Feb. 5, 1957 C. K. BIRCH 2,780,187

ASH REMOVAL APPARATUS

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FIG. 1

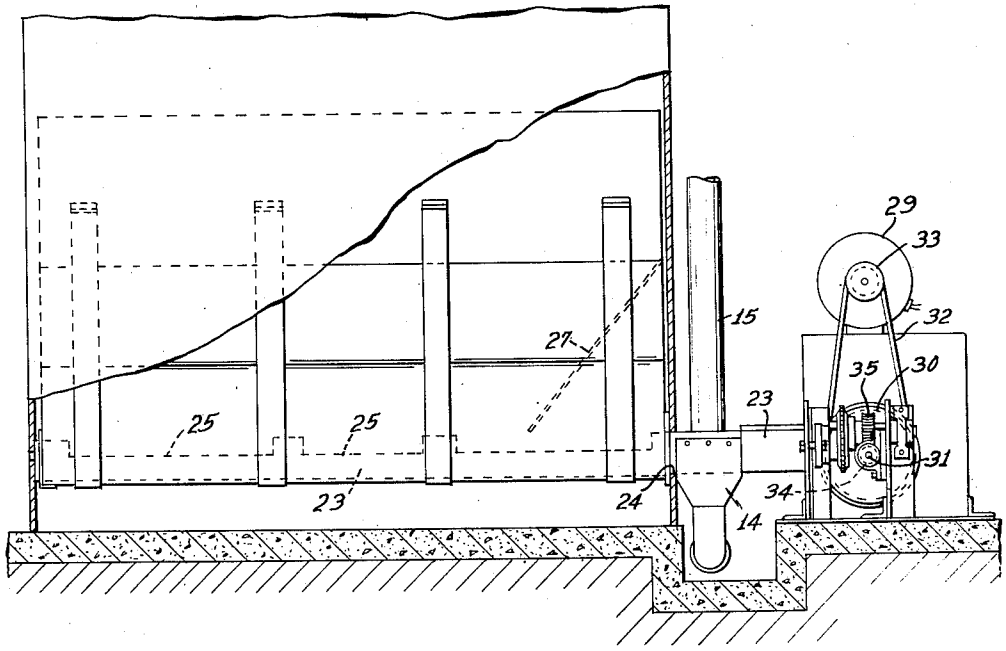
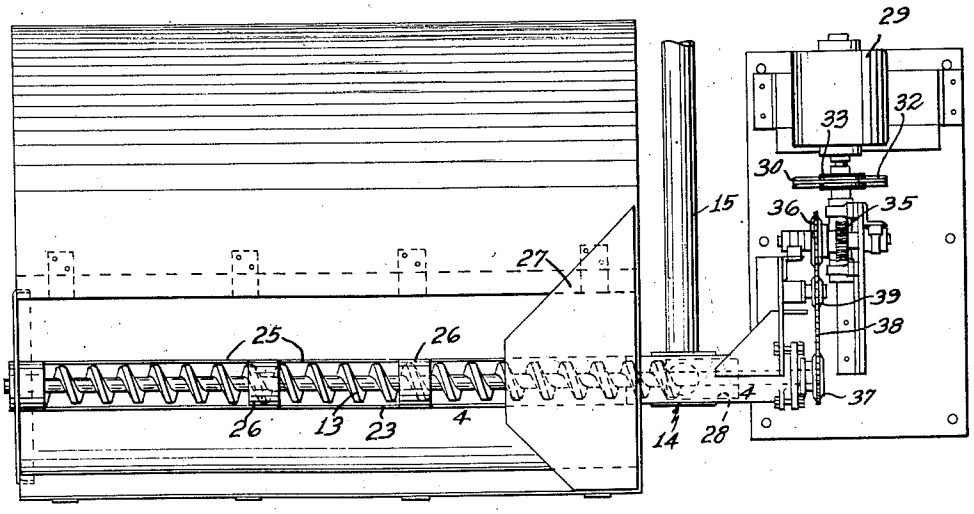



FIG. 2




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FIG. 3

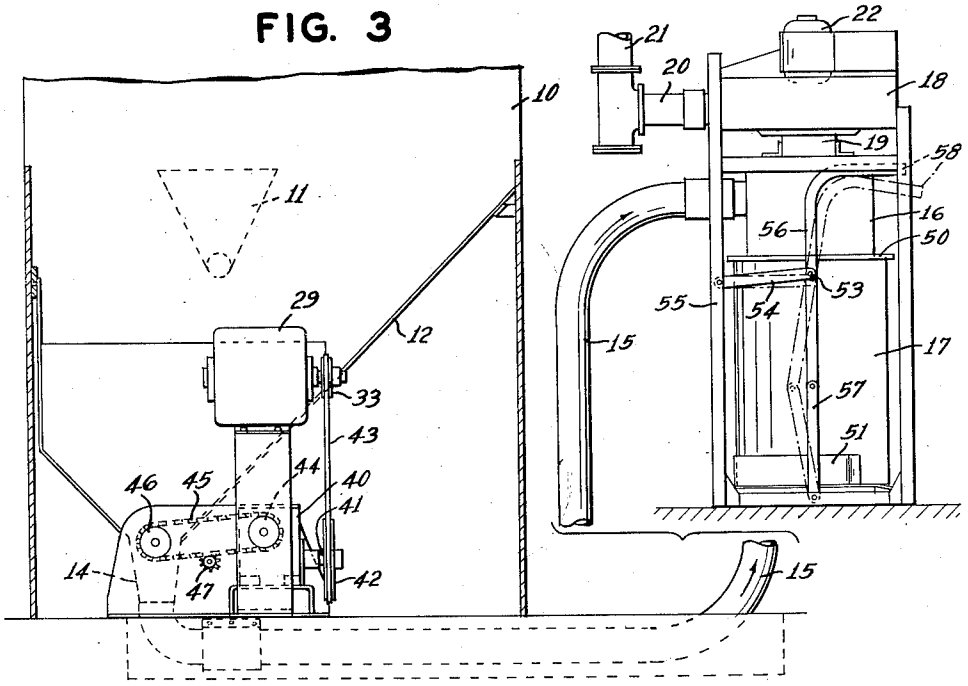



FIG. 5

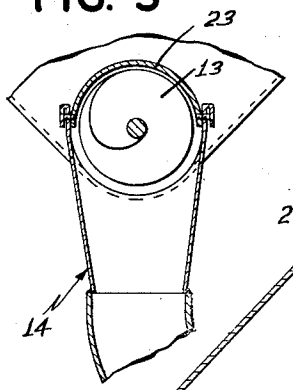
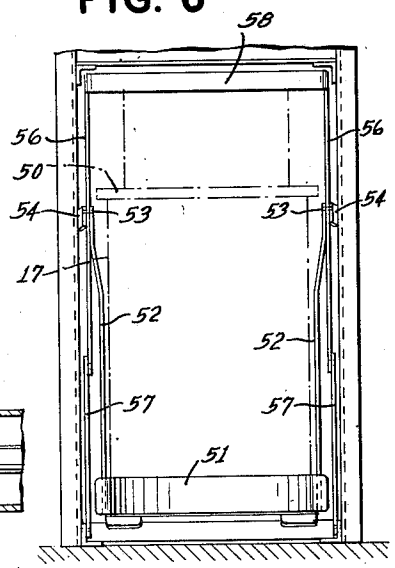



FIG. 4




FIG. 6




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2,780,187

# ASH REMOVAL APPARATUS

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Application March 8, 1950, Serial No. 148,419

2 Claims. (Cl. 110—165)

This invention relates to the provision of improved ash removal apparatus for transferring ashes from a coal-fired furnace to an ash receptacle located at a distance from the furnace. More particularly, the invention is concerned with a suction system for effecting a transfer of the ashes from a hopper beneath the furnace to the ash receptacle. While it has been primarily developed for use with a "spill over" type stoker furnace, it may also be used with a grate type furnace, if the coal used is of pea or buck wheat size. If larger sizes of coal are used, crushing grates must be incorporated in the furnace to initially crush the ashes prior to their being fed to my ash removal system. "Spill over" type stoker furnaces are well known, comprising a cone retort into the bottom of which coal is fed and in which the coal burns as it is forced up. If more coal is fed into the bottom of the retort, ashes are spilled over the top of the retort into the hopper beneath the furnace.

In my copending application Serial No. 82,341, filed March 19, 1949, and now Patent No. 2,685,480, I pointed out that suction systems for ash removal have been proposed heretofore but have not been generally accepted for use in connection with small furnaces, such as household heating furnaces. A careful study of the capacity and limitations of suction systems has led me to the conclusion that such systems are in princpile sound for eliminating the hard and dirty job of removing ashes by hand from a coal-fired furnace; but for the system to be practically useful, special provisions must be made to prevent clogging and the system must be essentially automatic in its operation for it to be suitable for widespread use, especially for use with furnaces for household heating and with other furnaces operated by mechanically untrained persons. Lack of effective provisions to accomplish these ends has been responsible for the indifferent success of the suction systems for ash removal heretofore proposed.

The apparatus contemplated by this invention is in many respects similar to that contemplated by the invention of my copending application. The apparatus of that invention included an ash hopper mounted beneath the coal-fired furnace, a suction pipe leading therefrom to an ash separator located at a distance from the furnace and in which the ashes ultimately are collected, a suction fan arranged so that its inlet is connected with the ash separator, its outlet being connected to a discharge vent or flue, a dust filter, or possibly directly to the atmosphere, and an electric motor for driving the fan. These elements of the apparatus of my copending application are included in the apparatus of the present invention. In the apparatus of the copending application, a suction box is connected directly to the bottom of the hopper, and the hopper serves merely to direct the ashes into it. However, I now contemplate having the suction box located adjacent, but outside the hopper, it being connected to the hopper by a conduit which extends into and throughout the length of the hopper. A combination screw conveyor and ash crusher is mounted within the conduit, an



electric motor and gear reducing means being provided to drive it. Portions of the conduit within the hopper are removed in order to permit ashes received by the hopper to flow into the conduit to be crushed and carried out of the hopper through the conduit by the combination screw conveyor and ash crusher. The conduit passes over the suction box outside the hopper but has a portion of its lower side removed above the suction box so that ashes withdrawn by the combination screw conveyor and crusher may be fed thereby to the suction box for removal by the current of air flowing through the suction box and suction pipe when the suction fan is operated. The opening in the lower part of the conduit over the suction box extends a short distance beyond the suction box, thereby placing the interior of the conduit in communication with the outer atmosphere, other than through the hopper, so that the suction box and suction pipe are provided with sufficient air when the suction fan is operated to form a current thereof capable of carrying ashes, that have been fed to the suction box, to the ash separator. Ashes carried to the separator are there separated from the air stream and settle into an ash receptacle.

My invention also contemplates the provision of a receptacle support by which ash receptacles may be easily and properly positioned with respect to the ash separator to receive ashes therefrom. It will be apparent that an ash receptacle must be placed in pressure tight relation to the separator if a current of air is to be drawn through the suction pipe by the fan, because, if this were not the case, air would merely be drawn into the separator through its open bottom rather than through the suction pipe. Thus the lower edge of the separator is provided with a rubber gasket which is adapted to receive the upper edge or rim of the ash receptacle. The receptacle support is designed to receive a receptacle and by simple manipulation to raise it upwardly so that its upper rim or edge tightly engages the gasket of the separator to form a pressure tight seal therewith.

The foregoing and other features of the new apparatus are described in more detail below with reference to the accompanying drawings which show a preferred embodiment thereof and in which:

Fig. 1 is an elevation of that portion of the apparatus which is to be located near the coal-fired furnace;

Fig. 2 is a plan view of the same portion of the apparatus;

Fig. 3 is an elevation of the complete apparatus;

Fig. 4 is an enlarged sectional view taken along line 4—4 of Fig. 2;

Fig. 5 is a sectional view taken along line 5—5 of Fig. 4; and

Fig. 6 is an elevation of the ash receptacle support.

My complete ash removal apparatus may best be seen in Fig. 3 in combination with a coal-fired furnace **10** in which a stoker-fed coal-burning retort **11** is diagrammatically indicated. As stated above, the new apparatus is designed particularly for use with a "spill over" type stoker furnace, but the type of coal-burner with which the apparatus is used forms no part of the invention, and it may, if desired, be used in combination with a grate-type furnace. A hopper **12** is suitably supported at the bottom of the furnace by the supporting framework for the furnace. Its walls slope downwardly toward its outlet. A combination screw conveyor and ash crusher **13** (Fig. 2) is located at the bottom of the hopper and is adapted to crush and convey ashes in the hopper to a suction box **14** to which a suction pipe **15** is connected. At the other end of the suction pipe there is an ash separator **16** (Fig. 3) in which ashes removed from the hopper through the suction pipe are adapted to settle out or separate from the current of air, in which they are carried, and fall into an ash receptacle **17** placed beneath the separator. A

suction fan 18 is mounted above the separator and is connected to it by an inlet conduit 19. An outlet 20 is provided to carry air from the fan to a discharge vent or flue 21 which expells it to the atmosphere or to a dust bag or a similar device which may be provided if desired for removing any residual ash or dust particles in the air. An electric motor 22 is supported above the fan to drive it.

Referring back to Figs. 1 and 2 it will be seen that the combination screw conveyor and ash crusher is supported in the bottom of the hopper in a conduit 23 which extends throughout the length of the hopper and outwardly beyond the end wall of the hopper through an opening 24 in that wall. Openings 25 are formed in the upper half of the conduit by the removal of portions thereof to permit the admission of ashes, falling into the hopper from the furnace, to the interior of the conduit. When ashes enter the conduit through the openings and the screw conveyor is in operation, the ashes will be moved along in the conduit by the conveyor, the larger clinkers or clumps of ashes at the same time being crushed between the conveyor itself and the walls of the conduit. Some of the clinkers or clumps of ashes, of course, may tend to ride along on top of the screw conveyor and not be crushed by it. However, the portions 26 of the conduit that have not been removed act as strippers to delay the further conveyance of such uncrushed clinkers or clumps until they have been properly crushed and will pass through these parts of the conduit. The stripper portions of the conduit also aid in the crushing of the ashes because some of the ashes being carried along on top of the conveyor will be caught between the conveyor and the edges of the strippers and be thereby crushed.

A deflector plate 27, as best seen in Fig. 4, is supported by the end wall of the hopper, through which the ashes are to be carried by the conveyor, and slopes downwardly toward the conveyor, preferably at a pitch of 45° or greater to the horizontal. The lower edge of the deflector extends to within a very small distance, for instance 3/16", from the upper extremity of the conveyor. The purpose of the deflector is to catch any ashes that have not been satisfactorily crushed by the conveyor and that may be carried along on top of the conveyor past the stripper portions of the conduit and to prevent their clogging the outlet. The deflector serves to collect any of these ashes present and to feed them back to the conveyor when a sufficient quantity of them has accumulated in order to tumble back over the conveyor.

As may also be best seen in Fig. 4, an opening 28 is formed in the bottom of that portion of the conduit 23 which extends outwardly from the hopper over the suction box 14. The suction box has a pair of upwardly extending sides 14' (Fig. 5) by which it may be secured to the conduit at a position to enclose a portion of the opening 28. Thus, ashes which have been crushed by the screw conveyor and carried out of the hopper thereby will fall downwardly into the suction box to be carried away by the current of air passing through it and the suction pipe 15 when the suction fan 18 is in operation. The portion of opening 28 which is not enclosed by the upwardly extending sides of the suction box is provided so that a sufficiently large quantity of air may be admitted to the suction box to form a current therethrough capable of supporting and carrying the crushed ashes, without at the same time causing any undesired draft of air, not under control of the furnace draft regulators, to flow through the furnace.

Driving power for the combined screw conveyor and ash crusher is provided, as may be seen in Figs. 1–3, by an electric motor 29. Figs. 1 and 2 show one type of gear transmission which may be used for connecting the motor to the screw conveyor, while Fig. 3 shows an alternate type. The type shown in Figs. 1 and 2 comprises a flywheel type pulley 30 mounted on a shaft 31 and driven by a drive belt 32 passing over a drive pulley 33 on the motor shaft. A worm 34 is carried on the flywheel shaft 31 and engages and drives a worm gear 35. A sprocket 36 is mounted on the same shaft as is worm gear 35 and is thereby driven, in turn driving a sprocket 37, mounted on the end of the shaft of the screw conveyor, through a sprocket chain 38. An idler sprocket 39 may be provided if desired to control the tension on the chain. By properly choosing the relative sizes of the pulleys, the worm, and worm gear used, the speed with which the screw conveyor is driven may be properly controlled. The purpose for using a flywheel type pulley is to decrease the strain placed upon motor 29. Once the speed of the conveyor has been brought up to normal driving speed, the inertia of the rotating flywheel supplies energy to crush any large clinker that suddenly becomes caught in the conveyor.

The type of gear transmission shown in Fig. 3 is of standard form and may be used with or without a flywheel type pulley. It comprises a standard reduction gear transmission 40, the details of which are not shown. The input shaft 41 of the gear transmission carries a pulley 42 driven from the pulley 33 on the motor shaft by a drive belt 43. The output shaft of the gear transmission carries a sprocket 44 by which a chain 45 is driven. The chain in turn drives a sprocket 46 secured to the shaft of the screw conveyor. Again an idler 47 may be provided if desired. Either type of gear transmission shown, that is, either the one shown in Figs. 1 and 2 or that shown in Fig. 3, may be satisfactorily used in order to drive the combination screw conveyor and ash crusher.

After crushed ashes have been fed to the suction box 14, they are picked up in the current of air passing therethrough, when the suction fan is in operation, and carried by the current through suction pipe 15 to the ash separator 16 (Fig. 3). Here, as previously indicated and as is more fully described in my copending application, the ashes are permitted to separate from the air stream and fall into an ash receptacle 17. The air is carried on through the inlet 19 of the fan and thence out of the fan through its outlet conduit 20 to the discharge vent or flue 21.

As may be seen in Figs. 3 and 6, a support is provided by which ash receptacles may be properly positioned with respect to the separator to receive ashes therefrom. The separator has an outwardly extending peripheral flange 50 on its lower side in which there is carried a rubber gasket (not shown) which is adapted to receive in pressure-tight relation the upper edge or rim of a receptacle 17. Were not this pressure-tight seal between the separator and the air receptacle achieved, the functioning of the suction system would not be satisfactory because the degree of suction in the suction pipe 15 and in the suction box 14 would not be great enough, for the suction fan would spend some of its power drawing air through the separator from the imperfect seal between the separator and the receptacle, rather than from the suction pipe.

The ash receptacle supporting means, shown, comprises a base supporting member 51 which is adapted to receive the bottom of an ash receptacle and to thereby support the receptacle. The base supporting member is in turn supported by lifting members 52 (Fig. 6) the lower ends of which are secured to the base supporting member. The upper ends of the lifting members are pivotally supported by pins 53 mounted in the outer ends of pivot members 54. The other ends of the pivot members are pivotally secured to a framework 55 by which the suction fan, its driving motor, and the ash separator are supported. A substantially U-shaped handle member 56 is also supported by pivot pins 53 at points intermediate the ends of its arms. The lower, or outer, ends of the arms of the U-shaped handle member are pivotally secured to the upper ends of locking members 57. The other ends of the locking members are pivotally secured to the framework 55. It is the locking members 57 which in the last analysis provide the supporting force for an ash receptacle 17.

As seen in Fig. 3, an ash receptacle is supported by the supporting means with its upper rim pressed tightly against the rubber gasket (not shown) in the peripheral flange

50 of the separator. In order that it may be removed the upper end 58 of the U-shaped handle member 56 is drawn to the right to the position shown in dotted lines. This movement of the handle pivots it about pin 53 causing the lower ends of its arms to move to the left as seen in Fig. 3, whereby the pivot pins are permitted to descend, thereby permitting lifting members 52 and the base supporting member 51 to descend. This disengages the upper edge of the ash receptacle from the separator, and the receptacle may be lifted or slid out of the base supporting member to be replaced by an empty one. When an empty receptacle has been placed in the base supporting member the handle member of the supporting structure is moved from the position shown in dotted lines in Fig. 3 to that shown in solid lines and the receptatcle is raised so that its upper edge will tightly engage the gasket in the lower peripheral flange of the separator. In order that the receptacle will be held in this engagement with the separator without the necessity of positively maintaining the handle in its solid line position, the members of the supporting structure are so designed that, in its solid line position, the upper end of locking member 57 is slightly to the right of its dead center position. The distance which an ash receptacle must be raised or lowered may be very slight, actually just enough to permit easy mounting and removal of it in the support without interference from the peripheral flange of the separator. The distance may thus be as little as one or two inches.

It is evident from the foregoing that the ash removal system of the invention is of uncomplicated construction, is easy to install, and provides a practical means for eliminating the most objectionable feature incident to the operation of small coal-fired furnaces, namely, the removal by hand of the ashes. It has also been found in use to be effective for removing ordinary coal ashes from a furnace to a receptacle remote from and at a substantially higher elevation than the furnace itself; and it has proved to be reliable and dependable.

I claim:

1. Apparatus for removing ashes from a coal-fired furnace comprising an ash hopper for receiving ashes from the furnace, a suction box having top and bottom openings, an ash removal suction pipe leading from the bottom opening of the suction box, a conduit extending throughout the length of the bottom of the hopper and leading from the hopper to and across the top opening of the suction box, a portion of the conduit adjacent the suction box opening into the suction box and a portion of the conduit beyond the suction box opening to the outer atmosphere, and a combination screw conveyor and ash crusher within the conduit, the upper part of said conduit within the hopper having openings formed therein to permit admission of ashes from the hopper into the conduit, whereby ashes in the hopper are crushed and carried to the suction box where such ashes and air from the outer atmosphere both may be drawn into the suction box and removed therefrom through the suction pipe.



2. Apparatus for removing ashes from a coal-fired furnace comprising an ash hopper for receiving ashes from the furnace, a suction box, a conduit extending along the length of the bottom of the hopper and leading from the hopper to and opening into the upper portion of the suction box, a combination screw conveyor and ash crusher within the conduit for conveying ashes from the hopper to the suction box, the upper portion of said conduit within the hopper having at least one opening to permit admission of ashes from the hopper into the conduit, the suction box having an opening in the lower portion thereof, an ash removal suction pipe leading from said opening, and means forming an opening of substantial size in an upper portion of the suction box to the outer atmosphere independent of the opening for the admission of ashes thereto, so that when suction is applied to said suction pipe air will be sucked into the suction system from a source other than the ash hopper and the suction in the suction pipe will not appreciably affect the draft of the furnace.

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