

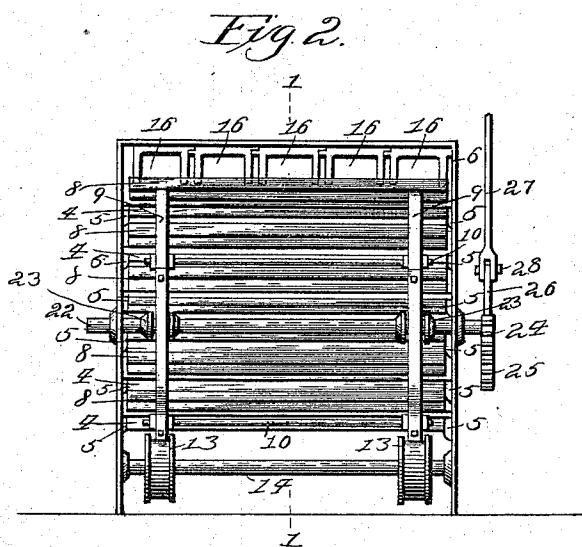
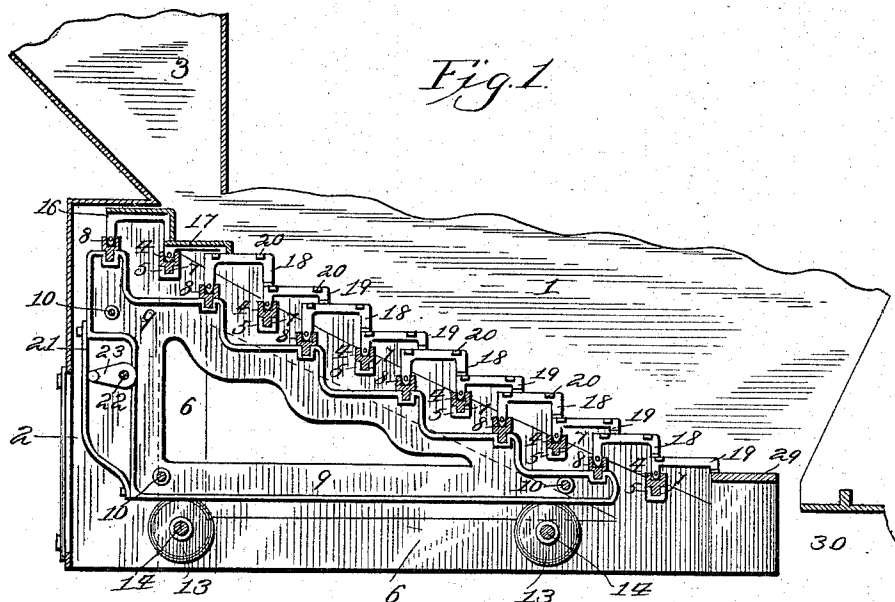
(No Model.)

2 Sheets—Sheet 1.

J. G. SANDERSON.
FURNACE GRATE AND AUTOMATIC STOKER.

No. 573,298.

Patented Dec. 15, 1896.



Witnesses:
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Geo. C. Curre

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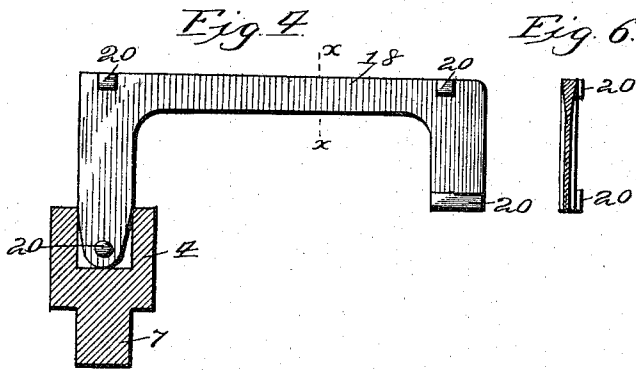
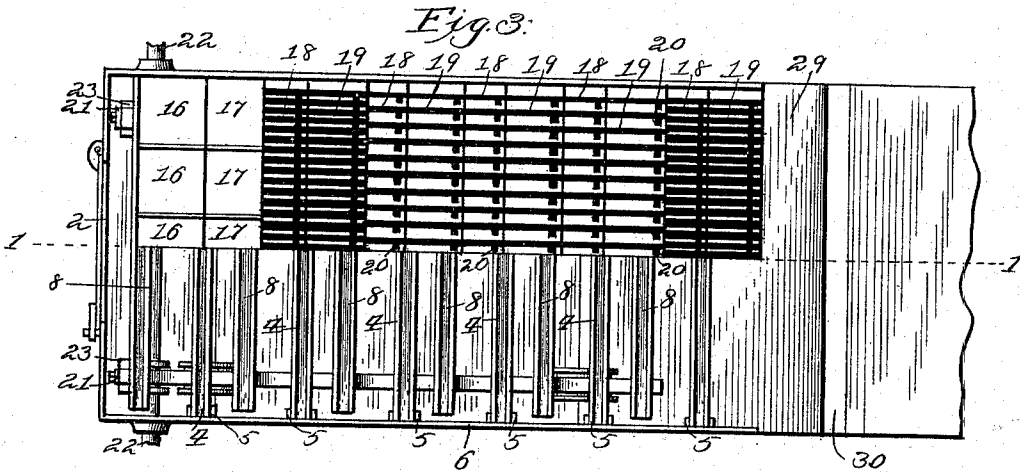


Fig. 6.

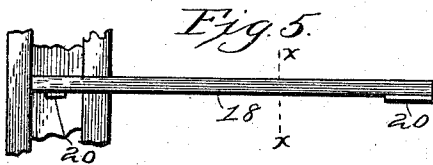
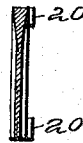
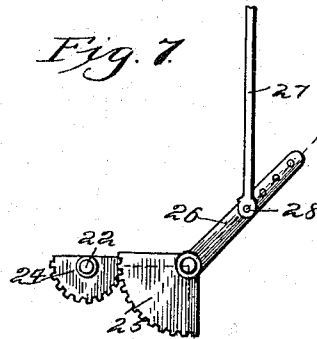


Fig. 7.



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UNITED STATES PATENT OFFICE.

JAMES GARDNER SANDERSON, OF SCRANTON, PENNSYLVANIA.

FURNACE-GRATE AND AUTOMATIC STOKER.

SPECIFICATION forming part of Letters Patent No. 573,298, dated December 15, 1896.

Application filed November 4, 1895. Serial No. 567,931. (No model.)

To all whom it may concern:

Be it known that I, JAMES GARDNER SANDERSON, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Furnace-Grates and Automatic Stokers, of which the following is a specification.

The object of my invention is to construct a furnace-grate and automatic stoker especially adapted to the utilization of small sizes of anthracite coal, culm, or screenings; and it consists in certain improvements and modifications of that form of grates designated as "reciprocating," which are found necessary for the purpose.

Reciprocating grates as heretofore constructed are found not adapted to the complete burning of the fuels mentioned, which require a proper distribution of air through proper openings in the grate-surface and but little disturbance of the fuel during combustion.

By referring to the following description and operation of my grate it will be seen that I have successfully provided for these necessary conditions.

My grate and automatic stoker consists, essentially, of a stationary frame supporting horizontal grooved cross-bars, which in turn support the rear end of the grate-plates and grate-bars, and an interior movable frame supported on rolls or wheels and which also carries horizontal grooved cross-bars arranged alternately with and parallel to the said stationary cross-bars. This last-mentioned frame supports and carries grate-plates and grate-bars alternating with those carried by the stationary cross-bars, the front end of one being supported on the rear of the other. The width of the grate-bars and space between them are so arranged as to provide for the proper distribution of air and support of the fuel, and the series of grate plates and bars carried by the movable frame constitute a series of pushers for advancing the fuel from front to rear of grate-surface with the least practical disturbance; and my invention further consists of certain features of novel construction that will be hereinafter

fully described, and specifically pointed out in the claims.

In order that my invention may be fully understood, I will proceed to describe the same with reference to the accompanying drawings, in which—

Figure 1 is a vertical section, taken on line 1 1, Figs. 2 and 3, of a furnace-grate embodying my improvements. Fig. 2 is a front and end view thereof, the front of the furnace being removed to show the interior. Fig. 3 is a top view or plan of the grate, one-half of the grate plates and bars being removed, showing the construction beneath. Fig. 4 is an enlarged detail view of one of the grate-bars and section of a supporting cross-bar. Fig. 5 is a top view or plan of the same. Fig. 6 is a vertical section of the same grate-bar, taken through line *xx*, Figs. 4 and 5. Fig. 7 is a view of the moving gear and driving-rod attachment.

In said drawings, 1 represents the side walls of a furnace, 2 the front thereof, with a door for access to the interior, and 3 the hopper for containing the fuel to be fed to the furnace, which in this case is fine coal or culm.

4 represents stationary cross-bars supported at their ends in suitable supports 5, projecting from the exterior or stationary plates 6 of the grate. These cross-bars have a U-shaped groove in their upper part for receiving the arms or lugs of the grate plates and bars, also a projection 7 on their lower part, which fits in the supports 5.

8 represents a number of cross-bars similar in construction to the cross-bars 4, but mounted on a movable frame interior to the stationary frame, and composed of plates 9, held together by means of the rods 10, and cross-bars 8, the cross-bars fitting into U-shaped openings in the top of the plates. These plates 9 are formed, as shown, on their upper ends to form steps, the treads thereof passing under the stationary cross-bars 4 and containing the openings in which are fitted the cross-bars 8. This movable frame is mounted on a series of flanged rollers or wheels 13, loosely mounted on shafts 14, which are journaled in suitable bearings projecting from the stationary side plates.

16 represents a series of grate-plates with solid top and front surfaces, having flanges on under side, with legs extending downward and fitting loosely in the U-shaped groove of the first or upper cross-bar of the movable frame. These plates have flanges also on their sides arranged to overlap each other, as shown, thus preventing fuel or air from passing through between the plates.

17 represents similar grate-plates differing only from plates 16 in height of vertical face and length of the legs which fit in the groove of the first or upper cross-bar of the stationary frame.

18 and 19 represent series of grate-bars mounted alternately upon the cross-bars of the movable and stationary frames, one downward-turned end of each bar resting in the groove of a cross-bar and the other downward-turned end resting upon the following row of grate-bars. The construction of these bars is shown more clearly in Figs. 4, 5, and 6. The rear ends of the bars are extended downward with tapering and rounded ends, which fit loosely in the grooves of the cross-bars, permitting a vertical movement of the front ends. The front ends turn downward, forming the tread of the steps of the grate. The top and front of the bars have a tapering section, as shown in Fig. 6. This is to allow a freer passage for air and prevent clogging of material between the bars. On one side of each bar are a series of projections 20, which keep the bars apart from each other the distance required, which may be regulated by the knobs or projections. These bars may vary in width, and thus vary the number of air-spaces. Those in the center portion of grate-surface should be as narrow as strength of material will permit, say three-eighths of one inch with one-eighth of one inch between the bars.

21, Figs. 1, 2, and 3, are metal straps securely bolted to the ends of plates 9. 22 is a shaft extending through the space between the straps 21 and the ends of plates 9 and through the stationary side plates 6, attached to which are suitable bearings. 23 are crank-arms fixed to this shaft, each pair being connected at their outer ends by a pin carrying a roller between the pair of arms. In Fig. 7, 22 represents the end of the shaft just referred to; 24, a portion of a toothed wheel fixed to said shaft and geared into a portion of a larger toothed wheel 25, which has a projecting arm 26, connected with which, by a pin 28, is the rod 27.

In Figs. 1 and 3, 29 represents a dead-plate, and 30 the ash-pit.

I will now describe the operation of my grate and stoker. The fuel is supplied to the hopper and falls upon the upper or front rows of plates 16 and 17. As the frame carrying the movable row of plates 16 moves forward it pushes the fuel from the row of stationary plates 17 onto the following row of movable grate-bars 18, and the reverse or

backward movement of the frame deposits the fuel on the stationary plates, reloading the upper row. This process continues until the surface of the grate is covered with a bed of fuel. The movement of the grate being then discontinued, the fuel is fired in the usual way. When combustion is well under way, the movable frame is again put in motion by means of the appliance shown and described or other suitable mechanism. Experience has shown that for most perfect and rapid combustion with a three-inch movement of the frame one reciprocation of the grate in every five minutes is sufficient for anthracite culm where steam-blast is used to force combustion. Other more rapidly-burning fuels would require a more rapid movement. There being no openings for air-passage through the two upper or front rows of plates 16 and 17, no combustion takes place there; but the fuel, being subjected to heat, is brought into condition for speedy combustion when it reaches the grate-bars 18 and 19, the spaces between these bars permitting a sufficient supply of air for perfect combustion to reach the fuel, but not so wide as to allow the fuel or ashes to fall through into the air-chamber. It is found by experience that more air is required for perfect combustion after the fuel has become thoroughly ignited than in the first and last stages of combustion, and in order to meet this requirement the grate-bars of the first and last series are wider than those of the middle series, thus diminishing the number of air-passages. The same result may be obtained by having the bars closer together. As will be seen from Fig. 1, the vertical flanges of the grate plates and bars, which act as pushers on the movable frame, vary in height, those at the front or feeding end being the highest and gradually diminishing to the rear or ash end. This is to compensate for the reduction in bulk of the fuel by combustion and to maintain a uniform covering of material on the grate-surface. As the fuel is advanced and becomes more thoroughly ignited the supply of air for combustion is increased by the greater number of spaces between the grate-bars, and as the fuel is consumed, requiring less air for combustion, the number of spaces are diminished. The fuel being consumed, the remaining ashes are first deposited onto the dead-plate 29 and from there pushed into the ash-pit 30.

The object of the dead-plate, which may be of fire-brick or other refractory material, is to permit the accumulation of ashes at the foot of the grate, utilizing its heat and completing the combustion of any carbon remaining therein. As shown in Fig. 3, I use wider grate-bars next to the side walls of the furnace. The object of this is to diminish the air-supply in this portion of the furnace and to cover the space allowed at the ends of the cross-bars for expansion and free movement.

It will be observed that the ends of the

grate plates and bars which rest upon the next series are free to move up or down and adapt themselves to an uneven surface caused by warping or otherwise; also, that a plate or bar can be readily replaced without disturbing other portions of the grate; also, that the expansion and contraction of grate bars or plates will not affect the operation of the grate. The extreme movement of the pushers being but three inches forward and return in five minutes and the horizontal surface of the grate-bars being about twelve inches, it will be seen that but slight disturbance of the fuel takes place.

The necessary horizontal movement may be imparted to the movable frame in various ways, but I prefer the device herein shown, which operates in the following manner: The crank-arms 23 are fixed to the shaft 22 on either side of the frames 9. These arms carry rollers or pins, which rollers bear alternately against the plates 9 and straps 21, attached to the plates, as the shaft is oscillated. The extent of this oscillation governs the distance the frame is moved forward and backward. This oscillation is imparted to the shaft by means of the mechanism shown in Figs. 2 and 7. The segment of a toothed wheel 24 is fixed to the shaft and geared with a segment of a toothed wheel 25 of twice its diameter, so that a quarter-revolution of the gear 25 will result in a half-revolution of 24 and half-revolution of the shaft 22 and arms 23, giving the maximum movement to the grate-frame. Attached to the gear 25 is an arm 26, which is connected with an eccentric or crank of a revolving shaft by the rod 27. This rod may be connected to the arm at various points by means of a pin or bolt. If connected at the point as shown, it is arranged to oscillate the gear 25 through one-quarter of a circle, and, as will be seen, if connected at points farther from the center the oscillation will be less, and hence the movement of the grate-frame will be less. Thus the movement of the movable portion of the grate may be regulated to suit the degree of combustion required.

To successfully burn the classes of fuel herein referred to, and particularly anthracite culm, which is the waste screenings from prepared coal and has accumulated in great quantities in the anthracite-coal regions, it is found necessary to employ considerable air-pressure through the openings in the grate to penetrate the fuel and to distribute the air-supply as thoroughly as possible through the mass of fuel when in combustion.

My invention and improvements provide for these necessary conditions, as such air-pressure as may be required can be maintained in the air-chamber beneath the grate, it being inclosed and separate from the ash-pit. The spaces between the grate-bars provide a thorough distribution of the air for combustion, there being no other outlet from

the air-chamber. For the fuel mentioned I prefer to use a McClave or some other form of steam-blower to produce forced blast for combustion, it being found by experience that less clinker is formed on the grate-bars and the bars are less damaged by fire than where air-blast alone is employed; also, a considerable amount of hydrogen gas is formed by decomposition of the steam as it comes in contact with the heated fuel, the burning of which in the combustion-chamber generates considerable heat in addition to that generated by the combustion of the fuel.

It will be seen that the entire grate may be withdrawn from the furnace and replaced without disturbing the walls of the furnace. This is an important feature of my appliance, but is not claimed itself as being novel.

Having thus fully described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. In a furnace-grate, the combination of a stationary frame arranged to carry cross-bars, and a movable frame mounted on wheels or rolls and interior to the stationary frame, said movable frame being also arranged to carry cross-bars, and said cross-bars being provided with a U-shaped groove in their upper side for the reception of the legs of grate plates and bars which are supported by said cross-bars, substantially as shown and described.

2. In a furnace-grate, the combination of a series of horizontal cross-bars, formed with a U-shaped groove in their upper side and a series of grate plates and bars adapted to be carried by said cross-bars, the cross-bars being so arranged that one end of the grate plates and bars is supported thereon while the other end overlaps and is supported by the grate plates or bars below which in turn are supported by the adjoining cross-bar; substantially as shown and described.

3. In a furnace-grate, the combination of the cross-bars, and the grate-bars independently and movably carried by said cross-bars, each grate-bar having ends projecting at right angles to the surface thereof forming legs, and projections on one side, for the purpose shown and described.

4. A furnace-grate, composed of a number of cross-bars, and a series of independent grate-bars of varying widths movably supported by said cross-bars and forming the grate-surface, each grate-bar being formed with legs extending at right angles to the surface thereof and with projections on one side thereof, substantially as shown and described.

5. In a furnace the combination of a grate, means in connection therewith for feeding the fuel from one end of the grate to the other, and means for supplying a greater quantity of air at the middle portion thereof than at the ends, substantially as shown and described.

6. In a furnace in combination with the grate-bars to be moved, the means for moving them consisting of a shaft carrying an arm adapted to engage with the bars, a
5 toothed segment on said shaft, a toothed quadrant of twice the diameter of the segment in engagement with said shaft and suitable means having an adjustable connection with the quadrant for moving the same, substantially as shown and described.

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