June 5, 1934. V. M. CRUIKSHANK 1,961,552

AUTOMATIC STOKER FOR FURNACES

Filed July 11, 1930 6 Sheets-Sheet 1

Fig. 1.

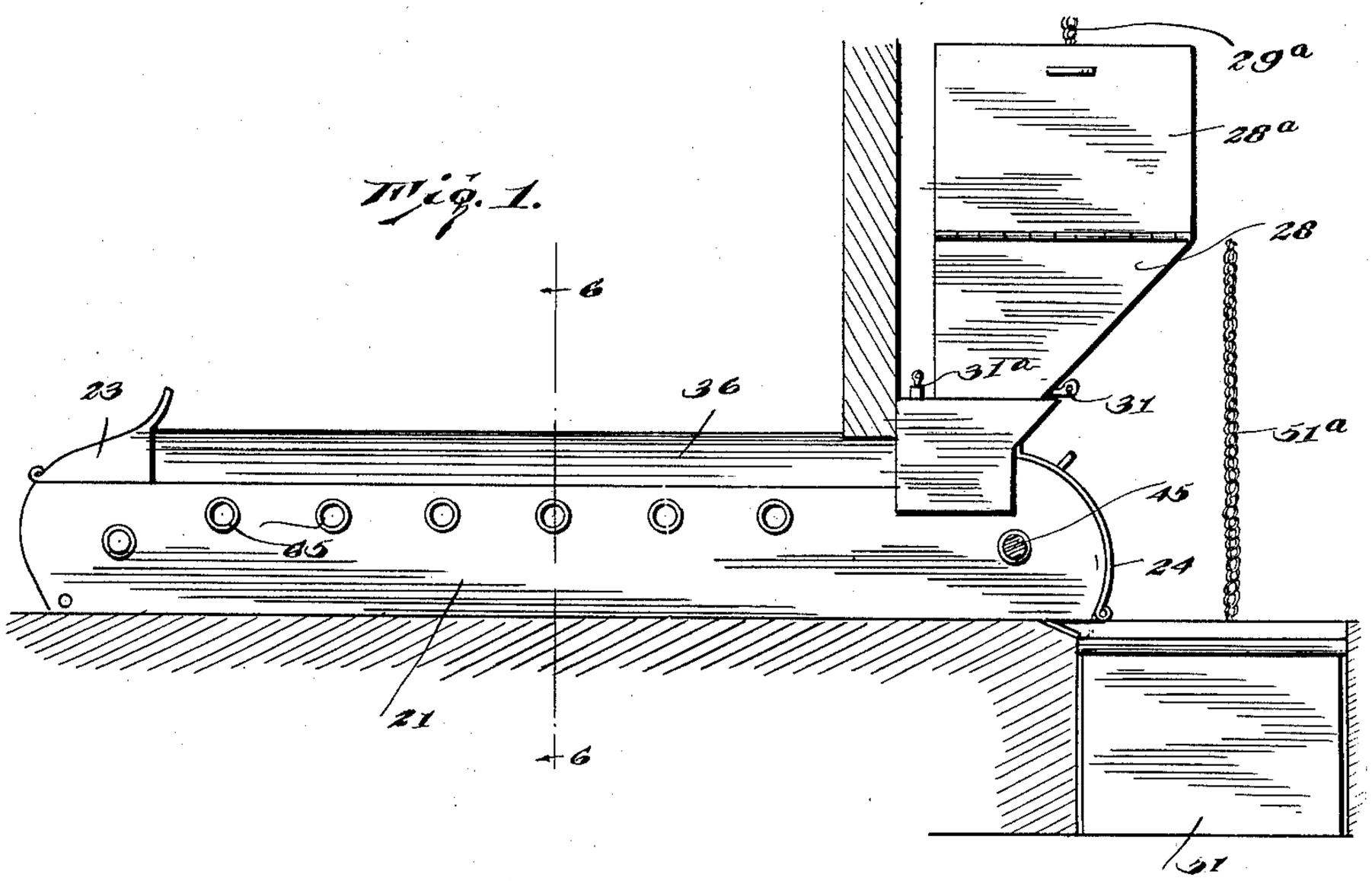


Fig. 2

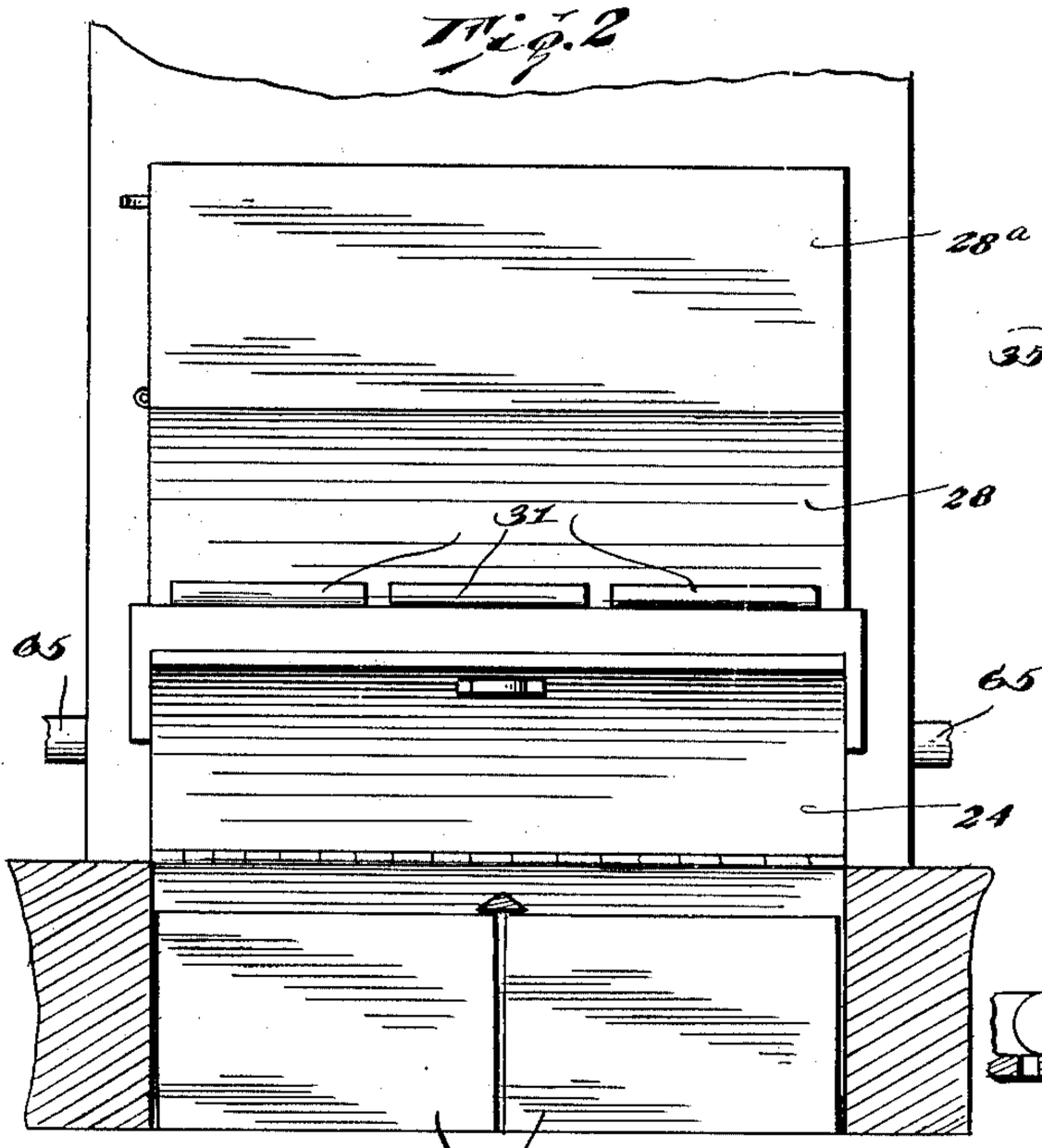


Fig. 3.

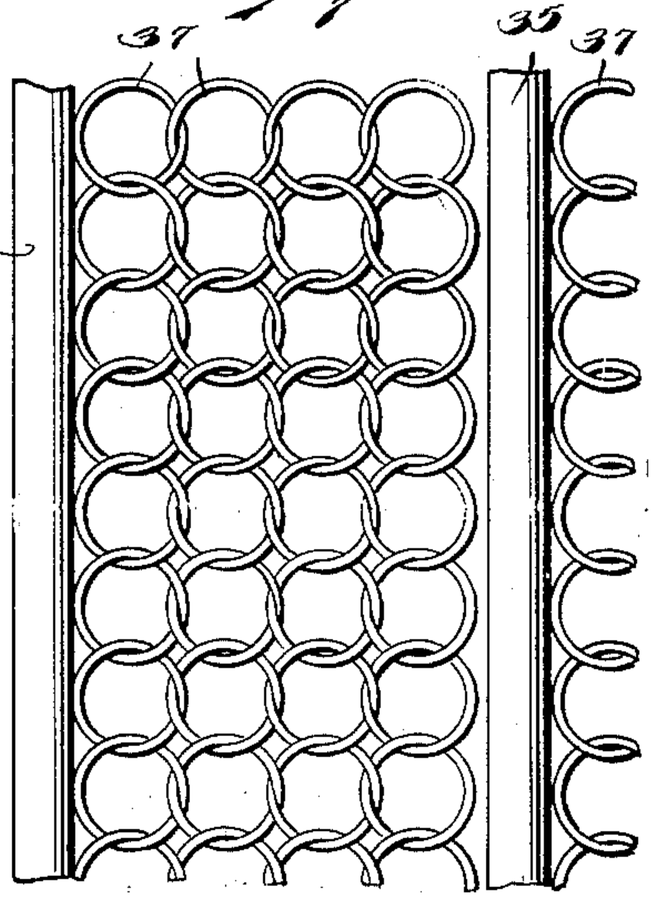
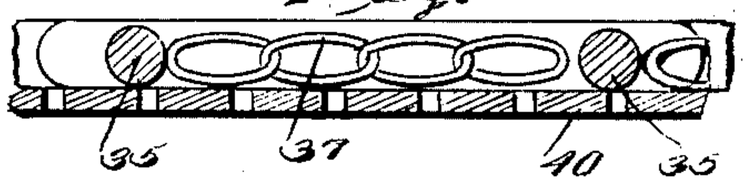


Fig. 4



WITNESS
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AUTOMATIC STOKER FOR FURNACES

Filed July 11, 1930 6 Sheets-Sheet 2

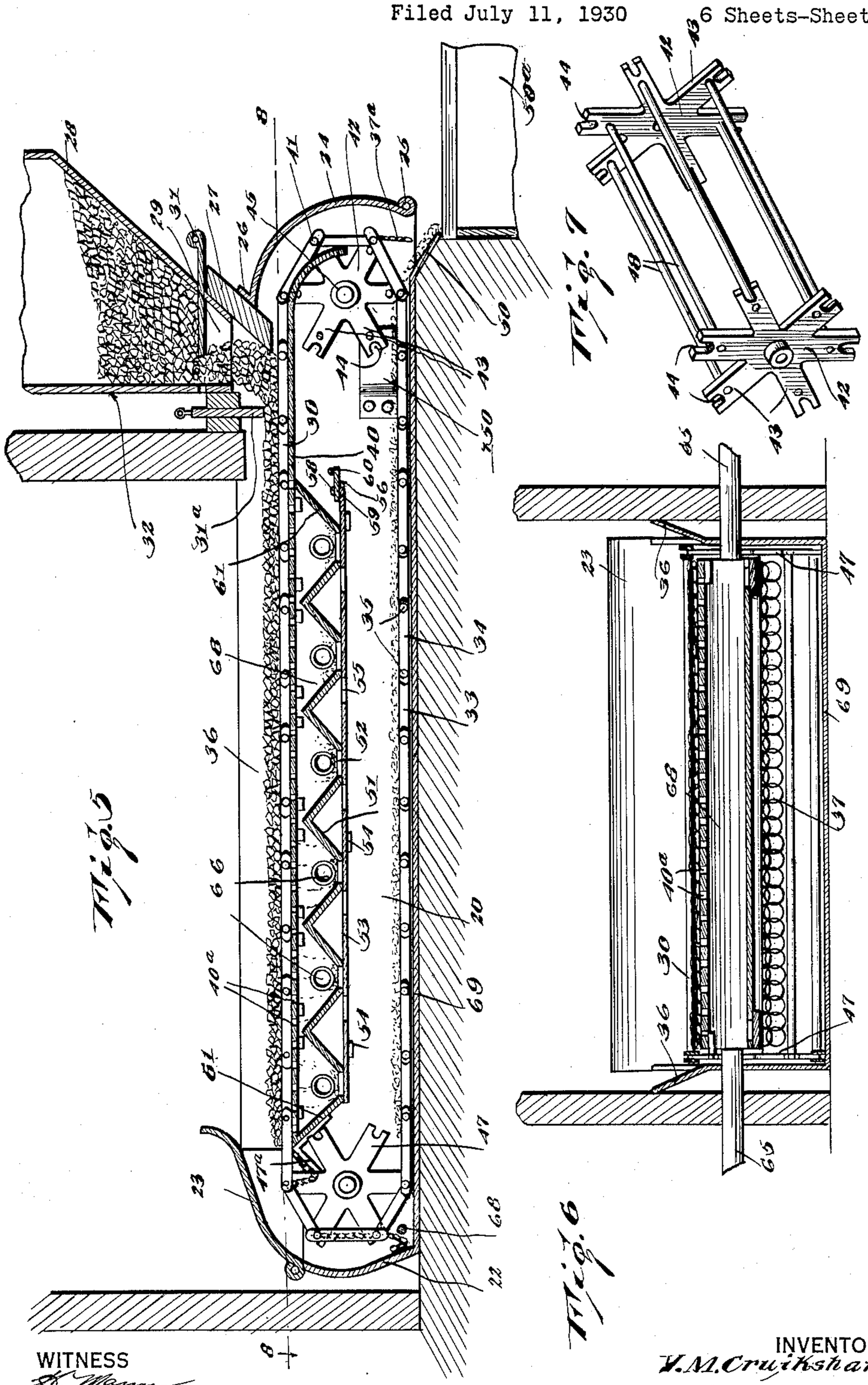

Fig. 5

Fig. 7

Fig. 6

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June 5, 1934. V. M. CRUIKSHANK 1,961,552

AUTOMATIC STOKER FOR FURNACES

Filed July 11, 1930 6 Sheets-Sheet 3

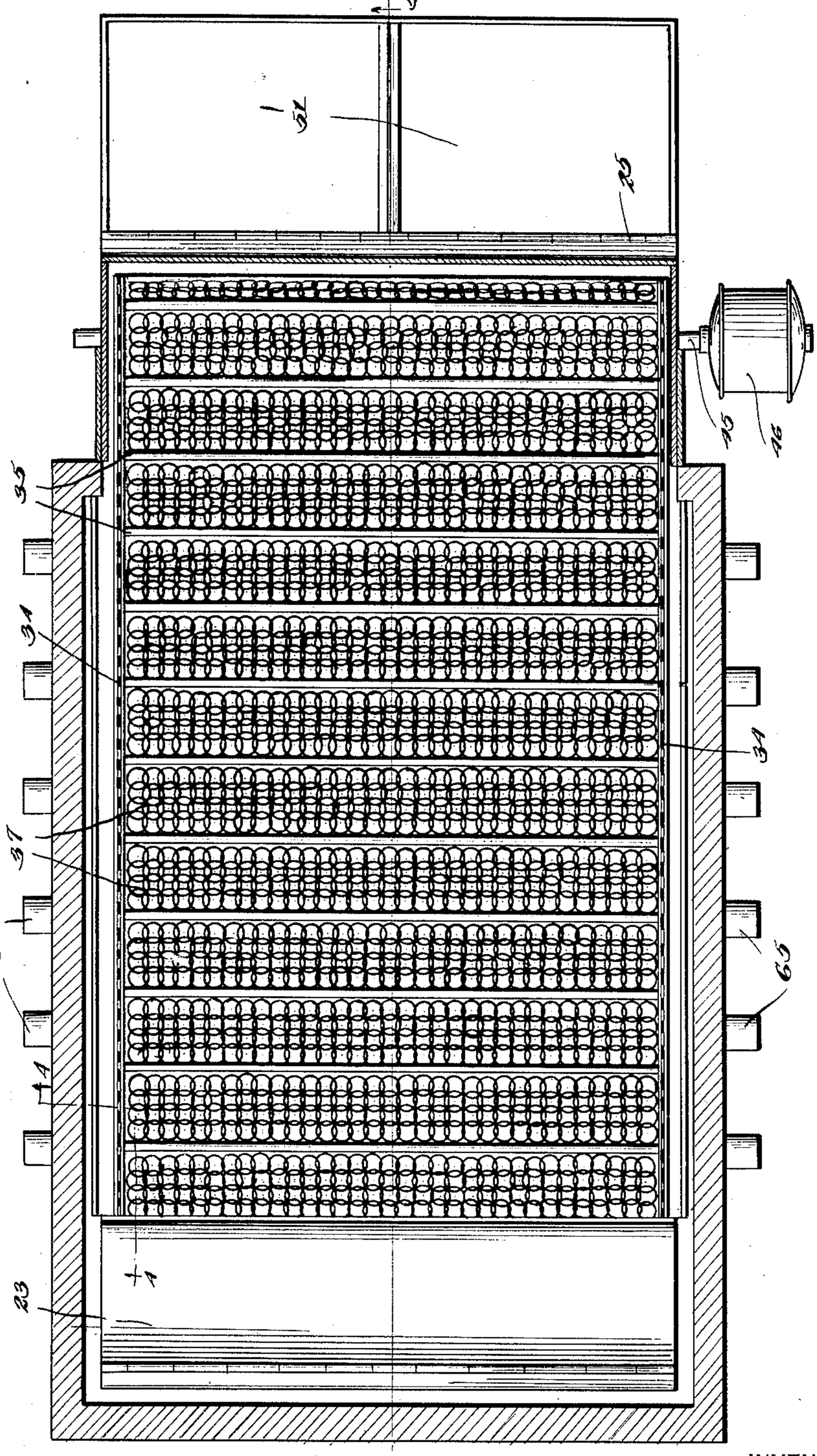

Fig. 1

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AUTOMATIC STOKER FOR FURNACES

Filed July 11, 1930 6 Sheets-Sheet 4

Fig. 9

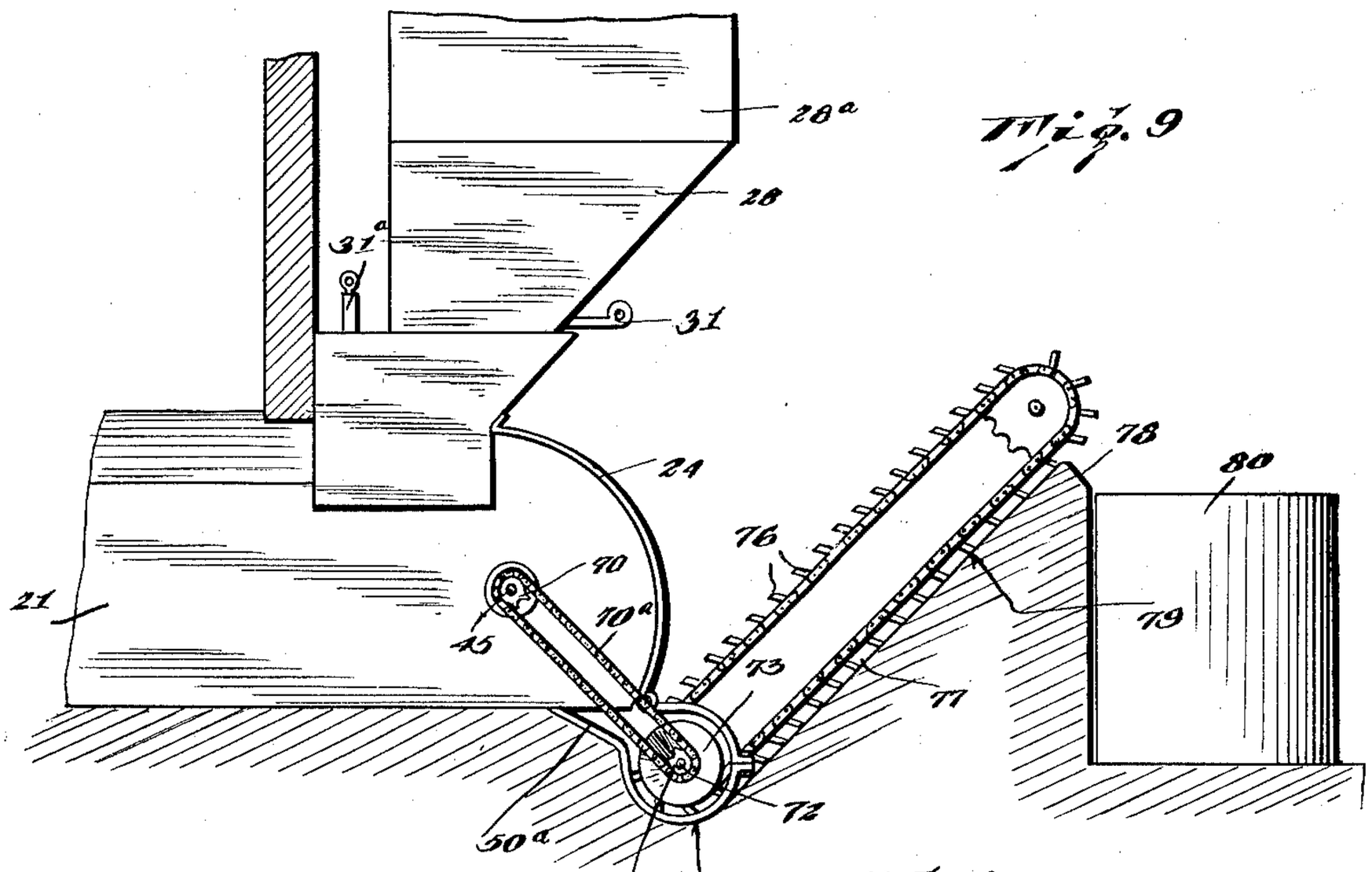

Fig. 10

WITNESS

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June 5, 1934. V. M. CRUIKSHANK 1,961,552

AUTOMATIC STOKER FOR FURNACES

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Fig. 11.

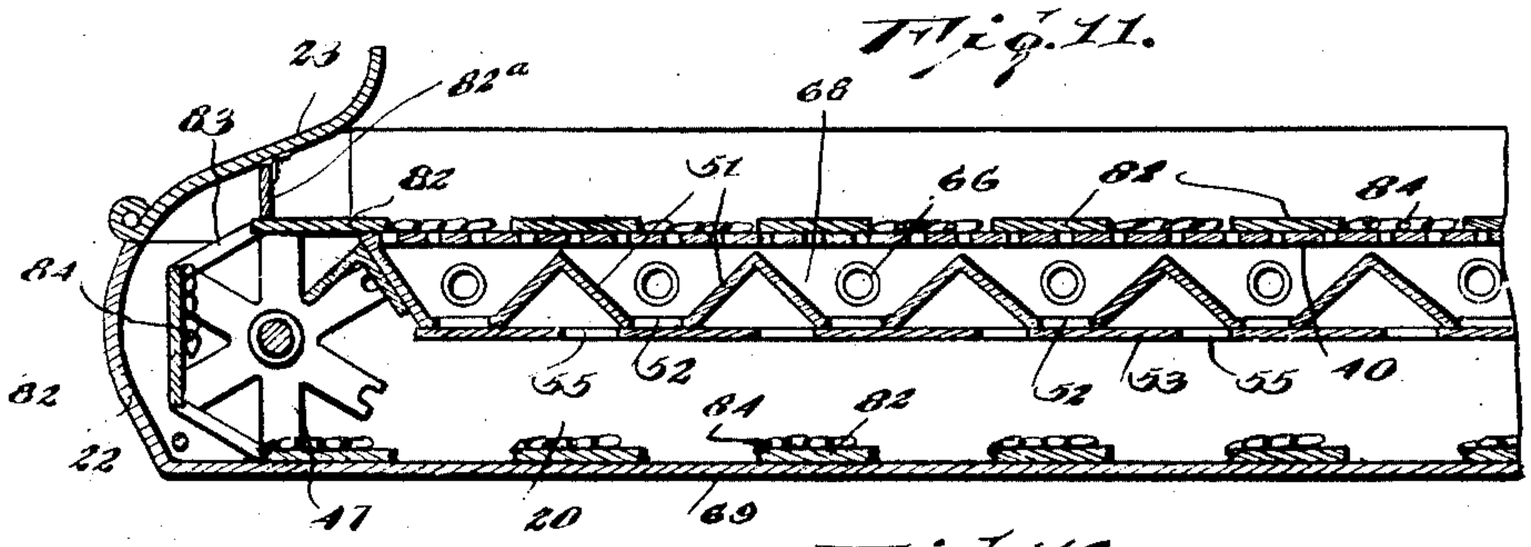

Fig. 12

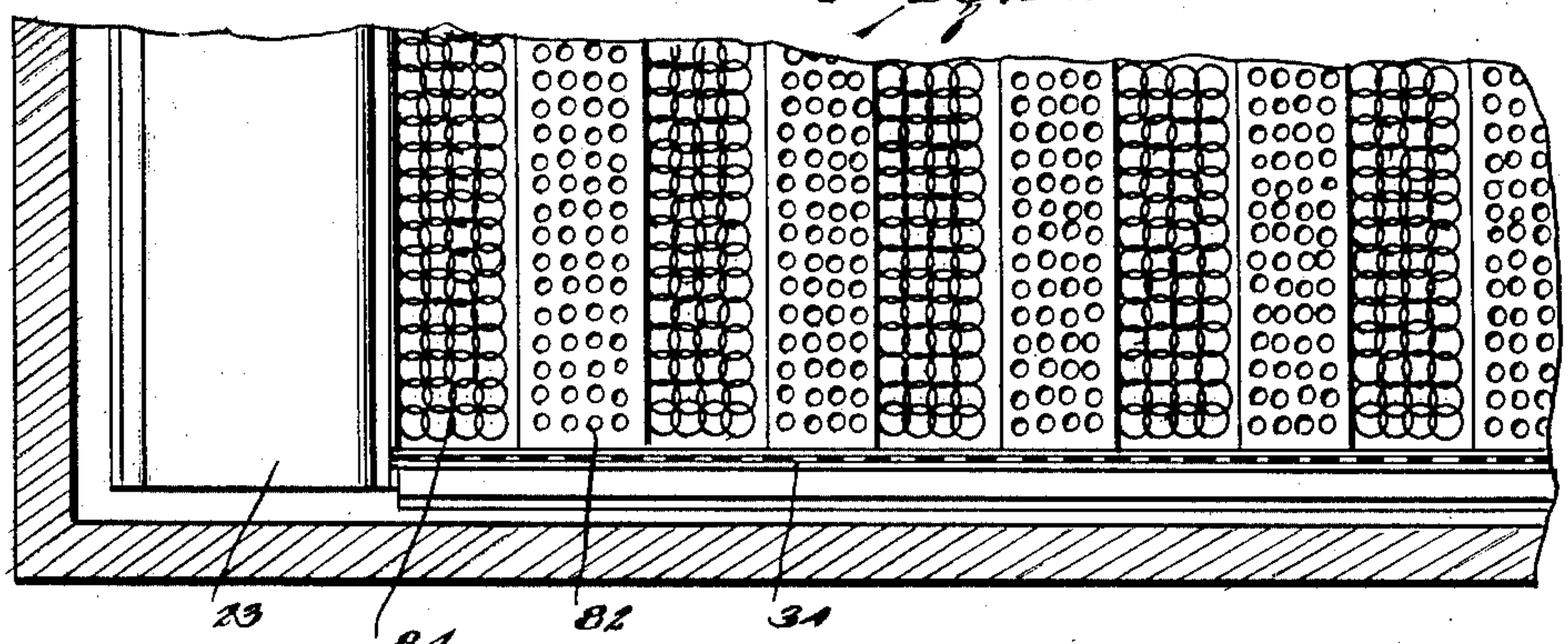

Fig. 13.

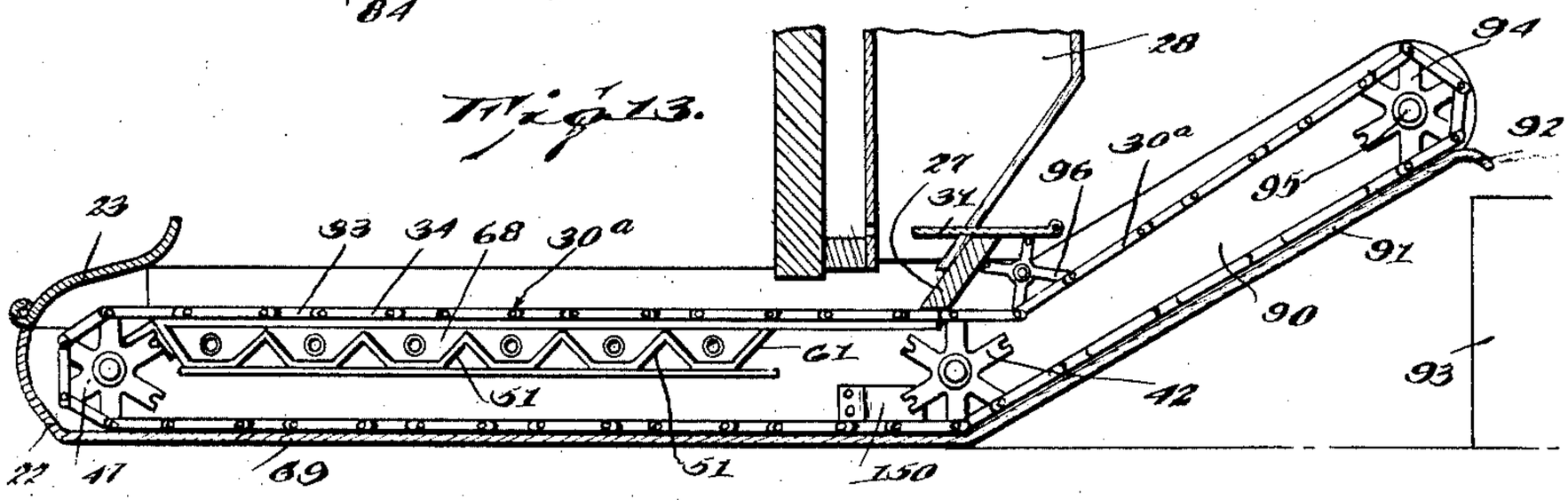

Fig. 15

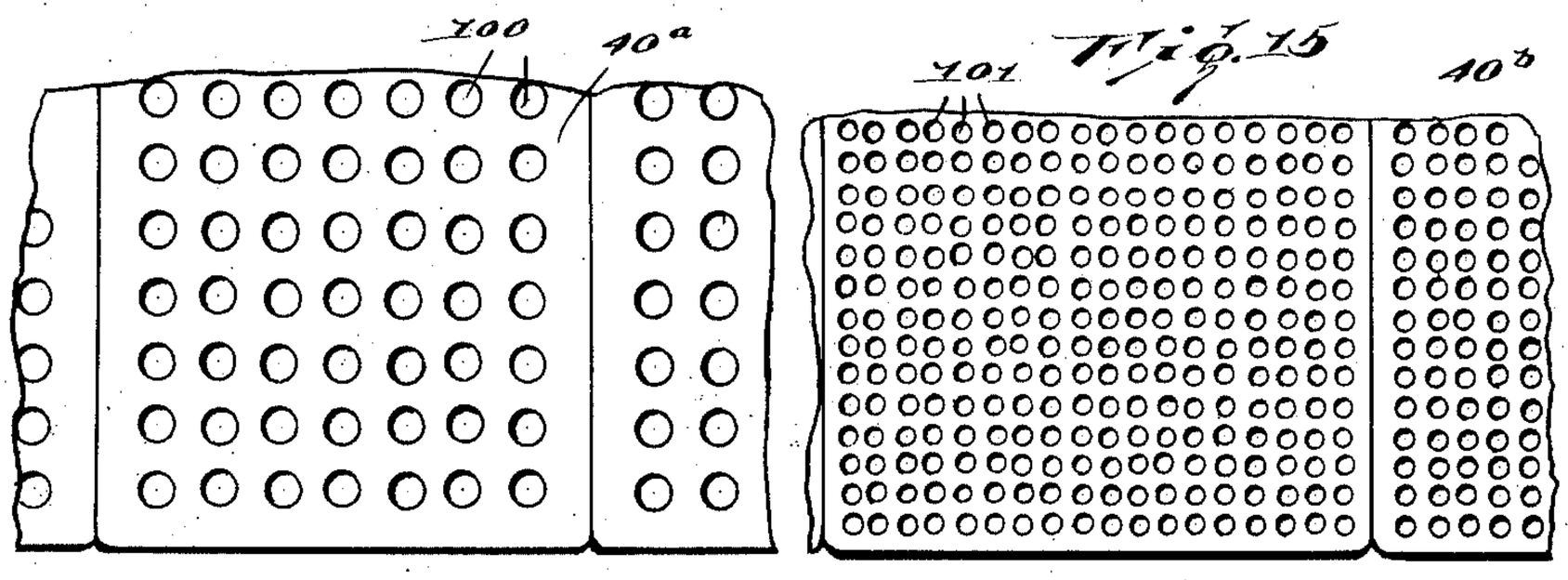

Fig. 14.

WITNESS
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AUTOMATIC STOKER FOR FURNACES

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Fig. 16.

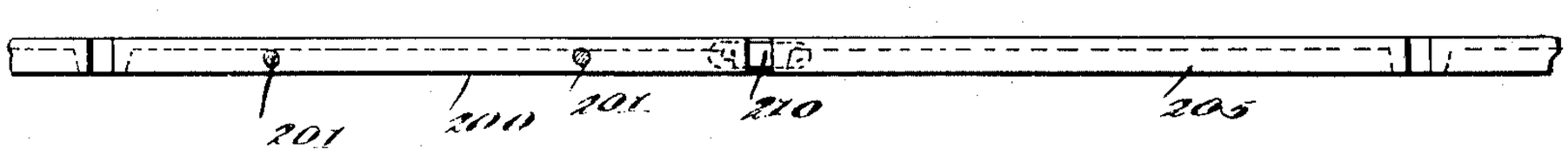


Fig. 17.

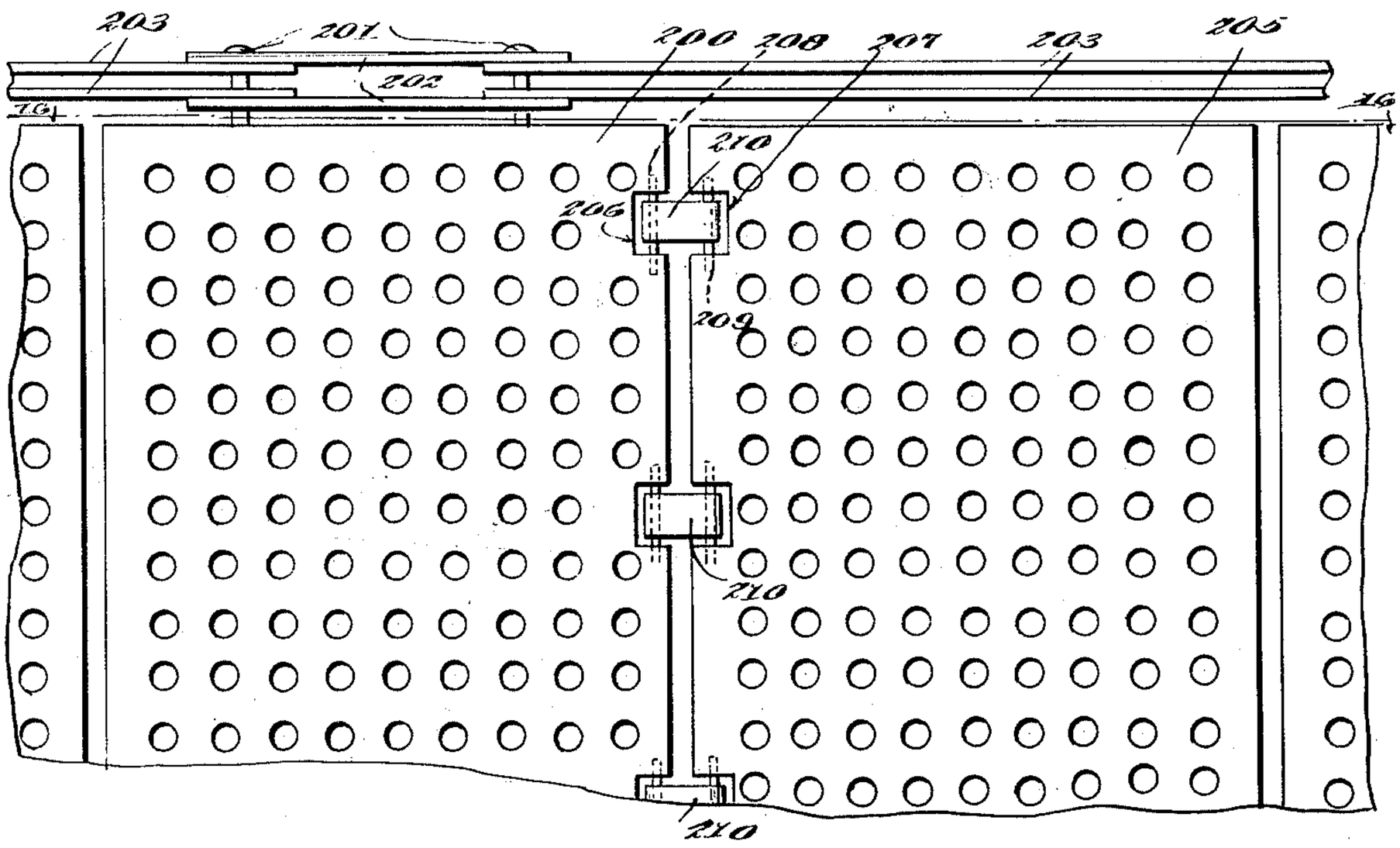


Fig. 18.

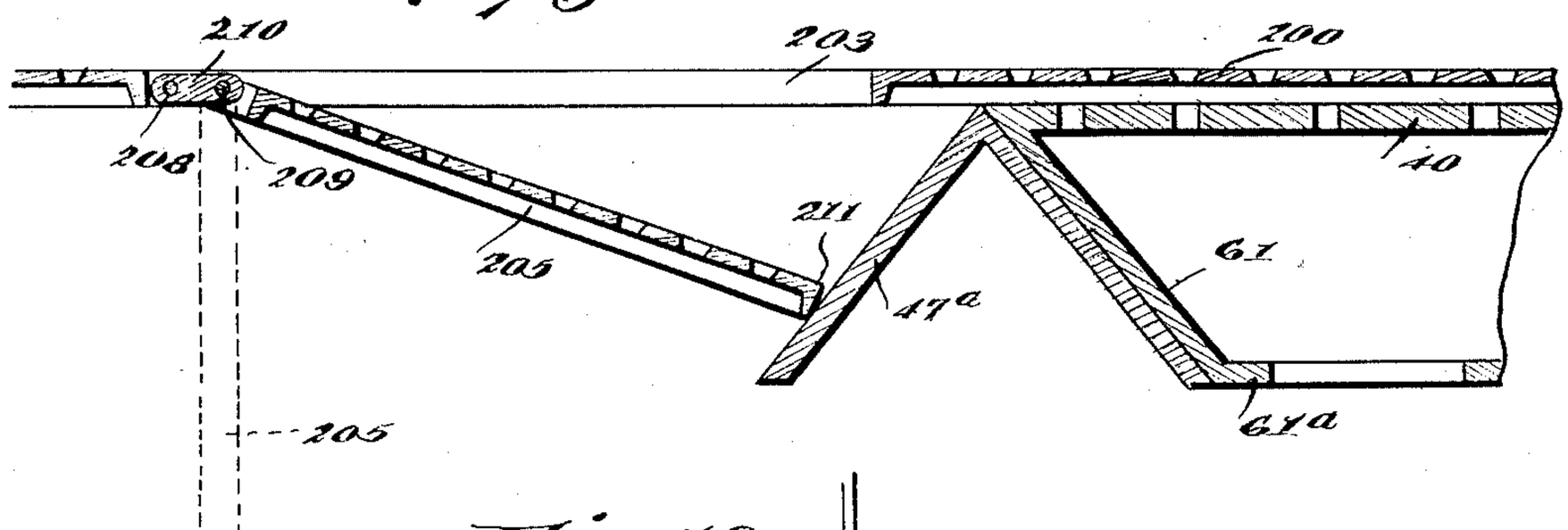
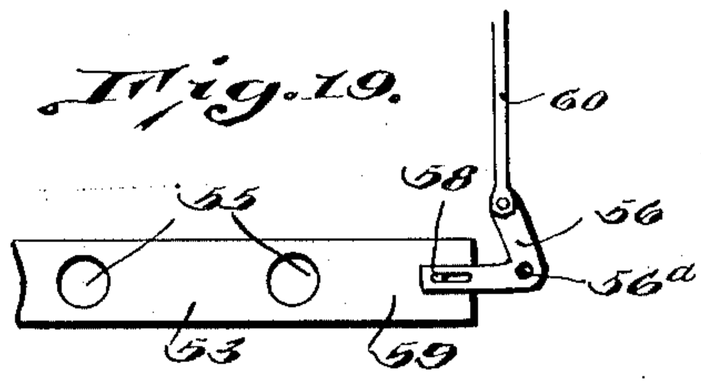


Fig. 19.



WITNESS

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Patented June 5, 1934 1,961,552

UNITED STATES PATENT OFFICE

1,961,552

AUTOMATIC STOKER FOR FURNACES

Virginius M. Cruikshank, Shamokin, Pa.

Application July 11, 1930, Serial No. 467,330

8 Claims. (Cl. 110—40)

This invention relates to automatic stokers for furnaces.

An object of the invention is the provision of a device for continuously feeding coal across the combustion plate of a furnace and for continuously removing the ashes of the consumed coal while supplying the combustible with the proper supply of air.

Another object of the invention is the provision or a device for continuously and automatically supplying the combustion plate of a furnace with fuel while providing means for the removal of the ashes from the fire box and carrying said ashes away from the box.

A further object of the invention is the provision of a device for feeding coal across the combustion plate of the furnace in a continuous manner by means of swingably mounted spaced plates of fabricated or rigid material which will deposit the ashes at the end of the grate, the ashes being received by preceding swingable members which are moving through the ash pit whereby the ashes are entirely removed from the furnace.

This invention will be best understood from a consideration of the following detail description, in view of the accompanying drawings forming part of the specification, nevertheless it is to be understood that the invention is not confined to the disclosure, being susceptible of such changes and modifications which shall define no material departure from the salient features of the invention as expressed in the appended claims.

In the drawings:

Figure 1 is a side view in elevation partly in section of a furnace equipped with a stoker constructed in accordance with the principles of my invention,

Figure 2 is an end view in elevation of a furnace equipped with my stoker partly in section,

Figure 3 is a fragmentary plan view of a section of the flexible conveyor for the coal,

Figure 4 is a fragmentary vertical section taken along the line 4—4 of Figure 8,

Figure 5 is a longitudinal vertical section taken along the line 5—5 of Figure 8,

Figure 6 is a transverse vertical section taken along the line 6—6 of Figure 1,

Figure 7 is a view in perspective of a sprocket for driving the conveyor,

Figure 8 is a horizontal section taken along the line 8—8 of Figure 5,

Figure 9 is a fragmentary side view in elevation showing a modified form of an attachment for removing ashes from the firebox,

Figure 10 is a fragmentary plan view partly in section of the device shown in Figure 9,

Figure 11 is a fragmentary vertical longitudinal section of a modified form of the conveyor,

Figure 12 is a fragmentary plan view partly in section of the conveyor shown in Figure 11,

Figure 13 is a longitudinal vertical section of a modified form of the conveyor,

Figure 14 is a fragmentary plan view of one form of the supporting plate for the conveyor,

Figure 15 is a fragmentary plan view of another modified form of a supporting plate,

Figure 16 is a longitudinal vertical section taken along the line 16—16 of Figure 17,

Figure 17 is a fragmentary plan view of a modified form of the invention,

Figure 18 is a longitudinal vertical section of the conveyor at the end of its travel,

Figure 19 is a fragmentary plan view of a slidably mounted ash dumping plate shown in Figure 5.

Referring more particularly to the drawings, 20 designates an ash pit having side walls 21 and an end plate 22 having a hinged member 23 which in co-operation with the end plate 22 provides a closure for one end of the furnace or stoker. A second end plate or closure 24 is hinged at 25 to the side walls 21 and has an annularly disposed flange 26 engaging a support 27 at one end of the furnace.

A hopper 28 has an open bottom portion 29 disposed above a travelling carrier generally designated by the numeral 30. A sliding valve 31^a is movable across the lower end of the hopper adjacent the open bottom for restricting the opening and for regulating the amount of coal which will be fed to the travelling carrier 30. The coal bunker or hopper 28 has the usual slanted bottom with an opening in the bottom extending approximately the width of the stoker and is preferably divided into sections. The section is provided with a controlling slide or valve 31 as shown in Fig. 2 so that in case it is desired to move the hopper for inspection or repairs or to remove the entire stoker, the hopper may be lifted by a hoist 29^a and conveyed away without necessitating emptying the hopper. The hoist may be mounted on a track for conveying the hopper to a place when the hopper may be readily refilled.

An important feature of the hopper is the hinged end wall 28^a. The wall may be moved outwardly on its hinges and lowered to permit

ready filling from the sides in those cases where there is insufficient head room for overhead filling. This construction however, does not permit complete filling of the hopper. After the wall 28a has been returned to its normal closed position, the small unfilled space at the door may be supplied with the requisite amount of fuel.

The slidably mounted leveler 31a is mounted in a vertical position adjacent the straight wall 32 of the hopper 28 and is adapted to have its lower end normally supported at a predetermined distance above the travelling carrier in order to control the depth of the coal on the travelling carrier.

The travelling carrier consists of a plurality of links 33 and 34 hingedly mounted on rods 35 which extend transversely of the ash pit 20 and have their side edges adjacent coal guards 36. Swingably mounted on each rod 35 is a section of fabricated or rigid material 37 and these sections are of a width that they will nearly extend between a pair of rods 35 and are supported in a horizontal plane when passing through the fire-bed preferably by a horizontal combustion plate 40 provided perforations 40a. This plate may be made in sections so that if it be desirable to replace or remove portions of the plate this may be done without necessitating the removal of the entire plate. The forward end of the plate is curved downwardly as shown at 41 for a purpose which will be presently explained.

The combustion plate 40 is of the proper width for the boiler fire box and extends from a point outside of the boiler to a point near the rear driving sprockets inside the boiler.

The travelling carrier 30 is driven by a sprocket 42 which has arms 43 provided with notches 44 receiving the rods 35. The annular disposition of the arm 43 or the chain links is such in connection with the spacing of the rods 35 that the notches will always receive the rods or chain links during the continuous travel of the travelling carrier 30. The sprocket 42 is driven by a shaft 45 in any approved manner as by a motor 46 connected with the shaft through reducing gears and necessary shifting. The speed of the shaft is dependent upon the type of coal employed, the complete combustion of the coal during its travel over the combustion plate and size of the combustion plate.

An idler sprocket 47 is located at the opposite end of the fire box and is similar in construction to the sprocket 42 except that the arms 43 of the sprockets 42 are connected together by means of rods 48 which are located below the notches 44. No rods are employed in connection with the sprocket 47. These rods aid in crushing possible cinder formation at the forward end of the device after the ashes and the cinders are discharged from the combustion plate.

Since the travelling carrier 30 is continuous it will move over the plate 40 and then downwardly to the bottom of the ash pit whence it moves in an opposite direction so that it will not only carry the coal through the fire box but will return the ashes to an inclined plate 50 whence said ashes will fall by gravity into a pit 50a or other suitable container or the plate 50 may direct the ashes upon a travelling carrier whereby the ashes are conveyed away from the furnace.

A plurality of inverted V-shaped members 51 are located below the supporting plate 40 and transversely of the ash pit thereby providing inclined surfaces to receive any ashes passing through the plate 40 and for guiding said ashes towards transversely disposed openings 52 formed between the lower edges of the adjacent V-shaped members. A slidably mounted plate 53 is supported by transverse bars 54 secured to the side walls of the ash pit and provided with openings 52 between the deflecting members 51.

A bell crank 56 is connected by means of a slot and pin construction 58 with an extension 59 formed at one end of the plate 53 and an operating rod 60 is connected with the lever 56 pivoted at 56a for reciprocating the plate 53 in order to cause the openings 55 to aline with the openings 52 and permit the ashes deflected by the members 51 to be blown into the ash pit 20 by air pressure supplied to air chamber as hereinafter described. Or it can be operated automatically at given intervals by an eccentric on drive shaft and suitable linkages and levers.

This inverted V-shaped construction together with the burner plates 40, end plates 61 and the stoker side frame form an especially designed air chamber to which may be connected a blower to provide sufficient air pressure to force air through the perforations in burner plates 40 to insure proper combustion under all operating conditions. Of course this can be cast as a whole or in parts as specified according to the manufacturing facilities or as preferred.

End plates 61 are secured in place and are inclined at an angle to the vertical and cooperate with the deflectors 51 aiding in causing the ashes which may pass through the perforated plate 40 adjacent the members 51 to be moved downwardly towards the respective openings 52.

The side walls 21 are provided with pipes 65 for supplying air to the air compartment 68 and beneath the perforated plate 40. Blowers, if desired, may be attached to the pipes to provide a forced draft, the air compartment is of special construction and is defined by the perforated combustion plate 40, the end plates 61, the side plates 66 and the V shaped members 51 which are connected together at their lower ends to provide in effect a bottom for the compartment. The pipes 65 are preferably connected to manifolds which are in communication with an air supply. The manifolds as is well known provide for an even distribution of the air to the perforated plate 40.

Said manifold may be built or cast as a part of the air chamber construction with a single outlet to the blower if desired.

The operation of the device shown in Figures 1 to 8 inclusive is as follows: The coal from the hopper 28 is fed through the open bottom 29 and the valve 31 controls the amount of coal falling upon the travelling carrier 30. As the motor 46 is placed in operation it will cause the sprocket 42 to be revolved thereby driving the travelling carrier in a direction indicated by the arrow in Figure 5 and the leveler 31a will limit the height of the layer of coal on the travelling carrier. As the coal is moved over the combustion plate it is consumed so that when the coal reaches the outer-most limit of travel it has been converted into ashes and cinders.

As long as the swinging members or fabricated sections 37 move upon the combustion plate 40 they are maintained in a horizontal position but as soon as they pass from within the inner end of said plate they will fall downwardly discharging the ashes on preceding sections of the travelling carrier which are moving through the ash pit 20 since the sections of the travelling carrier move

to the vertical position by gravity when they reach the sprocket 47. Shoes 47ª are provided adjacent the inner end of the combustion plate and above the outer end of the ash plate and said shoes are inclined at an angle to the horizontal so that the swinging member 37 of the travelling carrier breaks the fall of the swinging members as they dump the ashes thereby giving a smooth and silent operation. At the lower-most portion of the sections at the inner end of the ash pit 20 said sections will engage a transversely disposed rod 68 thereby causing said flexible section to follow the rods 35 in a horizontal plane upon the bottom 69 of the ash pit 20. As the ashes are blown through the holes 52 and 55 and as the ashes are deposited at the end of their travel adjacent this sprocket 47 said ashes will be deposited upon the swingable sections of the travelling carrier and be moved in the reversed manner to the travel of the coal and being deposited upon the inclined members 50 whence they will fall by gravity into the container 51.

When the swingable sections are moving they return to the coal carrying position adjacent to the hinged cover 24 and they will again fall to a vertical position as shown at 37ª thereby aiding in dumping the ashes from the sections on the inclined member 50 so that when the sections are again returned to a position beneath the open end 29 of the hopper 28 they will be free of ashes and receive the coal from said hopper. It will be noted that the feeding of the coal to the fire box is continuous and automatic as is also the removal of the ashes.

The amount of coal fed and burned may be regulated by controlling the depth of the coal bed, or the feed, or it may be regulated by varying the speed of the apron or the air supply or by the "on" and "off" system or by a combination of any of these well known methods of control.

In Figures 9 and 10 is shown a modified form of the front end of the furnace where the ashes are removed. In this instance a sprocket 70 is secured to the shaft 45 and a chain 70ª trained on said sprocket and a sprocket 71 secured to a shaft 72 whereby the shaft is driven and likewise a duplex or reverse threaded screw conveyor 73 mounted in a transversely disposed channel member 74 which receives the ashes from an inclined plate 50ª.

A plurality of travelling carriers 75 are located in spaced relation at the discharge end of the furnace and are provided with a plurality of disposed plates 76 moving through a restricted channel member 76 so that they will move the ashes from the member 74 upwardly and over the inclined edge 78 of the conveyor slide where the ashes are deposited in container 80 spaced at intervals in accordance with the spacings of the travelling carriers 75.

The construction of the internal mechanism of the furnace as shown in Figures 9 and 10 is identical with the construction described in connection with Figures 1 to 8 inclusive.

In Figures 11 and 12 is shown a modified form of the travelling carrier or conveyor for the coal. In this instance alternately disposed carrier plates 82 are connected together by means of links 83 thereby providing spaces between the adjacent edges of the plates wherein fabricated or rigid sections or trailer aprons 84 are swingably connected to a longitudinal edge of each plate and lie normally in a horizontal plane when moving over the perforated plate 40. They also lie in a horizontal plane when moving over the bottom 69 of the ash pit 20. The travelling carrier in this instance is revolved by the sprockets 43 and supported by the idler sprockets 47 in the same manner as that described for the travelling carrier in Figures 1 to 8 inclusive. However, in this instance the swingable sections or aprons 84 alone fall downwardly when they reach the end of the travel adjacent the end sprocket 47 while the plates 82 follow the edges of the sprockets 47 and are cleaned of ashes by the hinged scraper 82ª. As the plates 82 and the flexible sections 84 move across the bottom 69 of the pit 20 they will receive the ashes and carry them to the discharge end of the furnace, the swingable member now riding on the back or top of the fixed carrier plate instead of trailing behind it.

The furnace constructions shown in Figure 13 are similar to the previously described construction, except that the travelling carrier 30ª is made of sufficient length that it will extend through a passage 90 while carrying the ashes over an inclined base member 91, whence they will be discharged across the curved lip 92 to a container 93. An idler sprocket 94 is mounted on a shaft 95 and supports the outer, upper end of the travelling carrier. An idler sprocket 96 engages the travelling carrier at points adjacent to where the travelling carrier passes beneath the opened end of the hopper 28 in order to prevent frictional contact of the travelling carrier with the supporting member 27 while maintaining the incoming portion of the travelling carrier in spaced relation with the outgoing portion of the travelling carrier.

By this construction it is possible to convey the ashes directly away from the furnace by a single conveyor. Figure 14 illustrates the sections of a modified form of support plate 40ª in which the perforations 100 are considerable size and which is suitable for burning coal of rather large dimensions.

In the form shown in Figure 15 the sections of the supporting plate 40ᵇ are provided with reduced passages 101 and this type of plate is suitable for use in connection with burning coal which is formed into small lumps or finer sizes.

In all of the constructions a pair of cinder plate guides 150 are welded or riveted to the sides of the stoker frame and the free ends are curved inwardly to direct large cinders, slate and etc. towards the travelling carrier 30, and away from the sprockets and the driving chains. The guides are located adjacent the driving sprockets 42.

While there is normally no cause for any material cindering of the coal because of the large combustion area, it is possible, however, that certain conditions may cause excessive cindering and the rods 48 of the "squirrel cage" sprockets (Fig. 7) will break up the cinders as they are moved through the same at the outer end of the path of the travelling carrier and where the ashes are dumped from the combustion plate.

It will be noted that the duplex screw conveyor at the opposite or front end of the stoker will move the ashes in opposite directions for feeding pairs of the travelling carriers which remove the ashes from the ash pit. Each of the trailer aprons forming part of the travelling carrier passing over the combustion plate are of a flexible nature. However, these aprons may be formed of rigid material perforated and pivoted in order that they may drop to a dumping position when they leave the outer end of the combustion plate or they may be formed of sections

which are joined or riveted together, or linked, in any approved manner but will be of a relatively rigid nature in order to support the coal on the combustion plate. In this case the combustion plate 40 could be eliminated entirely and the swingable members supported by rails if preferred.

One end of the drive shaft of the "squirrel cage" sprockets may be extended and shaped to accommodate a wrench or crank so that the stoker may be operated by hand for inspection, repair, or to rid the combustion table from action during the firing. This crank arrangement may also be employed when the motive power fails.

The combustion table is made in sections so that parts may be removed or replaced without necessitating the removal of the entire traveling carrier or related parts or table. This replacement quality of the sections permits the removal of the section so that another section may be substituted which will give more or less air as may be desired. In cases where it is found that the combustion plate of ordinary build is too large the sections may be replaced with blank plates to accommodate the reduced space in which the combustion plate or table must operate. On the other hand the sectional construction of the plate permits the addition of other sections.

The duplex screw when rotated in one direction will remove ashes to the ends of the screw from the central point and may be picked up by several elevators. On the other hand, when the screw is rotated in the opposite direction it will remove the ashes to a central point where they may be carried by a single conveyor. This duplex screw can also be placed so as to receive the ashes as they fall at the inner end of the combustion plate 40 adjacent sprocket 47 with ash containers located at either side of boiler if conditions so suggest.

The apron may be made of sections jointed, pivoted, or linked together and be of a relative rigid nature, the entire section falling at the end of the table. However, it may be in the form of a solid bar but instead of being fastened rigidly or permanently fixed to the conveyor chain, it would be hinged, linked or pivoted, or otherwise fastened in such a manner that it would be free to drop at the trailer end to deposit the ashes.

The hinged member 23 forms an ash guide. The downwardly curving of the guide provides a shoe to break up the coal when it tends to fuse and form a sheet which may extend over the end sprocket, the guide causing the broken up sheet of coal to fall to the conveyor at a lower level. The hood or guide 23 is a separate attachment whence it will not interfere with the placing of the stoker when head room is at a premium.

A modified form of conveyor is shown in Figures 16 to 18, inclusive. In this type perforated flat metal plates 200 are connected to the pins 201 in any approved manner for supporting said plates on links 202 of the chain drive for the conveyor. Intermediate links 203 are pivoted on the pin 201 and extend in pairs in opposite directions from the links 202.

To each plate 200 is hingedly connected a perforated plate 205. The adjacent edges of pairs of the plates 200 and 205 are cut away, respectively, as shown at 206 and 207. A pin 208 is carried by the plate 200 and is located within the notch 206. A pin 209 is carried by the plate 205 and is disposed within the notch 207. A block 210 has transverse passages at its ends to receive the pins 208 and 209 for swingably mounting the plate 205 from an adjacent edge of the plate 200. A plurality of the blocks 210 are spaced in transverse relation of an edge of each plate 200 for swingably supporting each plate 205 from an edge of a plate 200. The remaining parts of the furnace are identical in construction with the elements previously described.

When the travelling carrier consisting of the plates 200 and 205 and the chain drive are in movement the free edges 211 of the swingable plates 205 will ride upon the inclined member 47ª after said plates leave the combustion plate 40 and the plates 205 will move to a vertical position gradually thereby preventing rapid dropping of said plates and eliminating noisy operation. The downward movement of the plates 205 while the travelling carrier is being engaged by the sprocket 47 provides for the dumping of the ashes. Both plates 200 and 205 are hollowed out on the underside to allow free passage of air from perforations in the combustion plate 40 to perforations in plates 200 and 205.

I claim:

1. In a furnace having an ash pit and firebox, a stoker comprising an endless traveling member having alternately disposed rigid and swingable fuel supporting sections extending transversely of the member with each swingable section attached to the preceding rigid section, and means for supporting the swingable sections in horizontal planes when said sections are traveling through the firebox and ash pit, said supporting means terminating adjacent the ends of the traveling member, the swingable sections assuming a vertical position when unsupported.

2. In a furnace having an ash pit and a fire box, a stoker comprising an endless travelling member having alternately disposed rigid and swingable fuel supporting sections extending transversely of the member, the swingable sections being secured along a transverse edge of the rigid sections, said swingable sections adapted to fall into a vertical position when unsupported in flat contact with the respective rigid sections, means for supporting the swingable sections in the upper run of the traveling member in a horizontal plane when said sections are traveling through the fire box, the swingable sections resting on the rigid sections when passing through the ash pit.

3. In a furnace having an ash pit and a fire box, a stoker comprising an endless travelling member having swingable fuel supporting sections secured along one edge transversely of the member, said sections adapted to fall into a vertical position when unsupported, means for supporting the swingable sections in horizontal planes when said sections are travelling through the ash pit and fire box, the swingable sections comprising a plurality of drag chains formed of links, spaced rigid members connected with the links, the sections being hinged to the rigid members.

4. In a furnace having an ash pit and a firebox, a stoker comprising an endless traveling member having alternately disposed rigid and flexible swingable fuel supporting sections extending transversely of the member with each swingable section attached to the preceding rigid section, said flexible sections adapted to fall into a vertical position when unsupported, means for supporting the flexible sections in a horizontal plane when said sections are travelling through

the fire box, the flexible sections being supported on the rigid sections when passing through the ash pit, and means for supporting the rigid sections in a horizontal plane when passing through the ash pit.

5. In a furnace having an ash pit and a fire box, a stoker comprising an endless travelling member having swingable fuel supporting sections secured along one edge transversely of the member, said sections adapted to fall onto a vertical position when unsupported, means including an ash pit floor for supporting the swingable sections in horizontal planes when said sections are travelling through the ash pit and fire box, sprockets, said travelling member being trained on the sprockets, means for driving one of the sprockets, the supporting means terminating adjacent one of the sprockets to permit the swingable sections to fall into a vertical dumping position, one of the pairs of sprockets having a plurality of rods cooperating with the floor of the pit for breaking up the ashes as they are discharged from the ash pit.

6. In a furnace having an ash pit and a fire box, a stoker comprising an endless travelling member having swingable fuel supporting sections secured along one edge transversely of the member, said sections adapted to fall onto a vertical position when unsupported, means including an ash pit floor for supporting swingable sections in horizontal planes when said sections are travelling through the ash pit and fire box, sprockets, said travelling member being trained on the sprockets, means for driving one of the sprockets, the supporting means terminating adjacent one of the sprockets to permit the swingable sections to fall into a vertical dumping position, one of the sprockets having a plurality of rods cooperating with the floor of the pit for breaking up the ashes as they are discharged from the ash pit, and shoes adjacent the last-mentioned sprocket for guiding the ashes toward the rods.

7. In a furnace having an ash pit and a firebox, a stoker comprising an endless traveling member having alternately disposed rigid and swingable fuel supporting sections extending transversely of the member with each swingable section attached to the preceding rigid section, means for supporting the swingable sections in a horizontal plane when said sections are traveling through the firebox, said supporting means terminating adjacent the ends of the traveling member, the swingable sections assuming a vertical position when unsupported, spaced sprockets upon which the traveling carrier is trained, and a swingable scraper located adjacent a sprocket for removing ashes from the rigid sections when the swingable sections are moving to dumping position.

8. In a furnace, an endless stoker composed of fixed sections and swingable sections, the swingable sections being disposed in alternate relation with the fixed sections, each swingable section being pivotally connected with a fixed section, means for supporting the fixed sections and swingable sections in horizontal alignment for a portion of the travel of the endless stoker through the furnace, each swingable section being adapted to be folded upon its associated fixed section when the sections travel through the ash pit.

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