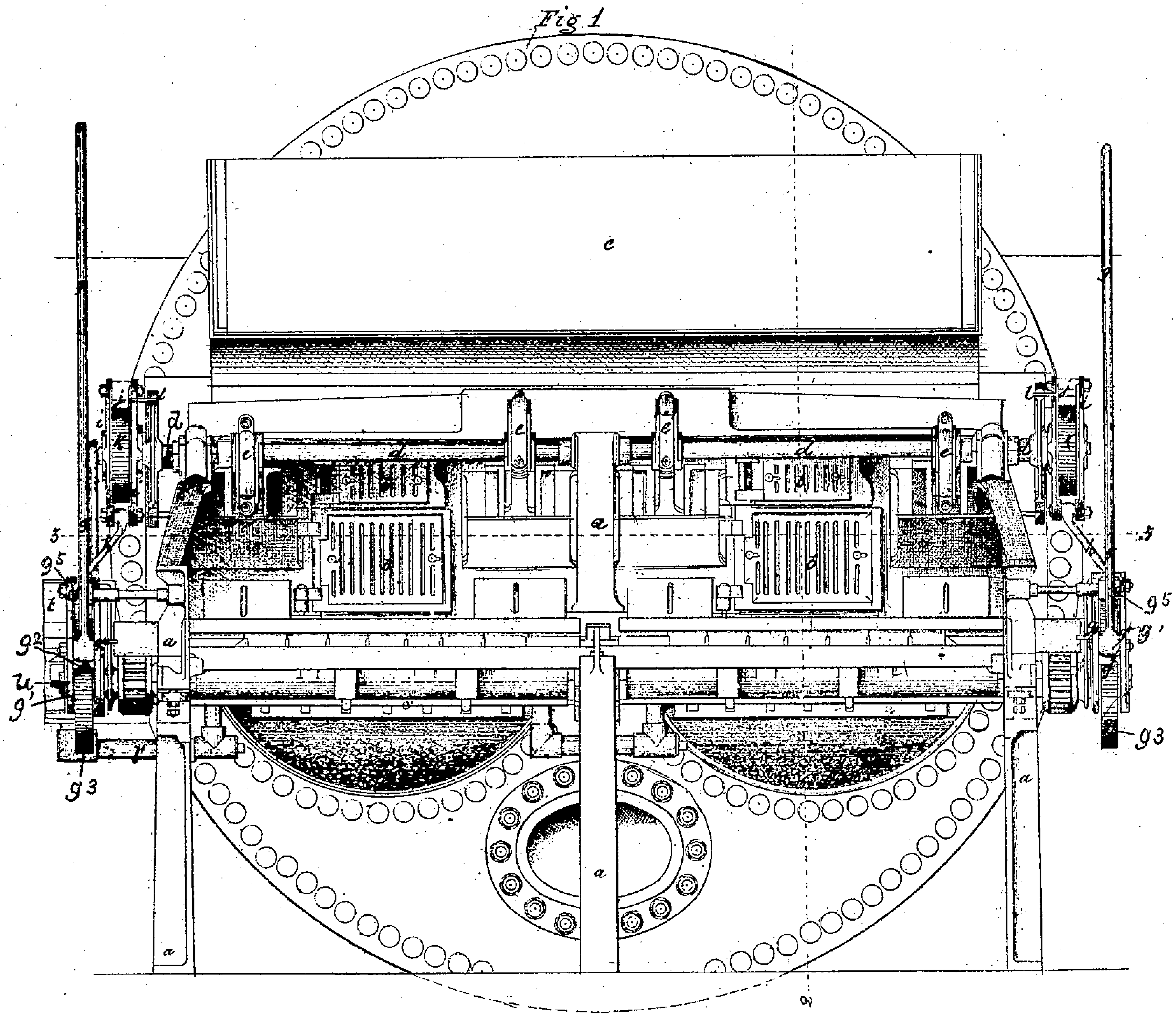
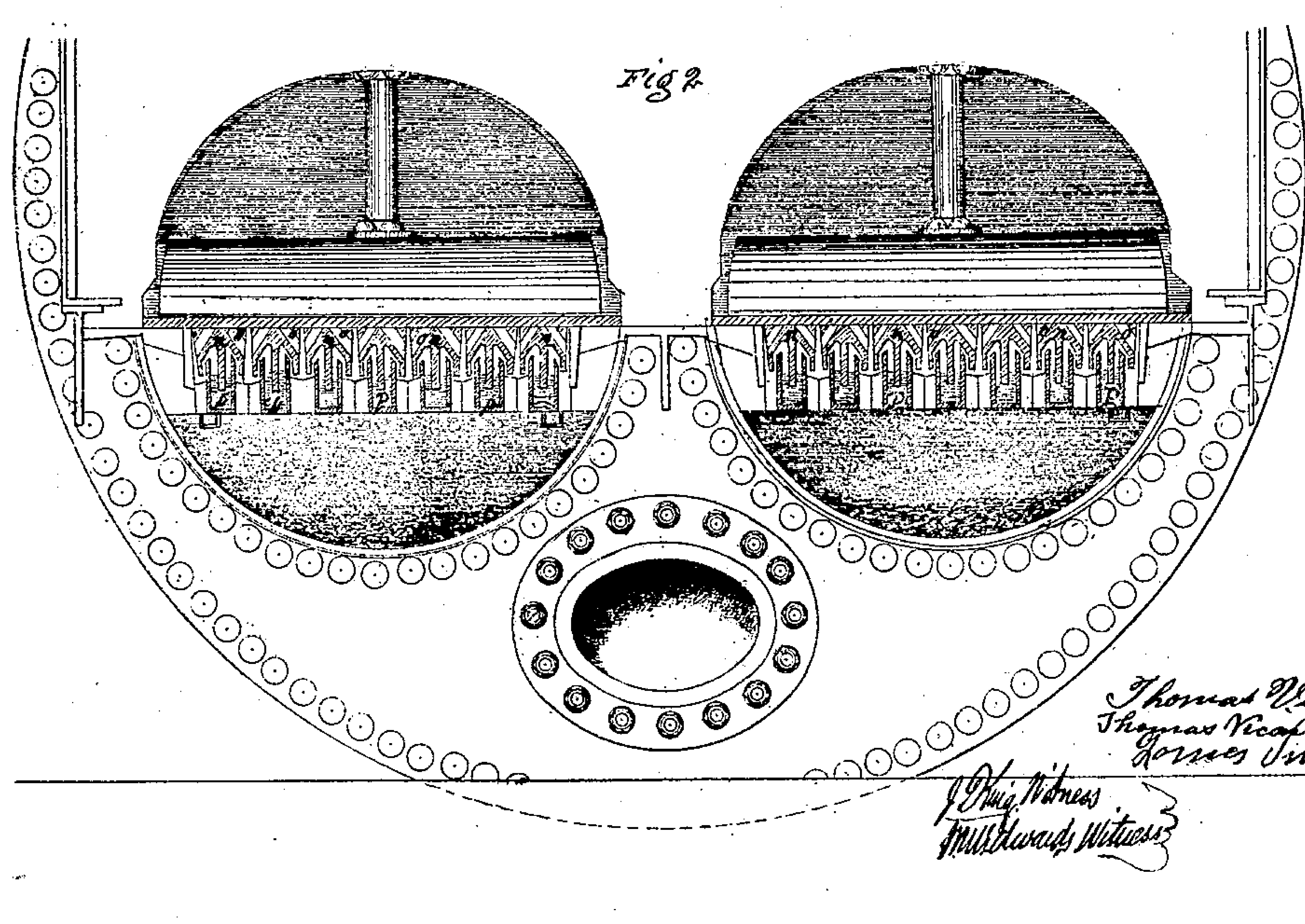


Fig 2



Thomas Vicars Sr
Thomas Vicars Younger
James Smith

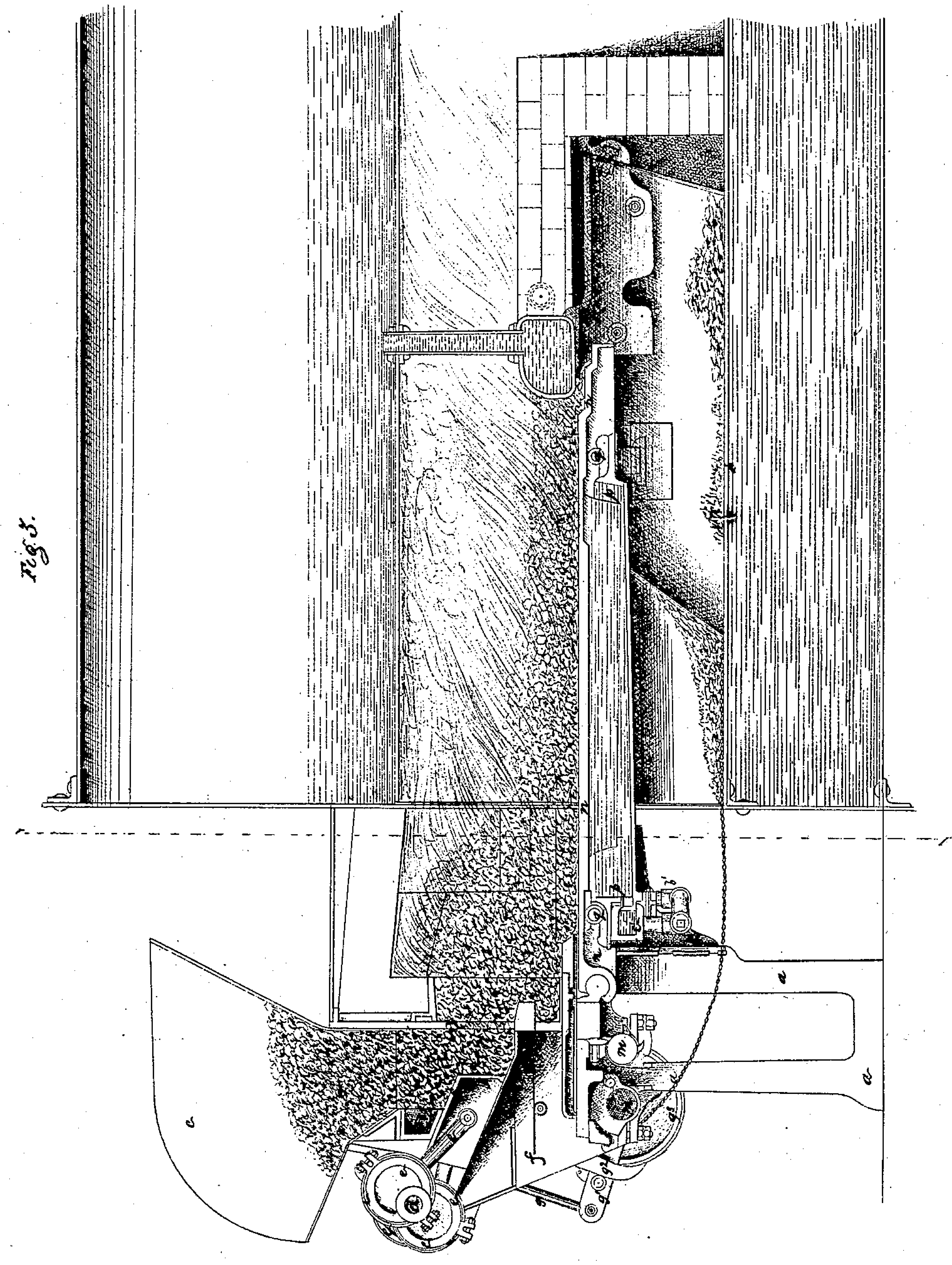
J. King Witness
M. Edwards Witness

5 Sheets—Sheet 2.

T. VICARS, Sr. T. VICARS, Jr. & J. SMITH.

BOILER FURNACE.

No. 110,313. Patented Dec. 20, 1870.

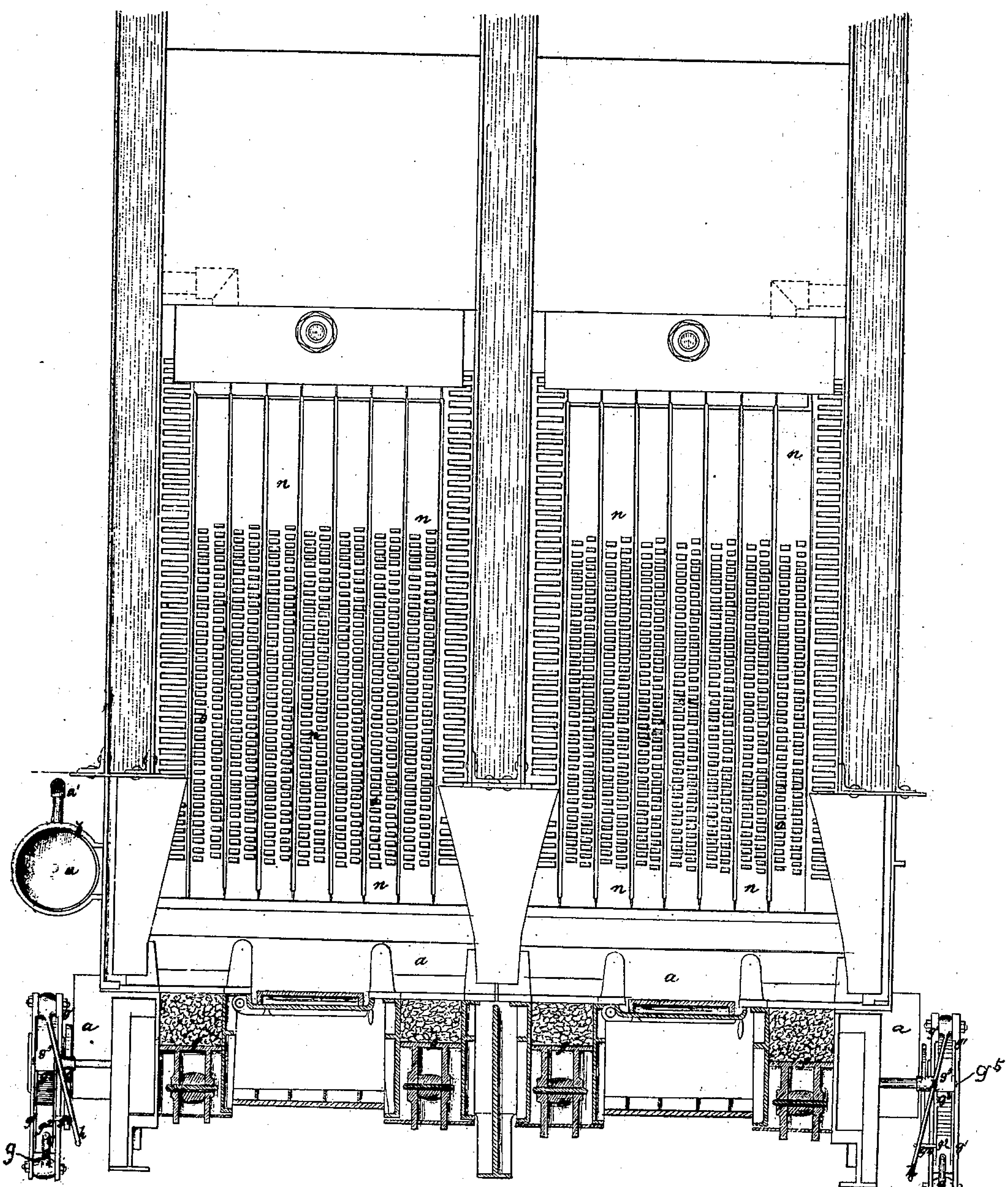


Thomas Vicars Sr
Thomas Vicars Junr
James Smith

T. VICARS, Sr. T. VICARS, Jr. & J. SMITH.

BOILER FURNACE.

No. 110,313. Patented Dec. 20, 1870.



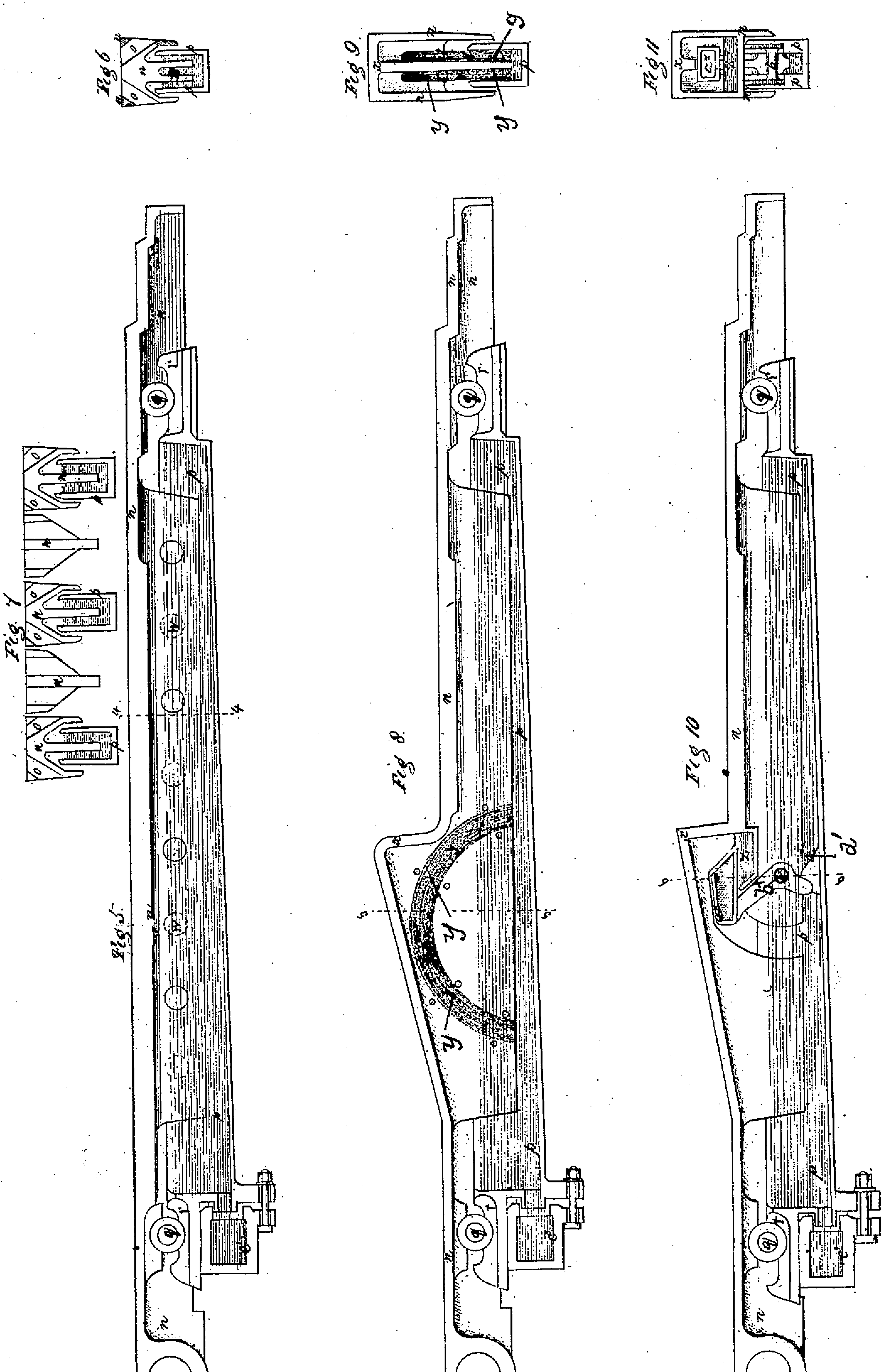
J. King Witness
Wm Edwards Witness

Thomas Vicars Sr
Thomas Vicars Younger
James Smith

T. VICARS, Sr. T. VICARS, Jr. & J. SMITH.

BOILER FURNACE.

No. 110,313. Patented Dec. 20, 1870.



J. D. King, Witness
W. Edwards, Witness

Thomas Vicars Sr
Thomas Vicars Younger
James Smith

5 Sheets—Sheet 5.

T. VICARS, Sr. T. VICARS, Jr. & J. SMITH.

BOILER FURNACE.

No. 110,313. Patented Dec. 20, 1870.

Fig. 13.

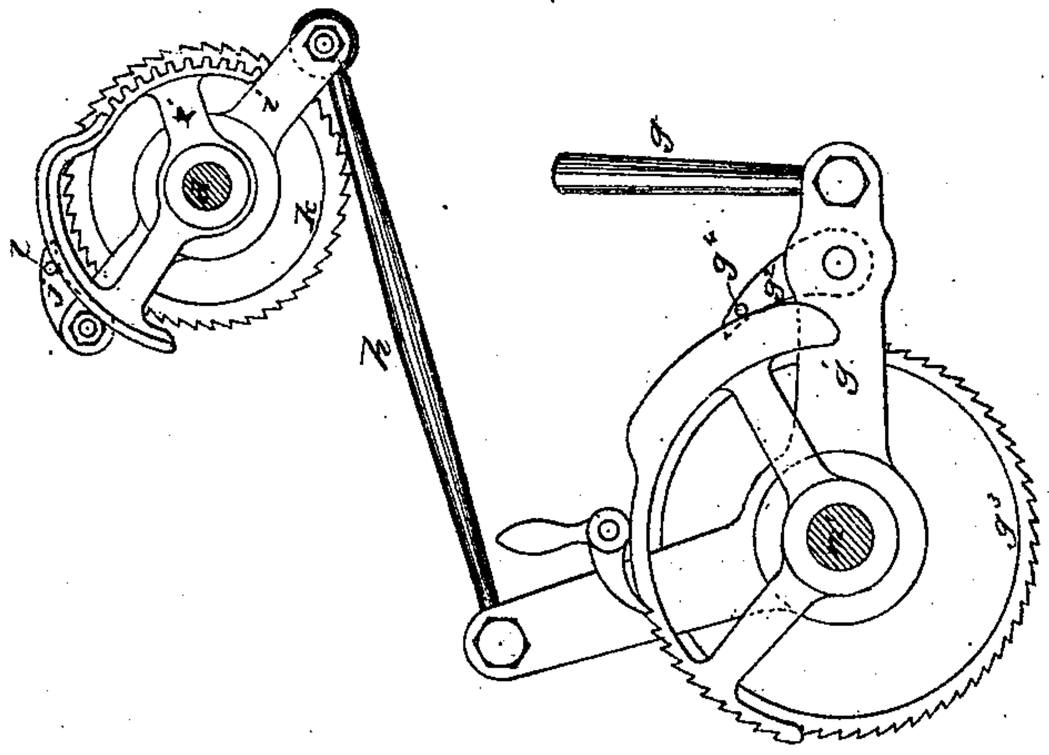
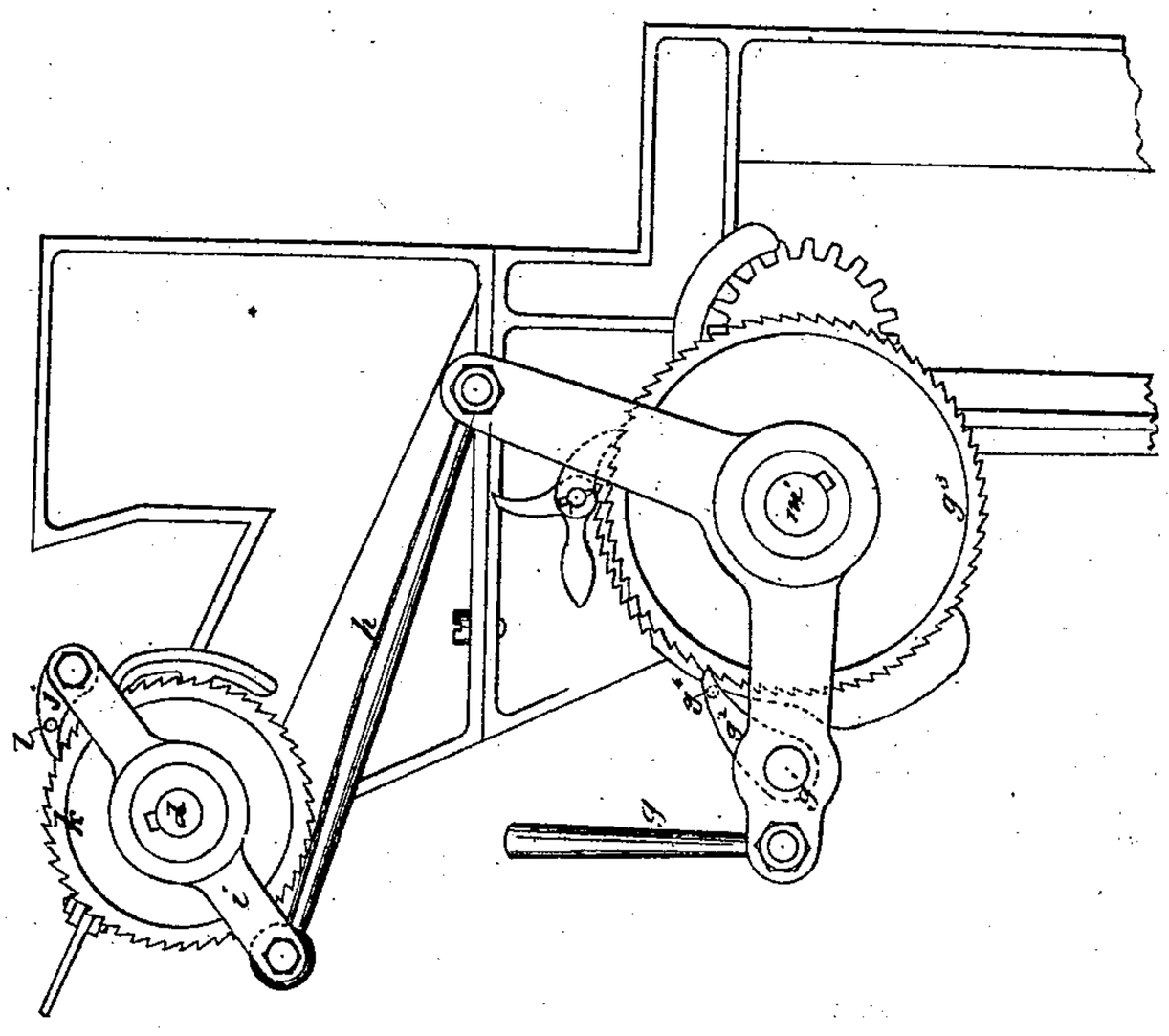


Fig. 12.



Witnesses:

Inventors:

United States Patent Office.

THOMAS VICARS, SR., THOMAS VICARS, JR., AND JAMES SMITH, OF LIVERPOOL, ENGLAND.

Letters Patent No. 110,313, dated December 20, 1870.

IMPROVEMENT IN BOILER-FURNACES.

The Schedule referred to in these Letters Patent and making part of the same.

To all whom it may concern:

Be it known that we, THOMAS VICARS the elder, and THOMAS VICARS the younger, and JAMES SMITH, all of Liverpool, in the county of Lancaster, England, have invented certain new and useful "Improvements in Self-feeding Smokeless Furnaces;" and we do hereby declare that the following is a full and ample description thereof, reference being had to the four sheets of illustrative drawings herewith which form part of this specification, and to the letters and figures marked thereon, that is to say—

We improve and add to that class of so-called self-feeding smokeless furnaces for heating purposes in which a progressive movement is given to the fuel from the front toward the rear of the furnace. The fire-grate for which we, VICARS, VICARS & SMITH, obtained Letters Patent of Great Britain, dated July 4th, 1867, No. 1,955, and the well-known Juckes' fire-grates, belong to the class.

We feed the fuel directly into and among the burning mass, at a certain distance above the fire-bars. The distance above the fire-bars will in all cases be determined by the quality or character of the fuel and the construction of the furnace. In externally-fired steam-boiler furnaces we find ten inches from the fire-bars to answer.

For this purpose we employ a reciprocating plunger, or push-piece, so fitted or adjusted that the amount of feed or quantity of fuel supplied can be varied at will.

We have also greatly facilitated the operation of the grate by introducing friction-rollers, properly protected.

We immerse the lower edges or under sides of the whole or part of the furnace fire-bars forming a grate, in water, with the object of making them last longer, and to prevent the adhesion of slag or clinker. To accomplish this each bar is provided with a trough, wherein water is maintained at the desired level by a float acting directly on a valve in the water-supply pipe or cistern, or by any other suitable means.

The bars are formed with flanges or ribs on their sides, to serve as covers for the troughs; or they are so passed into the troughs as to prevent dust and ashes from falling into them.

We form furnace-bars, the lower edges or under sides whereof are immersed in or dip into water, with cavities or passages through which water is allowed to circulate or flow from the troughs.

We provide, by means of a movable damper under the grate, for excluding the air at will from the back part of the grate.

The front part of the grate is always efficient. By opening the damper the back part of the grate may be also made effective; or by closing the said damper the back part will be deprived of air and little or no combustion will take place there.

This provision is very important when, in consequence of slow feeding or other cause, the back portion of the grate becomes only partially covered with fuel or cinders, it prevents the air under such conditions flowing up through the nearly-naked places, while it compels the air to rise through the thicker covered portions of the front with its proper effect.

We prefer to use a wide bar formed with open spaces inclined inward from the sides, to allow air to enter upward and to be properly distributed there, and the dust and ashes to fall through into the pit without contact with the water-vessels.

Sheets A, B, C, and D of the drawing illustrates details applied to a steam-boiler constructed with two fire-places.

Figure 1 is a front elevation.

Figure 2, a vertical transverse section at the line 1 1, in fig. 3.

Figure 3, a vertical longitudinal section at line 2 2 in fig. 1.

Figure 4, a horizontal section at the line 3 3 in fig. 1.

Figures 12 and 13 show details on a large scale. Fig. 12 is an outside and fig. 13 an inside view. They represent the mechanism for operating the shafts *m* and *d*.

In all these views like letters denote the same parts.

Of the mechanism which more particularly belongs to and operates under and with our invention—

a is the supporting frame.

b, hinged fire-doors; two are shown for each fire-place.

c, fuel-container or hopper.

d, shaft, made to rotate by an intermittent motion.

The said shaft *d* gives, by the eccentrics, straps, and rods *e*, motion to the fuel-feed plungers or push-pieces *f*. In the size of furnace and arrangement delineated, four of these plungers or push-pieces are shown; but it will be obvious any convenient greater or lesser number may be used. With Lancashire slack of ordinary quality on the two grates shown, these being of medium area and in connection with an average draught, we have found about one hundred and twenty strokes of four inches each per hour, that is to say, one hundred and twenty distinct portions (or sixty to each grate) fed or forced in during that time, to answer well.

In practice, the coal-slack or fuel does not fall onto

the progressive motion fire-grate, but is forced into and among the burning mass.

In the drawing—

The distance from the lower edges of the plungers or push-pieces to the upper surfaces of the fire-bars is seven and one-half inches, so that in the furnace immediately in front of the said plungers or push-pieces there is a large body of fuel in combustion. With bituminous fuel we have found, in fact, that at the fronts of the plungers or push-pieces the fuel becomes coked, is subjected to a process of destructive distillation, and that the gases thereby evolved or liberated are in a highly-heated and fit condition to freely combine with the oxygen admitted, and hence most effective and economical combustion is induced.

The mechanism by which intermittent rotary motion is communicated to the shaft *d* is actuated indirectly, that is to say, from the parts employed to operate the fire-bars. But we would have it understood that the motion may be communicated direct, any available motive power being used to give the proper reciprocating motion to the rod *h*.

The parts employed to give the motion to the fire-bars are those described and claimed in the specification of the invention for which Letters Patent of Great Britain were granted to VICARS, VICARS & SMITH, as aforesaid, in 1867.

These consist of the first motion-reciprocating connecting-rods *g*, rocking side-levers g^1, impulse-pallets g^2, ratchet-wheels g^3, lever with carved head or adjustable guard g^4 to regulate the movement of the bars, and pallet or pawl g^5 mounted on a fixed center.

Duplicates of these parts are fitted to and with the shaft *d* for the purpose of imparting motion thereto. Thus, *h* are reciprocating connecting-rods; *i*, rocking side-levers; *j*, impulse-pallets; *k*, ratchet-wheels; *l*, curved levers acting on studs fitted in the impulse-pallets.

The connecting-rods *h*, by being coupled nearer to or further from the end or ends of g^1 or *i*, will give more or less throw to *i*, and hence will vary the travel of *j*, and the resulting movements of *k*, *d*, and *f*, and the fuel forced in by the latter will be augmented or diminished.

But we prefer the arrangement for adjusting by the guards or curved levers first described, as thereby we can increase or decrease the speed of the bar, tappet-shaft, or the shaft *d* and the plungers or push-pieces *f*, at will, by simply adjusting the levers with curved heads g^4 *l*.

The amount of feed allowed to fall from the hopper in front of the plungers or push-pieces, to be afterward forced in by them over the fire-grate, can be adjusted by the means described with great delicacy, so as to suit the character of the fuel, the amount of draught, the state of the atmosphere, and the other conditions incident to combustion in furnaces. Of the mechanism g g^1 g^2 and g^3 are the bar-actuating parts above described; *m*, tappet-shafts; *p*, troughs to contain water; *n*, fire-bars; these are formed as shown, with outward and downward-projecting flanges or ribs which fit over the sides of the water-troughs, shortly to be mentioned, and with a large number of openings, marked *o*, seen best in fig. 4, to serve for the admission of air and steam upward into, among, and through the incandescent fuel.

One of the troughs *p*, combined with a fire-bar, *n*, is drawn to a larger scale on sheet D, where fig. 5 is a longitudinal section and fig. 6 a transverse section at the line 4 4.

The lower edge of the midfeather of the fire-bar *n* dips into and is immersed in the water in the trough *p*, but such midfeather does not reach the bottom. The object of this arrangement is to obviate friction. To reduce such friction to a minimum, we interpose friction-rollers, *q*, between the bearers *p* and the bars *n*.

A damper, *s*, is fitted to serve, as represented, under the grate-bars, to shut off air, when desired, from the back part of the bars.

To maintain the level of the water in troughs *p* at a uniform height, we employ a cistern, *t*, provided with a self-acting controlling float, *u*, connected to a valve fitted in or to the source of water supply or cistern, with a ball-cock; or a valve of any of the ordinary well-known constructions can be used for this purpose.

Should the character of the fuel evaporate a large quantity of water, then the float falls, opens a taper-valve, (not represented,) and increases the supply; but should the quantity evaporated be reduced, from any cause, then the float will rise and the supply be reduced.

This cistern or valve-chamber *t* is supplied by the pipe, *a'*, from a reservoir or other water supply; and the water is conducted from the valve-chamber through a pipe, *b'*, to a hollow transverse bar, *c'*, or channel, which communicates with all the water-troughs *p*, as shown in figs. 1, 3, 4, 5, 8, and 10.

Figure 7 illustrates the said traveling bars, with water-troughs placed alternately, with ordinary traveling or stationary bars not provided with such cooling means.

Further details of our mechanism are illustrated on sheet D by figs. 5 and 6: *v*, cavity formed in the midfeather of the bar; this is open at the lower end to the water, and may be continuous from end to end; or there may be one, two, or more connecting pieces cast therein so as to form several cavities; *w* are transverse passages formed through the midfeather, whether the same be made single or double.

Modifications which we esteem of some value are also illustrated on sheet D.

Figure 8 is a longitudinal section through a fire-bar, *n*, and its trough *p*, and

Figure 9 is a transverse line at the line 5 5.

x is a raised projection or poker. In practice, two or more of the bars in a furnace of ordinary size would be fitted with these pokers.

y denotes a bundle of iron or other wire fitted in a cavity or passage formed in the said poker *x*. The said wire serves, by capillary attraction, to convey water from the trough *p* upward, to prevent damage to the poker by the heat of the fire.

Figure 10 is a longitudinal section, and Figure 11 a transverse section at the line 6 6, of another similar bar *n* and trough *p*.

The poker *x*, however, is here kept cool by water in bulk, supplied to a container, *g*, attached to the bar *n*, from the trough *p*, by a tumbling scoop, $a^{\times}$, hinged at $b^{\times}$ to the bar *n*, just below the container *z*. As the bar *n* travels toward the fire-door, the said scoop falls by gravity into the water and becomes filled; but on the return stroke the scoop is raised into the position shown on the drawing by the contact of its lower end with a stationary projection, D', on the bottom of the trough *p*, and made to deliver its contents to the container *z*.

Having now described the nature of our said invention, and particularly ascertained the same by details which we have found to answer well in practice, we would have it understood that we do not confine ourselves to the exact details of parts shown, as these may be considerably modified without departing from the leading features of our invention. For instance, we have only delineated our improvements applied to and in connection with certain furnaces; but it will be perfectly obvious that they are equally applicable to the whole class of self-feeding smokeless furnaces in which a progressive motion is given to the fuel.

We do not claim in this application the peculiarities of the grate-bars themselves, intending to make further application for Letters Patent in which some or all these shall be claimed; but

What we do claim is—

1. The combination of the ratchets *k*, vibrating pawl *j*, and adjustable guard *l*, arranged to operate relatively to each other and to the reciprocating rod *h*, and to means for moving fuel into or within a furnace, substantially as herein specified.

2. The combination of the hopper *c*, shaft *d*, eccentrics, straps, and rods *e*, pushers *f*, sliding grate-bars, shafts *m m*, and the adjustable guard g^4, pawl g^5, impulse-pallet g^2, and ratchet-wheel g^3, for impairting motion to the said shaft *m* and to the shaft *d*, all operating substantially as herein described for the purpose specified.

3. The damper *s*, arranged and operated as represented relatively to the grate or grates *n*, so as to render available for combustion either the whole surface of the grate or only the front portion, at will, as specified.

In testimony whereof we have hereunto set our names in presence of two subscribing witnesses.

THOMAS VICARS, ER.
THOMAS VICARS, YOUNGER.
JAMES SMITH.

Witnesses:
J. S. KING,
W. M. EDWARDS.