

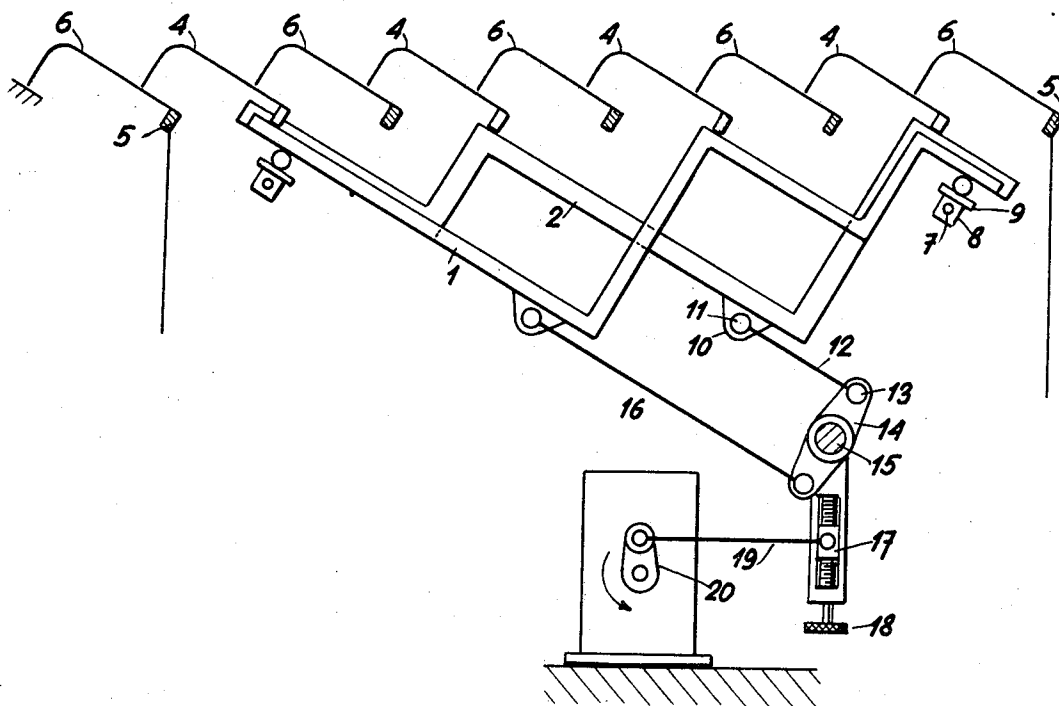
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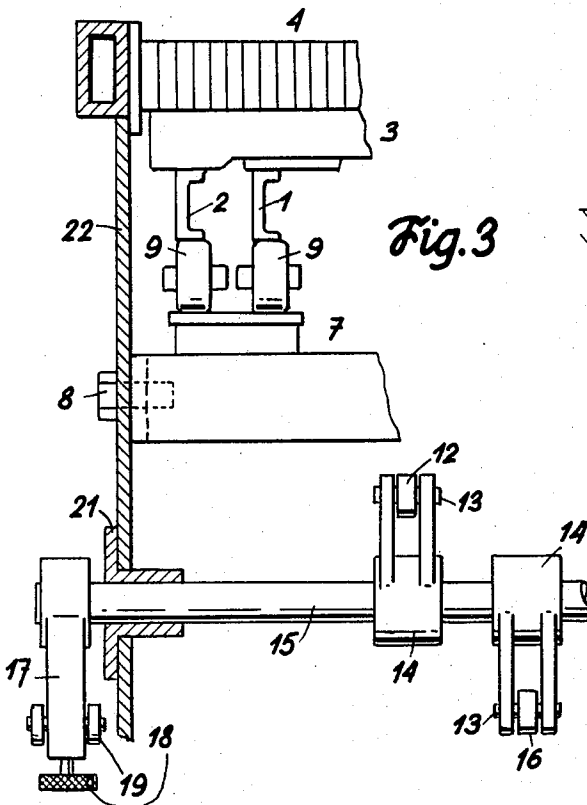
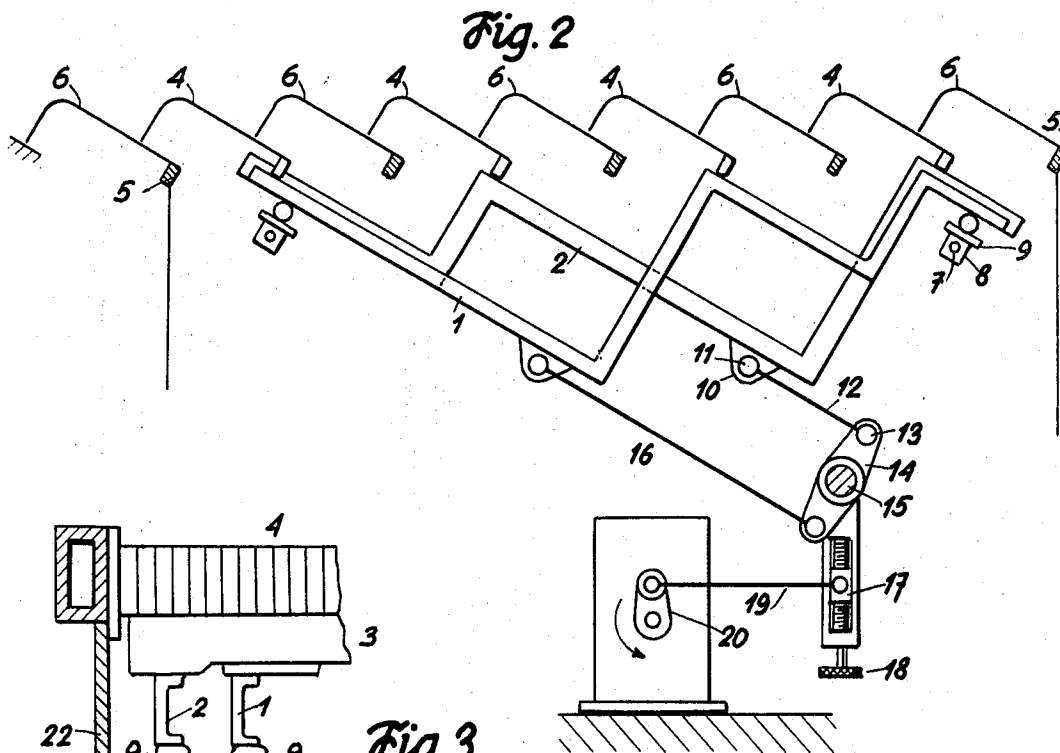
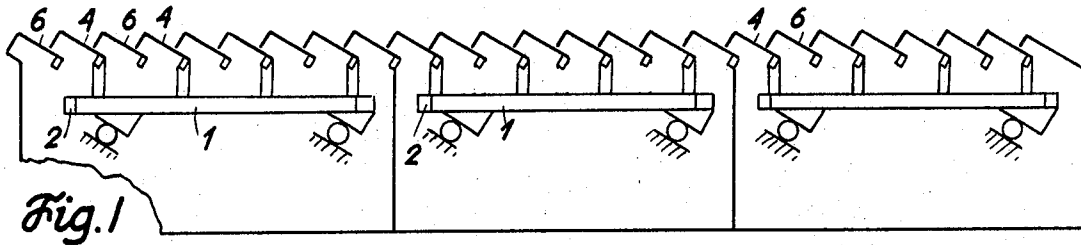
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ABSTRACT: Stokers, particularly for incinerating low-quality fuel of high ash content, such as urban or industrial refuse. The stoker includes at least three bar fields successively arranged one after the other in the direction of fuel movement from the rear toward the front of the stoker. Within each field there are a plurality of rows of bars extending transversely across the stoker so as to extend transversely with respect to the direction of fuel movement, and these transversely extending rows of bars include stationary rows alternating with reciprocating rows. In each row the bars are arranged in side-by-side relation, and each reciprocating row has a front end extending over and slidably engaging the rear end of the next following stationary row and a rear end extending beneath and slidably engaging the front end of the immediately preceding row. A moving means is operatively connected to the reciprocating rows of bars of each field for reciprocating the rows of bars to advance the fuel with each reciprocating row of bars reciprocating in a direction opposite to the directions of reciprocation of the immediately preceding and immediately following reciprocating rows of bars.

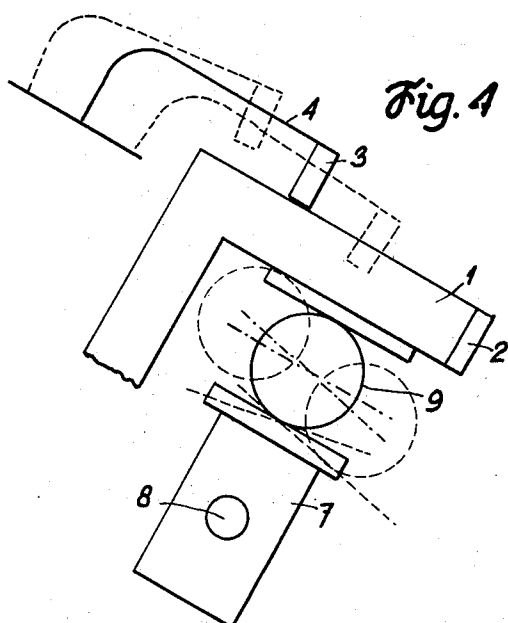
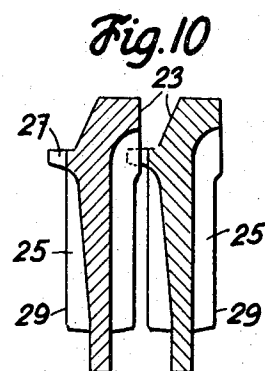
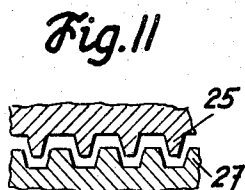
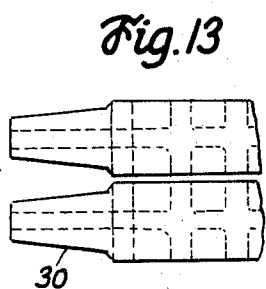
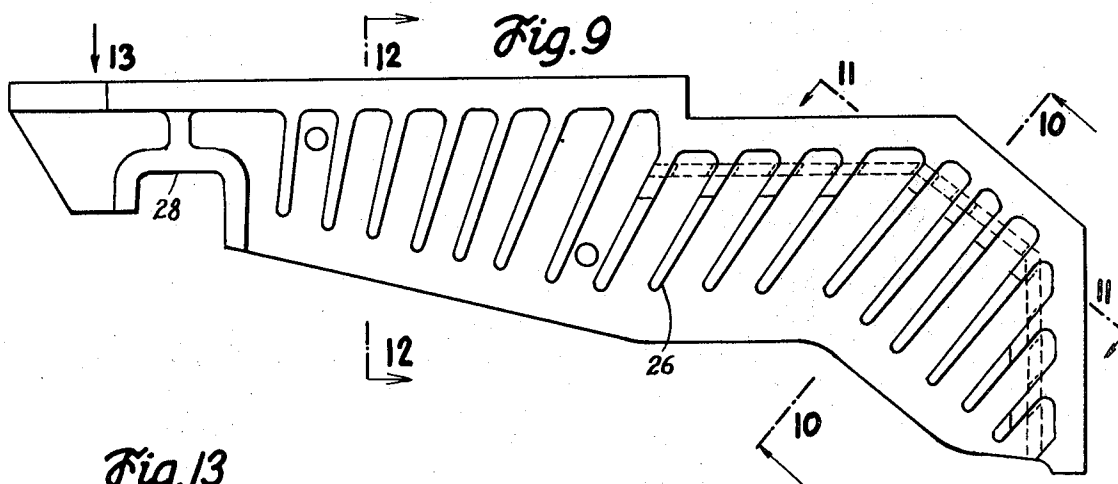
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Fig. 5

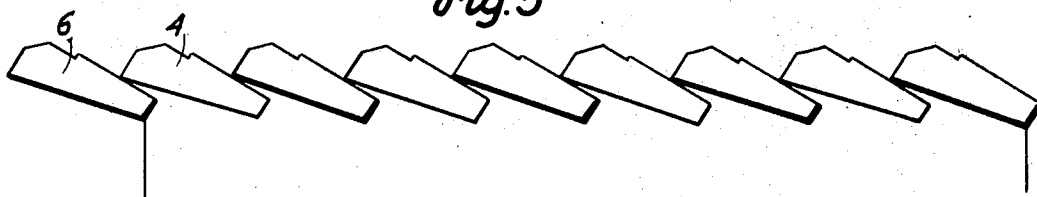


Fig. 6

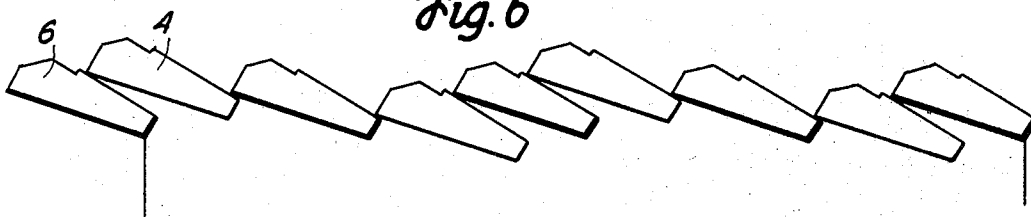


Fig. 7

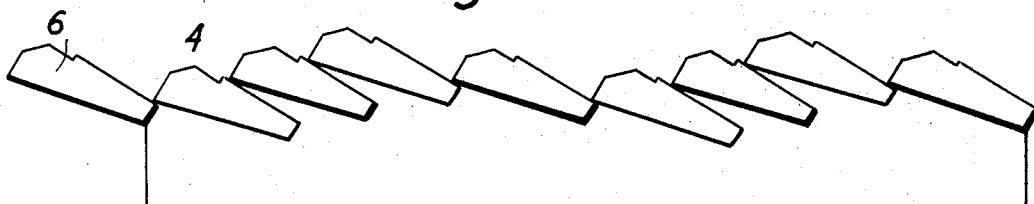
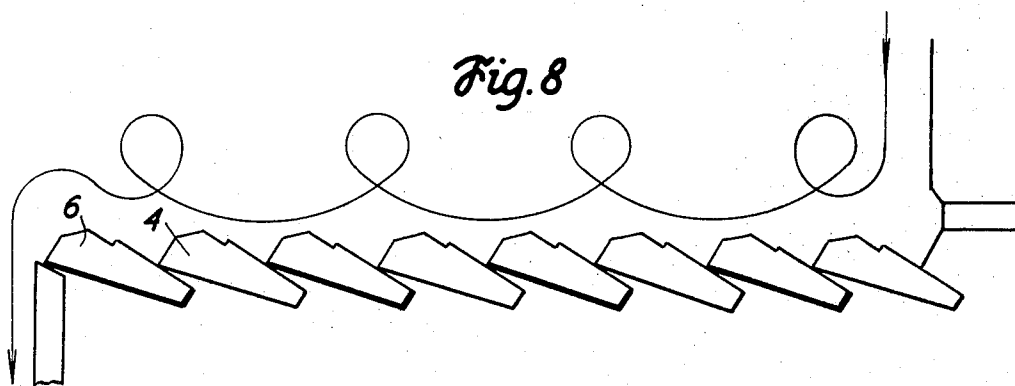


Fig. 8



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STOKERS

BACKGROUND OF THE INVENTION

The present invention relates to stokers.

In particular, the invention relates to stokers which are adapted to incinerate fuel of low quality and high ash content, such as urban or industrial refuse.

Incineration of fuel of this latter type presents particularly difficult problems. These problems arise because the calorific value, the extent of granulation, the composition, and the incinerating characteristics of such fuels are highly variable. These factors constantly change from one batch of fuel to the next, depending upon the influences to which the fuels have been subjected. Thus, during the summer months, refuse will be predominately of plant origin, having a character completely different from winter refuse consisting primarily of ashes from a household. It is, therefore, difficult and costly to achieve, in a sufficiently hygienic manner, an efficient incineration of such refuse.

Of course, there are known stokers which have been designed for the incineration of urban and industrial refuse. Some stokers of this type provide only for movement of the fuel, the transfer of combustion occurring only as the result of falling of burning fuel particles through the coarse granular structure of the lower fuel layer as a result of gravitation. This type of structure has not been used successfully with refuse. It was proposed, therefore, to use traveling and shaking grates. However, on such stokers, the fuel is at rest with respect to the grate and is fed only onto the stoker from the feed hopper toward the end of the stoker. Such stokers cannot and do not provide any relative movement between the particles of the refuse itself, and the greater the proportion of finer grains in the fuel, the more compact it becomes and the smaller the extent of incineration thereof. The refuse is not mixed with a sufficient intensity.

It was, therefore, also proposed to provide a stoker divided into longitudinally extending areas, one of which is moved while the other is fixed, but even with such construction, the refuse does not become mixed sufficiently, since it is subjected only to a forward push. The entire length of such a stoker is formed by individual bands which do not make it possible to change the velocity or life of the bars which make up each band.

There are also known stokers which act to carry out the stoking itself, and in this type of known construction, the stoker is obliquely arranged at a relatively large inclination. All of the bars of such a stoker are movable and have the same degree of lift and the same velocity of movement from the first to the last bar. With this construction, it is not possible to control the ignition, the combustion, and the termination of the combustion in accordance with the characteristics of the fuel. The movable bars are supported by carriers which extend straight through the entire length of the stoker. In these known constructions, it is extremely difficult to obtain a perfect seal for the undercarriage by way of band plates. There are constant difficulties with respect to servicing of the seals and adjustment of the flow of combustion air into the individual bands of the stoker during the course of incineration. These known constructions do not take into consideration the fact that when burning a fuel which tends to form a sintered mass, heaps of such sintered masses will accumulate at different parts of the stoker.

It is essential, therefore, that the stoker be arranged in such a way that the formation of heaps of sintered masses be prevented. It should, as a minimum, be possible to breakup and eliminate such sintered masses automatically by the action of the stoker itself. In known constructions, the stokers are made up of two or more horizontal or inclined stoker assemblies, of which the first, which is shorter, is situated higher than and serves as a feeding and predrying stoker, while the next is the incinerating stoker proper. However, with this construction, there is no fuel regulation to adjust the height of the

layer of refuse or other low-quality fuel. The layer of refuse which is on the feedstoker is a function of the height of the outlet orifice of the feed hopper and the slope of the refuse itself, so that the refuse automatically adjusts itself on the feeding and predrying regions of the stoker and assumes an undesirably large height. The result is that satisfactory predrying is impossible, and an efficient ignition is also impossible.

The operation and servicing of stokers of the above type is influenced also to a considerable extent by the bars of the stoker. The best type of stoker bars are those which are capable of preventing the fuel from falling downwardly through the bars. In known structures, the ribs are arranged in such a way that they form chambers, channels, and the like, which retard the flow of cooling air, so that the extent of cooling is lowered. The rows of cooling ribs are interrupted primarily at the upper part of the stoker bar which is under the greatest thermal stress, with the result that insufficient heat is carried off at this critical region of each stoker bar. Bosses on the surfaces of the bars provide obstacles for the fuel moving on the bars, with the result that the gaps and channels through which cooling and combustion air should flow become clogged. As a result, such conventional bars have an extremely small life.

SUMMARY OF THE INVENTION

It is accordingly a primary object of the invention to provide a stoker which will eliminate the above drawbacks.

In particular, it is an object of the invention to provide a stoker which will efficiently advance the fuel along the stoker, while providing an efficient combustion thereof.

In particular, it is an object of the invention to provide a stoker which will have a controlled admission of combustion air in such a way as to achieve a highly efficient combustion.

It is furthermore an object of the invention to provide a stoker which can be adjusted so as to control the manner in which the fuel is moved, as well as to control the movement of bars of the stoker.

It is also an object of the invention to provide a stoker having components which can be efficiently cooled and which will have a long life.

Also, it is an object of the invention to provide a stoker where the fuel, such as urban or industrial refuse, is constantly stirred and mixed, providing a highly efficient stoking and rolling of the refuse.

In particular, it is an object of the invention to provide a stoker which will prevent the formation of sintered masses.

Also, it is an object of the invention to provide a stoker which is of a relatively small height so that it requires a relatively small amount of space in a vertical direction, the stoker being easily adapted for accommodation into preliminary combustion chambers, and into the combustion chamber proper.

In particular, it is an object of the invention to provide a stoker which can be operated under the most hygienic conditions which do not require the operator to come into contact with the refuse.

Also, it is an object of the invention to provide a stoker which requires only a small number of moving parts which are subjected only to a small degree of wear.

Also, it is an object of the invention to provide a stoker wherein the moving components are balanced so that a relatively small driving force is required to operate the stoker.

Because of the highly efficient cooling of the stoker bars, a long life is assured and the construction of the stoker bars is such that the refuse or other fuel is constantly advanced from the rear toward the front of the stoker.

In accordance with the invention, the stoker includes a plurality of bar fields arranged one after the other from the rear toward the front of the stoker in the direction of fuel movement. Each bar field includes transverse rows of stoker bars arranged in side-by-side relation along each row, with each bar extending longitudinally in the direction of field movement. Alternate rows of stoker bars are stationary, while

reciprocating rows of stoker bars are situated between the alternate rows of stationary bars. The reciprocating rows of stoker bars each has a front end overlapping and situated slidably over the rear end of the immediately following stationary row of bars in the direction of fuel movement and a rear end extending beneath and slidably overlapping the immediately preceding row of stationary stoker bars in the direction of fuel movement. A moving means which is connected with the reciprocating row of bars reciprocates them in such a way that each reciprocating rows of bars reciprocates simultaneously with, but oppositely to, the immediately preceding and immediately following reciprocating rows of bars.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated by way of example in the accompanying drawings, which form part of this application and in which:

FIG. 1 is a schematic elevation showing the arrangement of three stoker fields, one after the other, in the direction of fuel movement from right to left, as viewed in FIG. 1;

FIG. 2 is a schematic longitudinal sectional illustration of the manner in which stationary and reciprocating rows of stoker bars are arranged and moved in a given field;

FIG. 3 is a fragmentary transverse sectional elevation showing also the manner in which the stoker bars are supported and moved;

FIG. 4 is a fragmentary, partly schematic side elevation of the structure which adjusts the nature of the movement of the reciprocating rows of stoker bars;

FIGS. 5-7 schematically illustrate the relationship between successive rows of stoker bars during operation of the stoker;

FIG. 8 shows the structure of FIG. 5 in connection with the manner in which the fuel is moved and advanced by the stoker;

FIG. 9 is a side elevation of a stoker bar of the invention;

FIG. 10 is a transverse section taken along line 10-10 of FIG. 9, and showing the transverse structure of each stoker bar, as well as the relationship between a pair of adjoining stoker bars;

FIG. 11 is a fragmentary section taken along line 11-11 of FIG. 9, and showing the relationship between a pair of adjoining stoker bars;

FIG. 12 is a fragmentary transverse section along line 12-12 of FIG. 9, and showing also the structure of the stoker bars and the relationship between adjoining stoker bars; and

FIG. 13 is a fragmentary top plan view taken in the direction of arrow 13 of FIG. 9, and showing the configuration of the top surfaces of the stoker bars at the regions of the rear ends thereof.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to FIG. 1, the stoker of the invention is schematically illustrated therein as divided at least into three successive stoker fields, situated one after the other from right to left in the direction of fuel movement. The fuel enters the stoker at the upper right rear portion thereof, as viewed in FIG. 1, and during operation the fuel continuously advances toward the left to the front discharge end of the stoker, with the fuel being continuously mixed as it is advanced and incinerated, in a manner described in greater detail below.

The three stoker fields are identical in construction and each is made up of stoker bars which prevent the fuel from falling downwardly through the stoker. The stoker bars are arranged in transverse stationary rows of bars 6 and transverse reciprocating rows of bars 4, which alternate with the bars 6.

Each of the rows of stoker bars have the bars thereof arranged in side-by-side relation, with each row extending transversely of the stoker, considered in the direction of fuel advance. A moving means is operatively connected to the reciprocating rows of bars 4 in order to reciprocate the latter, and each field is provided with its own moving means so that

the several fields are independently controllable. The moving means includes for each field an outer carriage 2 and an inner carriage 1. Each independently adjustable zone is controllable in such a way that it is possible, during operation, to adjust the stroke and velocity of the reciprocating bars 4.

As is apparent from FIG. 2, the outer carriage 2 is connected with reciprocating rows of bars 4, which respectively alternate with reciprocating rows of bars 4, which are fixed to the inner carriage 1. Each row of bars is inclined as shown in FIG. 2, with the entire field being arranged horizontally. The front upper ends of each reciprocating row of bars 4 overlaps and slidably engages while extending over the rear end of the next following stationary row of bars 6 in the direction of fuel movement, while the lower rear end of each reciprocating row of bars 4 extends beneath and slidably engages the front end of the immediately preceding stationary row of bars 6. Each row of bars is supported in the region of its rear end by a transverse beam 3, which extends longitudinally of each row, and it is the beams 3 of the reciprocating rows of bars 4 which are fixed to the carriages 1 and 2 in the manner indicated in FIG. 2.

These carriages are supported for movement on rollers 9, which are themselves supported on roller supports 7. These roller supports 7 are tiltable so as to adjust the manner in which the bars 4 are reciprocated. The several bars 4 and 6 simply rest on the beams 3, which are in turn fixedly mounted, the beams 3 of the reciprocating rows being fixed to the carriages 1 and 2. As is apparent from FIG. 3, the stoker has sidewalls 22 between which the roller supports 7 extend, these supports being fixed at selected angles by the screws 8, so as to adjust the angle of the surface on which the rollers 9 ride. The rollers 9 extend beneath and support the carriages 1 and 2 which are formed from channel members and which are fixed to the beams 3 in the manner indicated fragmentarily in FIG. 3.

As is also apparent from FIGS. 2 and 3, the moving means includes an elongated bar 15 supported for rotary oscillating movement in bearings 21, respectively carried by the walls 22, and the bar 15 is fixed to a crank arm 17, which is pivotally connected to a connecting rod assembly 19, pivotally mounted on a crank pin and situated on one side of a rotary crank arm 20, driven by any variable drive so as to rotate in a counterclockwise direction, as indicated in FIG. 2. As a result, the connecting rod assembly 19 will provide swinging of the crank arm 17 back and forth to oscillate the rod 15, and an adjusting device 18 which is schematically indicated adjusts the location of the pivot axis between connecting rod 19 and crank arm 17, so as to control the stroke and speed of movement of the crank arm 17.

The rod 15 fixedly carries lever assemblies 14, which extend in opposed directions from the rod 15 in the manner shown in FIGS. 2 and 3. The downwardly extending levers 14 are connected through a pin 13 with a connecting rod 16, which is in turn pivotally connected to the inner carriage 1. The oppositely extending, upwardly directed lever 14 is pivotally connected by a pin 13 with a connecting rod 12, which is in turn pivotally connected by a pin 11 to the bracket 10, which is fixed to the outer carriage 2. A similar structure provides the pivotal connection between the connecting rod 16 and the inner carriage 1. Because the levers 14 are oppositely directed, the carriages 1 and 2 will be simultaneously reciprocated on the rollers 9 in opposite directions during rotation of the crank 20, so that each reciprocating row of bars 4 will be reciprocated simultaneously with and oppositely to the direction of reciprocation of immediately preceding and immediately following rows of reciprocating bars 4. The extreme positions of the reciprocating bars 4 is indicated in dotted lines in FIGS. 2 and 4.

In FIG. 4, the adjustable, tiltable roller support 7 is shown in solid lines in an intermediate position. By tilting the support 7 about the axis of the pins 8, it is possible to change straight reciprocating movement of the rows of bar 4 into swinging movement so as to achieve, whenever required, a better mixing and incineration of the refuse of the stoker. It will be noted

that in FIG. 4, the extreme positions of the reciprocating bars 4, as well as of the rollers 9, are shown in dotted lines.

Various phases in the operation of the stoker are illustrated schematically in FIGS. 5-8. In FIGS. 5-8, the rows of stationary bars 6 are shown darker than the reciprocating bars 4, so as to be easily distinguishable therefrom. The reciprocating bars 4 are shown in FIG. 5 in an intermediate position, with respect to the stationary bars 6. Each row of reciprocating bars 4 is to be considered as moving oppositely to the immediately preceding and immediately following reciprocating rows of bars 4.

Thus, in FIG. 6, the reciprocating bars 4 are shown in a position where the inner carriage 1 has pushed the alternate rows of reciprocating bars connected thereto upwardly to their highest elevation at their forward extreme positions, while the outer carriage 2 has retracted the rows of bars 4 connected thereto downwardly and rearwardly to their rear extreme positions. In FIG. 7, the parts are shown at the opposite end position where the inner carriage 1 has retracted the bars 4 connected thereto down to their lower rear positions, while the bars 4 connected to the outer carriage 2 have been advanced upwardly to their forward upper extreme positions. In FIG. 8, the reciprocating bars 4 are again shown in the position of FIG. 5, FIG. 8 indicating by the looped line with the arrows thereon the path and direction of movement of the refuse during advancing and incineration thereof, with the stoker of the invention.

The details of each of the bars 4 and 6 are illustrated in FIGS. 9-13. Each stoker bar has an upper longitudinally extending wall portion providing the bar with an upper longitudinally extending smooth surface 23, which prevents the fuel from falling through, and which is free of any ribs or other protrusions, so that the fuel can freely slide toward the front end of each bar. Intermediate its ends, each bar is provided with a forwardly directed shoulder 24 preventing retrogression of the advancing fuel. The bar is provided, at its top wall, with a downwardly longitudinally extending web, from which ribs 25 laterally project. These ribs 25 are in a fan-shaped arrangement at each side of the longitudinal web. FIG. 9 showing how the ribs 25 adjacent the rear left end region of each bar, as viewed in FIG. 9, are almost perpendicular to the top wall of the bar, while they become progressively inclined to a greater extent upwardly and forwardly to the right, as viewed in FIG. 9, as they approach the front end of each bar. Because the ribs 25 are arranged in a fan-shaped assembly 26 indicated in FIG. 9, there is a highly efficient contact between the cooling air and the bar and also the combustion air is fed very efficiently toward the advancing fuel.

As is apparent from FIGS. 10 and 11, the bars are situated close to each other in side-by-side relation with each bar having only bosses 27 projecting laterally and defining between themselves gaps which receive the ribs 25 of the adjoining bar. In this way, although there is a certain clearance between the exterior end surfaces 29 of the ribs 25 of adjoining bars, falling through of the fuel is avoided. The adjoining bars are connected to each other in such a way that each bar can move with respect to its neighbor to an extent of approximately 1.5 mm. As a result, lodging of small particles between neighboring bars is avoided, and instead such particles are ground by the relative movement of the bars into fine particles which simply fall and prevent clogging between the bars.

The rear regions of the bars are provided with tapered end portions 30, which increase the clearance between the bars at their rear ends so that in this way also clogging between the bars is prevented. At the region of the rear ends of the bars, the webs thereof are provided at the lower edge regions with the structure 28 of inverted channel-shaped configuration forming notches for receiving the upper regions of the beams 3, so that by situating a beam 3 in aligned notches 28, each row of bars will be connected with a beam 3. The front ends of the bars simply rest on and are slidable along the next-following row of bars in the direction of fuel movement. The tapered surfaces 30 at the rear regions of the bars are open in a

downward direction, and the cooling and combustion air can therefore flow freely along the entire exterior surfaces of the bars to provide an efficient cooling thereof, as well as an efficient combustion. To this end, the webs are also formed with openings 31 through which the cooling and combustion air can also freely flow completely around the bar.

Inasmuch as the stoker of the invention provides its own stoking action with the bars coacting to prevent falling through of the fuel, it is particularly suited for the incineration of urban and industrial refuse. Optimum combustion conditions are provided. It is possible to adjust the stroke and speed of the bars and control the quantity of combustion air during operation. In this way, conditions for satisfactory, efficient incineration of refuse, taking into consideration the variability of the characteristics thereof, are achieved. The stoker has a highly efficient stoking action with the refuse being constantly stirred. The operation of the stoker provides a good mixing, stoking and rolling of the refuse. Inasmuch as the fuel is advanced while forming high steps, cascades, and deep hollow regions, sintering of the fuel into large masses is avoided. The admission of radiant heat into the layer fuel and the perfect admission of combustion air are achieved. The stoker is horizontally arranged so that it occupies only a small height, the requirements with respect to the height and volume occupied by the precombustion chamber and combustion chambers being at a minimum. In addition, the best possible hygienic conditions are achieved with the stoker of the invention, inasmuch as the operator does not in any way come into contact with the refuse. The moving means is composed of a small number of moving parts which are subject to wear. Moreover, the opposite reciprocating movements of the carriages provides a balance which achieves the required movement with a small amount of power. Inasmuch as the stoker bars prevent the fuel from falling through and have no sudden drops, while using chambers and ribs, the bars are constantly cooled in a highly intense manner, preventing any burning off of the bars to assure a long life for the latter. The smooth upper surfaces of the bars extending longitudinally thereof, makes possible a constant advance of the refuse toward the front of each bar.

Although the stoker of the invention has been described above as being particularly suitable for incineration of refuse, the stoker of the invention can be advantageously used with all fuels of inferior quality which have a high ash content.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.

We claim:

1. A grate for incinerating urban and industrial refuse, said grate being substantially horizontal and of stoking type with bars preventing the refuse from falling through, comprising fixed rows of bars and moving rows of bars, every second row of bars being moving, the said grate being longitudinally divided into at least three movement zones, every movement zone being provided with a system of an inner carriage and an exterior carriage so that every movement zone is independently controllable during operation, the said movement zone having an independent sealed air with controllable admission of air, wherein the said every second moving row of bars is movable in a direction of movement opposite that of the preceeding moving row of bars and the length of travel and velocity of the moving row of bars is adjustable in every movement zone.

2. The combination of claim 1 and wherein an adjusting means coacts with said reciprocating rows of bars for selectively adjusting the latter to carry out either straight reciprocating movements or swinging reciprocating movements.

3. The combination of claim 1 and wherein each bar has a longitudinally extending top wall extending in the direction of fuel movement and having an upwardly directed smooth sur-

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face engaged by the fuel, each of said bars having, beneath said top wall, downwardly extending ribs.

4. The combination of claim 3 and wherein said ribs of each bar are distributed in a fan-shaped arrangement with said ribs being almost perpendicular to said top wall of each bar in the region of the rear end thereof, and with said ribs gradually becoming inclined to a greater extent toward a horizontal position progressively toward the front end of each bar.

5. The combination of claim 3 and wherein each bar is formed along one side with laterally extending bosses defining between themselves gaps which receive edge portions of the ribs of the next bar.

6. The combination of claim 1 and wherein a transverse

beam extends longitudinally along each row of bars transversely across rear end portions thereof for supporting each row of bars, and each row of bars having a substantial clearance between the successive bars, thereof in the region of said beam.

7. The combination of claim 6 and wherein the bars of each row have tapered rear ends providing the substantial clearance in the region of said beams.

8. The combination of claim 1 and wherein said bars all have smooth top surfaces for engaging and supporting the fuel and are all formed beneath said top surfaces thereof with openings through which combustion air flows.

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