(No Model.)

3 Sheets—Sheet 1.

R. H. WILLIAMSON.

AUTOMATIC STOKING APPARATUS.

No. 546,371. Patented Sept. 17, 1895.

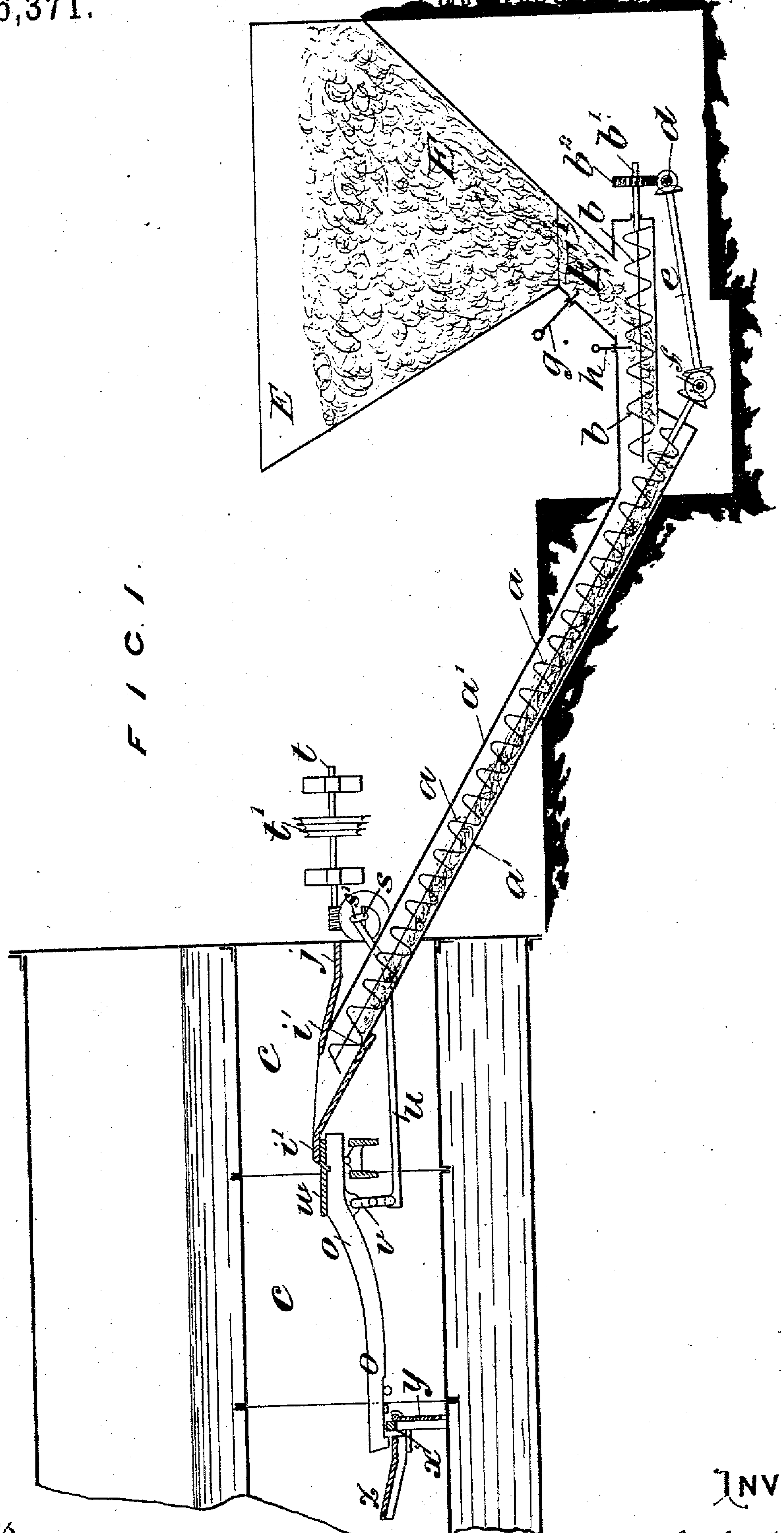

FIG. 1.

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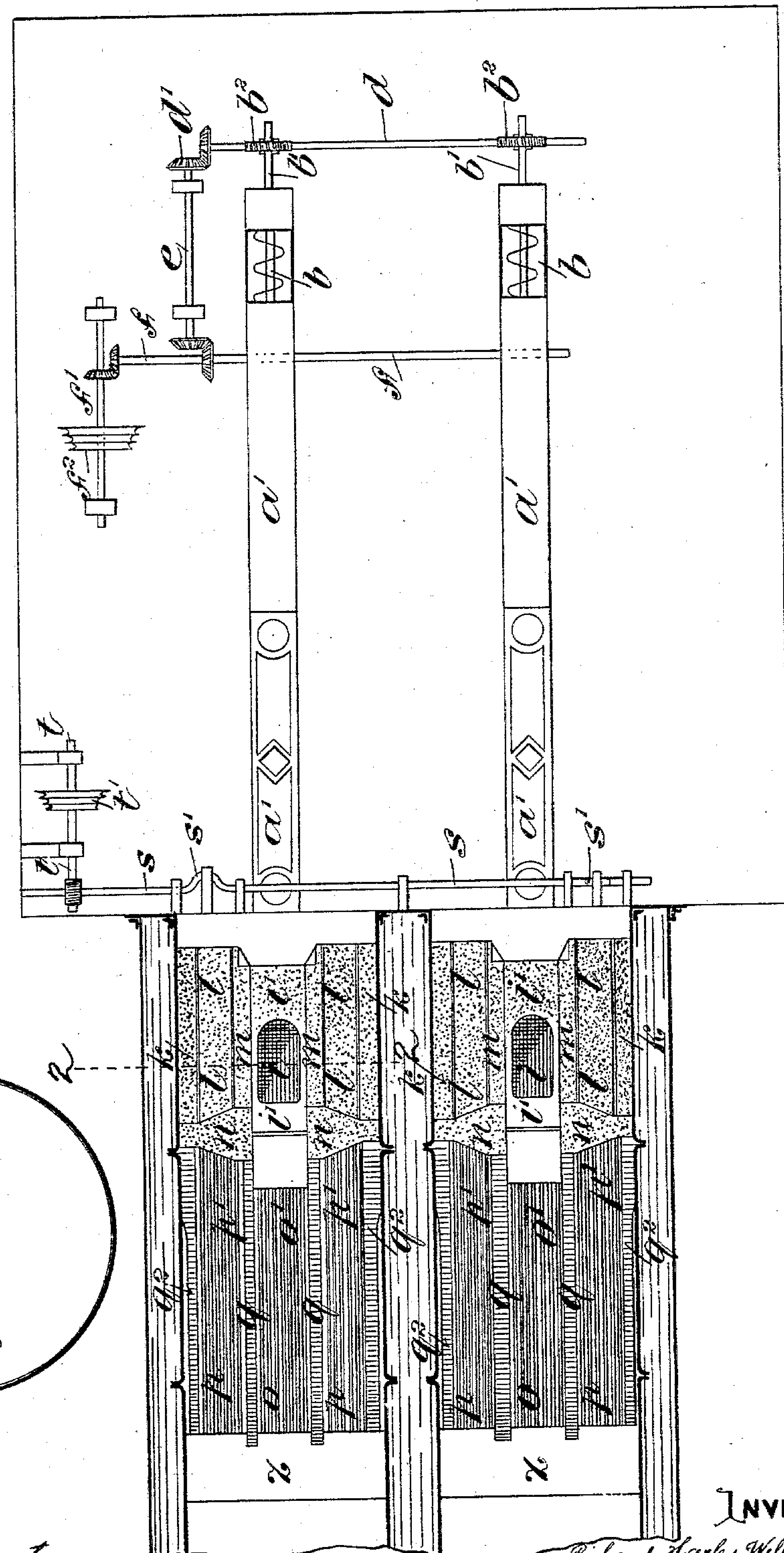

FIG. 2.

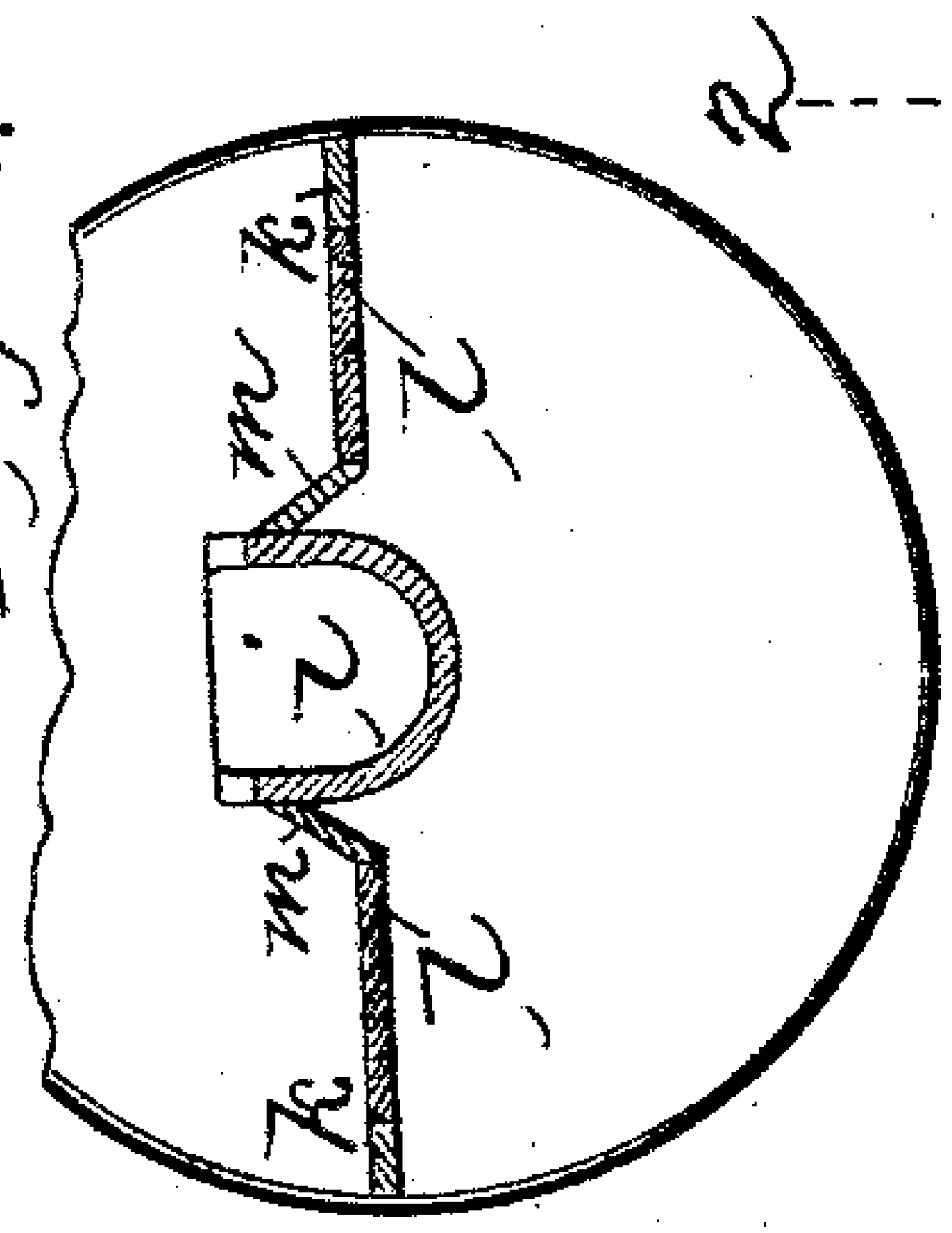

Fig. 2a.

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(No Model.) 3 Sheets—Sheet 3.

R. H. WILLIAMSON.

AUTOMATIC STOKING APPARATUS.

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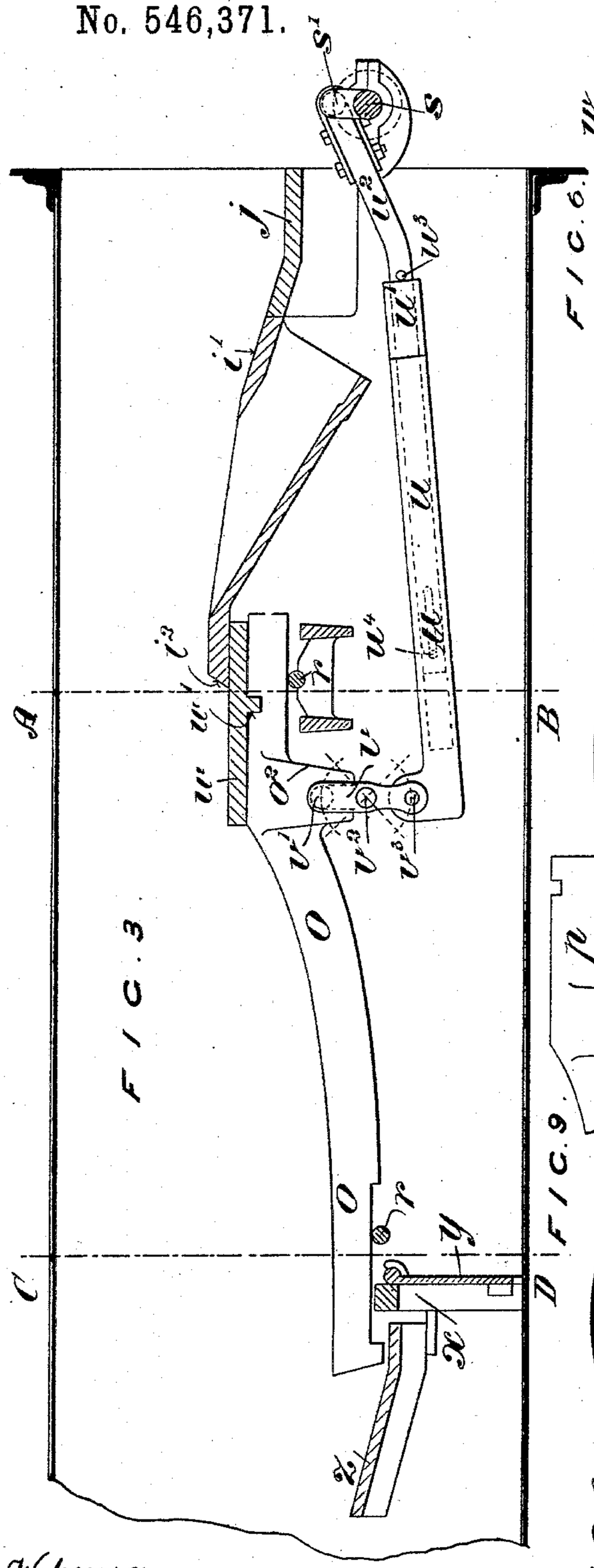

FIG. 3.

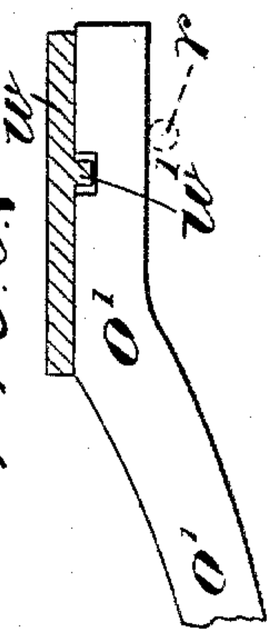

FIG. 6.

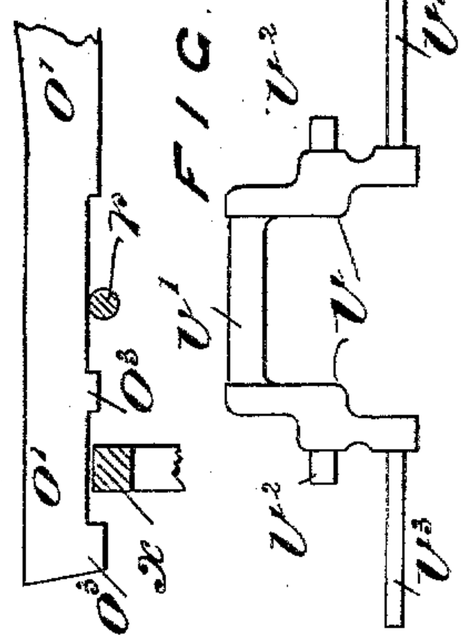

FIG. 7.

FIG. 8.

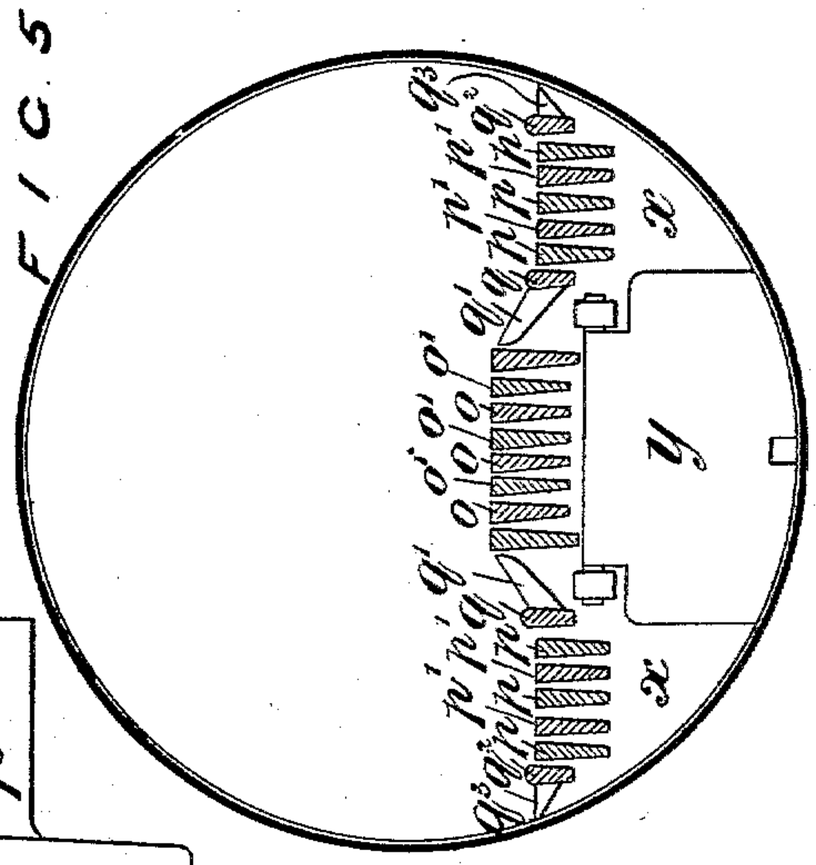

FIG. 5.

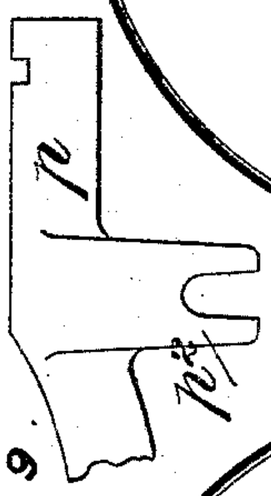

FIG. 9.

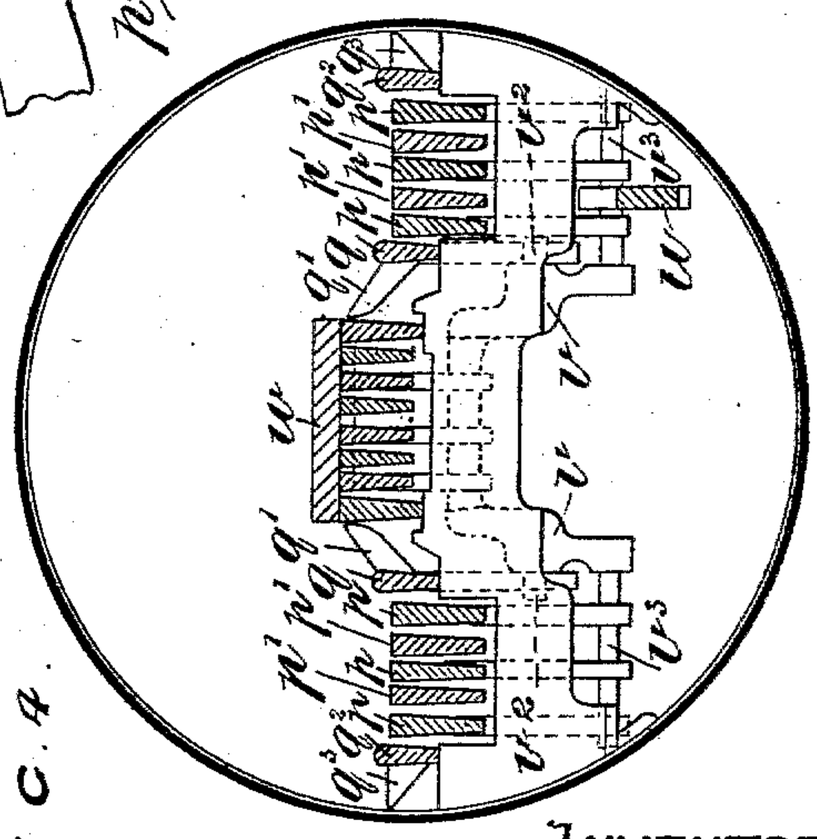

FIG. 4.

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UNITED STATES PATENT OFFICE.

RICHARD HARLEY WILLIAMSON, OF ASHTON-UNDER-LYNE, ASSIGNOR TO THE DIRECT AUTOMATIC STOKER SYNDICATE, LIMITED, OF MANCHESTER, ENGLAND.

AUTOMATIC STOKING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 546,371, dated September 17, 1895.

Application filed December 18, 1894. Serial No. 532,223. (No model.) Patented in England October 24, 1894, No. 20,320.

To all whom it may concern:

Be it known that I, RICHARD HARLEY WILLIAMSON, a subject of the Queen of Great Britain, residing at Ashton-under-Lyne, in the county of Lancaster, England, have invented certain new and useful Improvements in Automatic Stoking Apparatus and in the Grates and Fire-Bars of Steam-Generators and other Furnaces, (for which a patent has been granted in Great Britain, No. 20,320, dated October 24, 1894,) of which the following is a specification.

My invention relates to certain improvements in automatic stoking apparatus, whereby I am enabled to carry into practical effect certain convenient and economical modes of moving the fuel from a bunker, hopper, or heap to a spiral or other conveyer by which the fuel is carried to the furnace-grate.

The invention also refers to improvements in the construction, operation, and arrangement of the bars and other parts composing the furnace-grate.

To render the whole matter clear to the reader, I have attached to this specification three sheets of drawings, to which I will hereinafter refer.

Figure 1 is a general sectional view showing the working of the whole apparatus. Fig. 2 is a general plan view, also partly in section. Fig 2^a is a sectional view on line $x\,x$ of Fig. 2. Fig. 3 is an enlarged sectional view which shows the construction, arrangement, and operation of the bars and other parts more clearly than in Fig. 1. Fig. 4 is a cross-section of Fig. 3 at the line A B. Fig. 5 is a similar cross-section at the line C D, Fig. 3. Fig. 6 is a view of the front end of one of these bars in the central set which are not positively driven. Fig. 7 is a view of the rear end of the bar shown at Fig. 6. Fig. 8 is a view of the double rocking lever which moves the positively-driven bars. Fig. 9 is a view of the front end of one of the positively-driven bars of the side sets.

The bunker containing the fuel is marked E. To move the fuel from the bunker E to the conveyer *a*, I make use of a horizontal spiral or screw traverser *b*, arranged at the foot of the chute E′, which opens from the bottom of the fuel-bunker E. The spiral traverser *b* extends to the lower end or to any convenient point in the length of the inclined spiral conveyer *a* and its casing, by which the fuel is carried to the furnace-grate *c*. The employment of the said horizontal spiral traverser *b* gives a steady and equal feed of fuel to the inclined spiral conveyer; but I do not absolutely confine myself to this, as a reciprocating-pusher or a traversing apron or chain might be used for the same purpose. The shaft *b′* of the spiral traverser *b* carries a worm-wheel b^2, which gears with a worm on a shaft *d*, which receives motion through bevel-gearing *d* from the side counter-shaft *e*, which is in its turn driven by bevel-gearing *e′* from the shaft *f*, which drives the inclined spiral conveyer *a*, which raises the fuel to the furnace-grate. The shaft *f* is actuated from a short shaft *f′*, driven by a pulley f^2. A sliding shutter *g* is placed in the bunker-chute E′ to shut off the supply of fuel entirely when desired, and in addition to this shutter *g* the mouth of the chute is also furnished with a shutter *h*, which enables the quantity of fuel advanced by the spiral traverser *b* to be accurately adjusted. The spiral conveyer and traverser are boxed in by suitable casings, and the casing *a′* of the spiral conveyers *a* rise at an angle from the well in front of the boilers, and so as not to interfere with the free movements of the attendant or attendants in charge of the boilers. Upon reaching the grate the casing *a′* joins a specially-formed mouth *i*, which opens into the front of the grate and through which the fuel is pushed by the spiral conveyer *a*. The mouth *i* carries a separate plate *i′*, this plate forming a portion of the floor of what we term a "coking-chamber," situated in front of the bars of the furnace-grate, and in which the fuel is partially coked before being moved upon the bars proper. The plate *i′* can be removed and replaced without disturbing the mouth *i*. If the reader will refer to the plan view, Fig. 2, he will observe that the front portion of the grate is composed of a number of plates, which are for the most part perforated

with a series of holes large enough to let a sufficiency of air through and also to shed fine ash, but not so large as to let any of the freshly-fed or green fuel fall through. The plate i' forms one of these floor-plates. The dead-plate is marked j. There are also side plates k, rolling plates l, angle-plates m, and saddle-plates n, the arrangement and functions of which will be more apparent as this description proceeds. Suffice it to say, in the meantime, that the united plates form a partly-movable and partly-fixed floor to the coking-chamber. The fuel is drawn forward from the coking-chamber by the movements of the fire-bars, which consist of a center set $o\ o'$ and $p\ p'$. The central set lies at a higher level than the side sets, as plainly seen from Figs. 4 and 5, and the gaps between the central and side sets are occupied by bars q, which carry fingers q', extending at an angle from the bars q and bridging the spaces between the sets, or perforated plates might be used for the bars q. The spaces between the sides of the side sets, of bars and the side of the flue are also occupied by bars q^2, having horizontal fingers q^3, which bridge the said spaces. The central set of bars $o\ o'$ is carried on rollers r, which permit of easy to-and-fro motion of the bars. It may be noted here that of the central bars the bars o receive positive to-and-fro motion from a crank-shaft s, arranged in front of the grate and driven by a worm on the shaft t, carrying the pulley t', as clearly apparent from Figs. 1 and 2. A connecting-rod u extends from each crank s' beneath each furnace-grate, and engages with a double rocking-lever v, the pivots v^2 of which are supported in snugs projecting from the bridge-bars q, as shown in Fig. 4.

In order to disconnect the bars from the crank-shaft s when desired, we place a saddle-block u' over the wrought-iron rod u^2 and between the pin u^3 and the end of the cast-iron sleeve u. When the block is in place, the whole connecting-rod forms practically one piece, but when the block is removed the rod u^2 slides to and fro on the pin u^4, which passes through a slot in the end of the rod u. The upper cranked end v' of the rocking-lever v engages with jawed snugs o^2, projecting downward from the bars o, these being alternately placed with the bars o'. (See Figs. 4 and 5.) Thus half of the number of the central set of bars—that is to say, the bars o—are positively moved by the to-and-fro motion of the cranked rocking-lever. Across the front ends of the bars o we lay a plate w with a rib w' extending across the cranked rocking-lever. Across the front ends of the bars o we lay a plate w with a rib w' extending across the under side. This rib passes through and occupies slots formed in the positively-moved bars o and thus locks them together, the plate w moving to and fro with the bars o and sliding beneath the front portion of the mouth-plate i'. The alternate bars o', which are not connected to the rocking-lever v, are moved either by frictional contact with the moving-bars o or by the aforesaid rib w' on the plate w, the said rib occupying longer clearing-slots in the front ends of the bars o', as shown in Fig. 6, and serving at times to jog or move the said alternate frictional-bars o' in one direction or the other. As the rib has a clearing-space on each side when in the slots of the friction-bars o', these bars are moved to a more limited extent than the bars o, which are positively reciprocated by the double-cranked lever v. As a rule, when at work the alternate friction-bars o' are moved to and fro by mere frictional contact, and to limit their play when such is the case I form the rear ends of the bars, as shown at Fig. 7, with abutments o^3 and interpose a stop x, which prevents the friction-bars from moving in either direction more than a certain and fixed limited extent. As in the case of the bars o, the friction-bars o' also rest and roll on the antifrictional rollers r. Thus there is a differential motion between each alternate bar of the central set, and clinkers are more readily broken up and the fire kept lively. As already stated, the central set of bars $o\ o'$ is flanked on each side by a set of side bars $p\ p'$, the said side bars lying at a lower level than the central set. The spaces between the central and side sets of bars are bridged by the bars q, with angular fingers q', and the spaces between the outer bars of the side sets and the sides of the boiler-flue are also bridged by bars q^2 of a similar make, with the exception that the fingers q^3 lie horizontally. The side sets of bars $p\ p'$ are moved in a reverse direction to the central set and are operated by crank-pins v^3, which might carry antifriction sleeves, and which extend from each side of the lower vibrating ends of the cranked rocking-lever v and engage with jawed snugs p^2, which extend downward from the bars p, as shown in Fig. 9. Each alternate bar p is thus positively moved by the rocking-lever v just as the bars o of the central set are positively moved, but in the reverse direction. The friction-bars p' are not similarly positively moved, but are moved in the same manner as the friction-bars o' of the central set. The rolling plates l are formed with ribs, which engage with slots in the side sets of bars $p\ p'$, the said slots fitting the ribs in the case of the positively-moved bars p and having clearance in the case of the friction-bars p'. In short, there is no difference in the method of actuating the side bars from the already explained method of operating the central bars. The rolling plates l extend up to the dead-plate j and are supported at the front by antifriction-rollers, which need not be shown. Fixed side plates k (see Fig. 2) fill up the spaces between the rolling plates l and the sides of the flue, while inclined angle-plates m occupy the spaces between the mouth-plate i and the rolling plates l. In the case of the central set of bars $o\ o'$, the forward motion of the bars, combined with the curved droop or fall of the bars, causes the

fuel to be fed or moved forward. On the return stroke of the bars and plate *w* the front edges i^2 of the mouth-plate *i'* prevents the fuel from returning with the plate *w*, so that the next forward stroke of the bars carries the fuel farther forward and causes it to advance as it is consumed. The same operation goes on in the case of the side bars, and to present an obstacle to the return of the fuel on the inward stroke of the side bars we provide saddle-plates *n*, which extend across the rolling plates and side bars and so obstruct the return of the fuel. While this forward feeding of the fuel is being carried on by the bars, the spiral conveyer continuously lifts the adjusted proportions of fuel from the bunker or heap and deposits it in the coking-chamber, where it is partially coked before being moved forward by the bars. At the rear of the bars is a frame *x*, the top of which acts as a stop to limit the play of the friction-bars. The frame contains a swing-door *y*, which can be opened by a chain from the front of the grate, so as to permit of ready cleansing and raking out of the clinkers and ash. Behind the bars is situated an upwardly-sloping shelf *z*, upon which the burned clinkers and ash drop from the ends of the bars, and up which they are pushed by the motions of the bars until they drop over the edge of the shelf into the furnace-flue, from whence they can be raked through the swing-door and removed. A bridge is or may be placed at a suitable distance behind the shelf *z*.

Although I have referred to the arrangements as more particularly applicable to the furnaces of steam-generators, the same might be used in the construction and operation of furnaces other than those used for steam-raising purposes.

I claim—

1. In combination in a furnace, the reciprocating grate, means for operating the same, the feed mouth *i* at one end of the grate and the ledge i^2 over the grate bars and means for feeding the fuel up through the feed mouth and over the ledge i^2, the said grate bars extending and working beneath the said overhanging ledge i^2, substantially as described.

2. In combination in a furnace, the grate bars and the plates *i* having feeding openings, the rolling plates *l* and the plates *k*, *m*, forming a floor for a coking chamber, substantially as described.

3. In combination in a furnace, the reciprocating grate bars having notches, the plate extending across the bars having a rib fitting in the notches and a second series of bars having wider notches to receive a limited amount of movement from the plate and means of operating the bars, substantially as described.

4. In combination in a furnace, the reciprocating grate bars, the bearings therefor, and means for operating the bars comprising the rod *u*, the rod u^2 having a sliding connection therewith and the removable collar *u'* with means for holding the same in place.

5. In combination in a furnace, the reciprocating bars having notches the plate *w* extending across the bars having a rib engaging the notches, means for operating the bars and the ledge i^2 under which the plate *w* extends, substantially as described.

6. In combination in a furnace, the grate comprising the elevated section of bars, the side sections in a lower plane, the saddle plates *n* over the side sections, the mouth plate *i'* over the elevated section of bars and means for operating the bars.

7. In combination in a furnace, the grate bars, with means for moving them lengthwise and the upwardly sloping shelf at the rear end of the grate bars, said shelf being below the bars whereby the rear ends of the bars will act directly upon the material on the shelf, substantially as described.

8. In combination in a furnace, the reciprocating grate bars, a coking chamber at the front end of said bars having a floor composed of plates with small perforations therein, said plates being arranged in different horizontal planes to provide a central elevated portion, the feed mouth opening up through the said coking chamber floor at the central elevated portion and means for reciprocating the grate bars below the plane of the said floor, substantially as described.

9. In combination, the central elevated section of grate bars, the side sections in a lower plane, means for reciprocating the bars, the feed mouth opening up in front of the elevated section and means for feeding the fuel through the same, substantially as described.

10. In combination, the central elevated section of grate bars, the side sections in a lower plane, the means for reciprocating the grate bars, the feed mouth *i'* and ledge i^2 extending over the central elevated sections of bars and the plates *l*, *k*, *m*, arranged laterally of the feed mouth, and in line with the lower section of bars, said plates forming the floor of a coking chamber at the front ends of the grate bars, substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

RICHARD HARLEY WILLIAMSON.

Witnesses:
DAVID FULTON,
FREDERIC HARRISON.