

Aug. 21, 1934.

W. H. FULTON

1,971,035

AUTOMATIC STOKER

Filed Oct. 25, 1929

5 Sheets-Sheet 1

FIG. 1

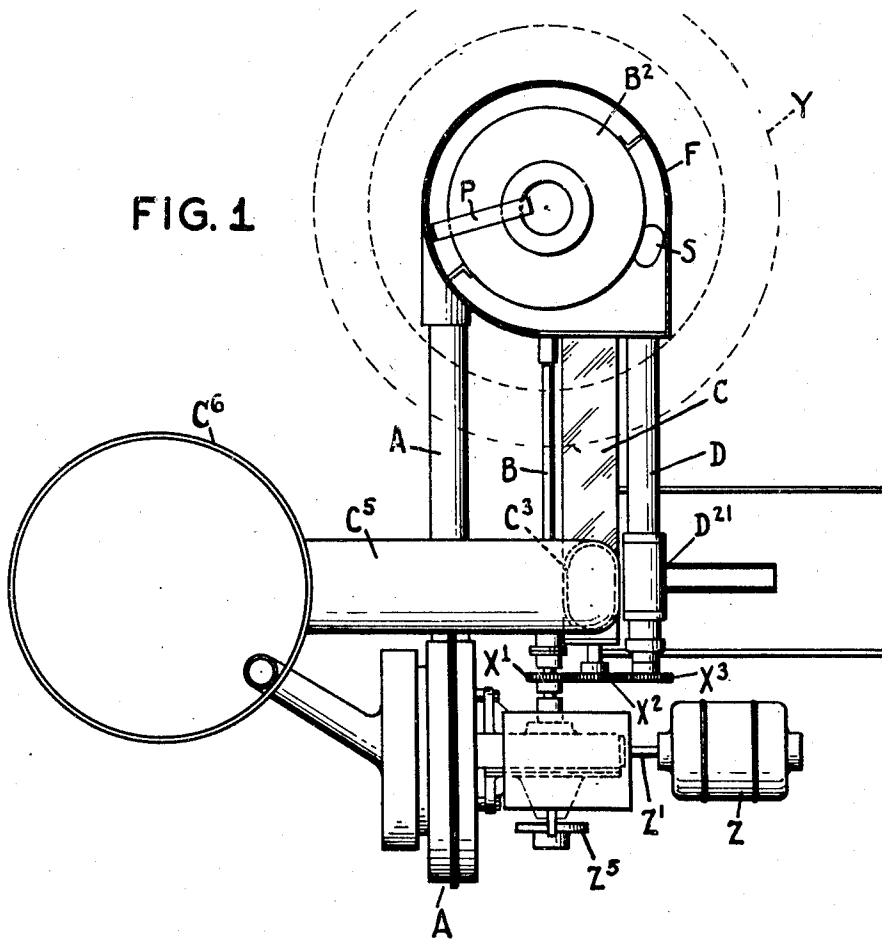
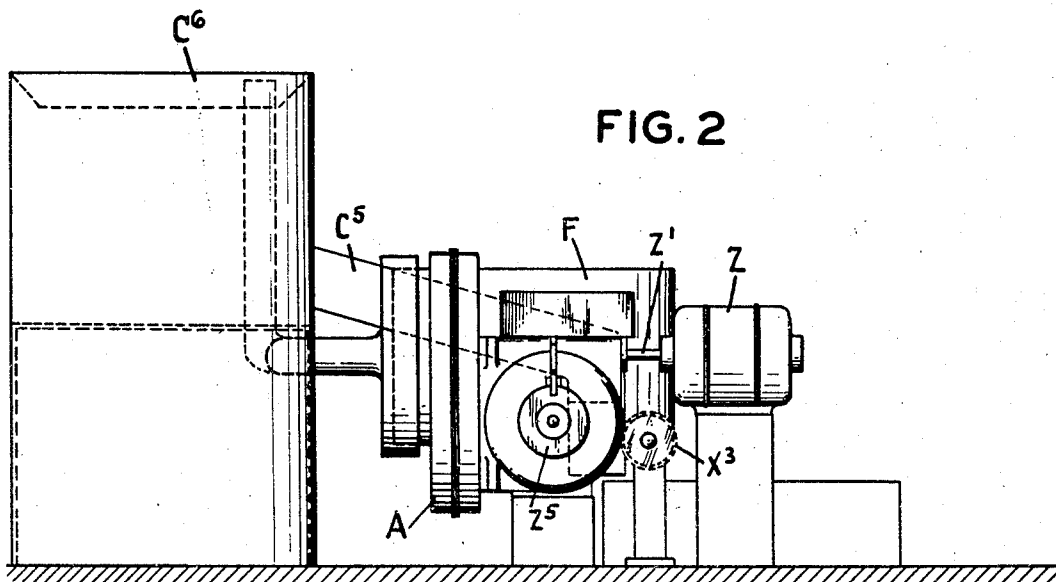


FIG. 2



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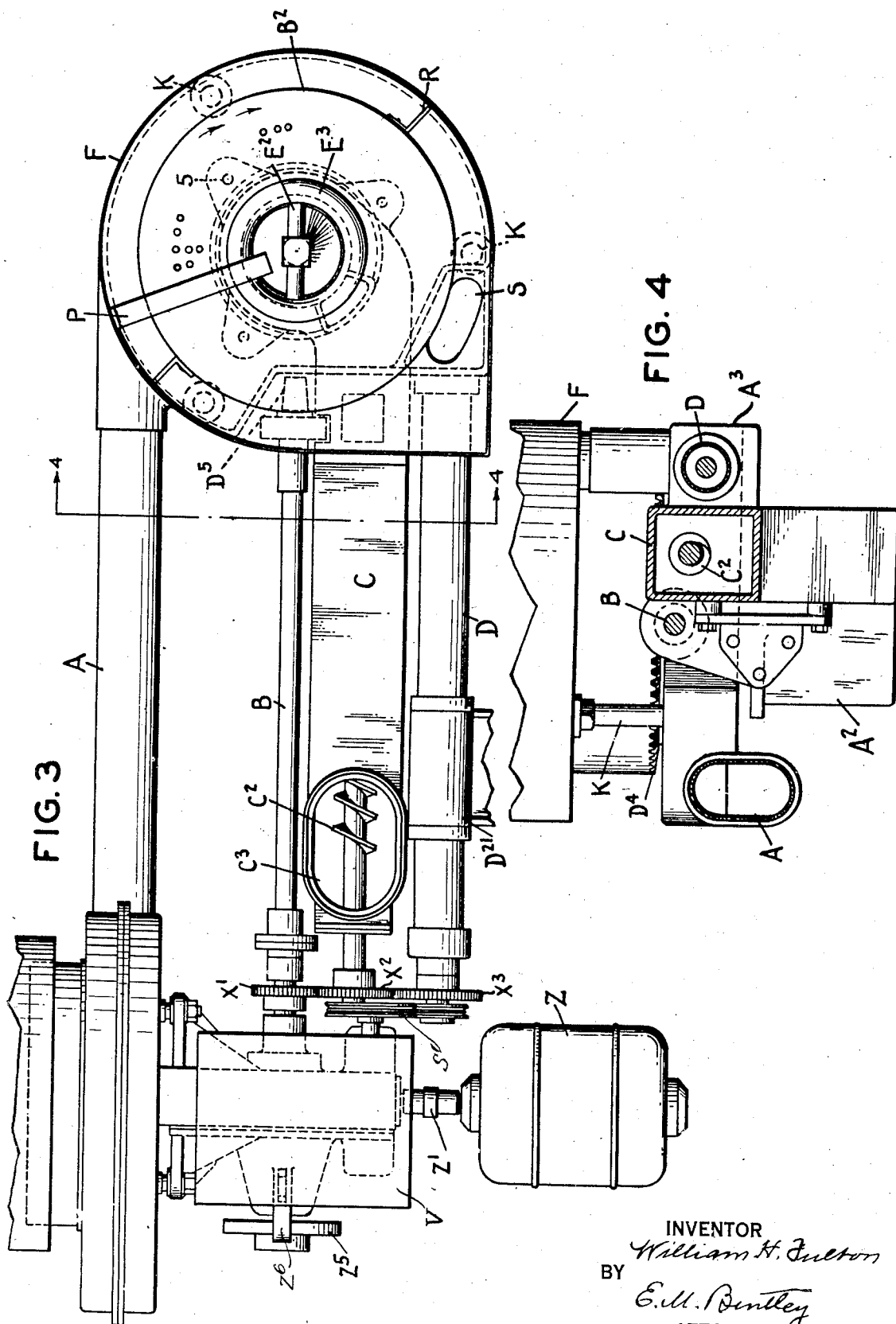
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5 Sheets-Sheet 2



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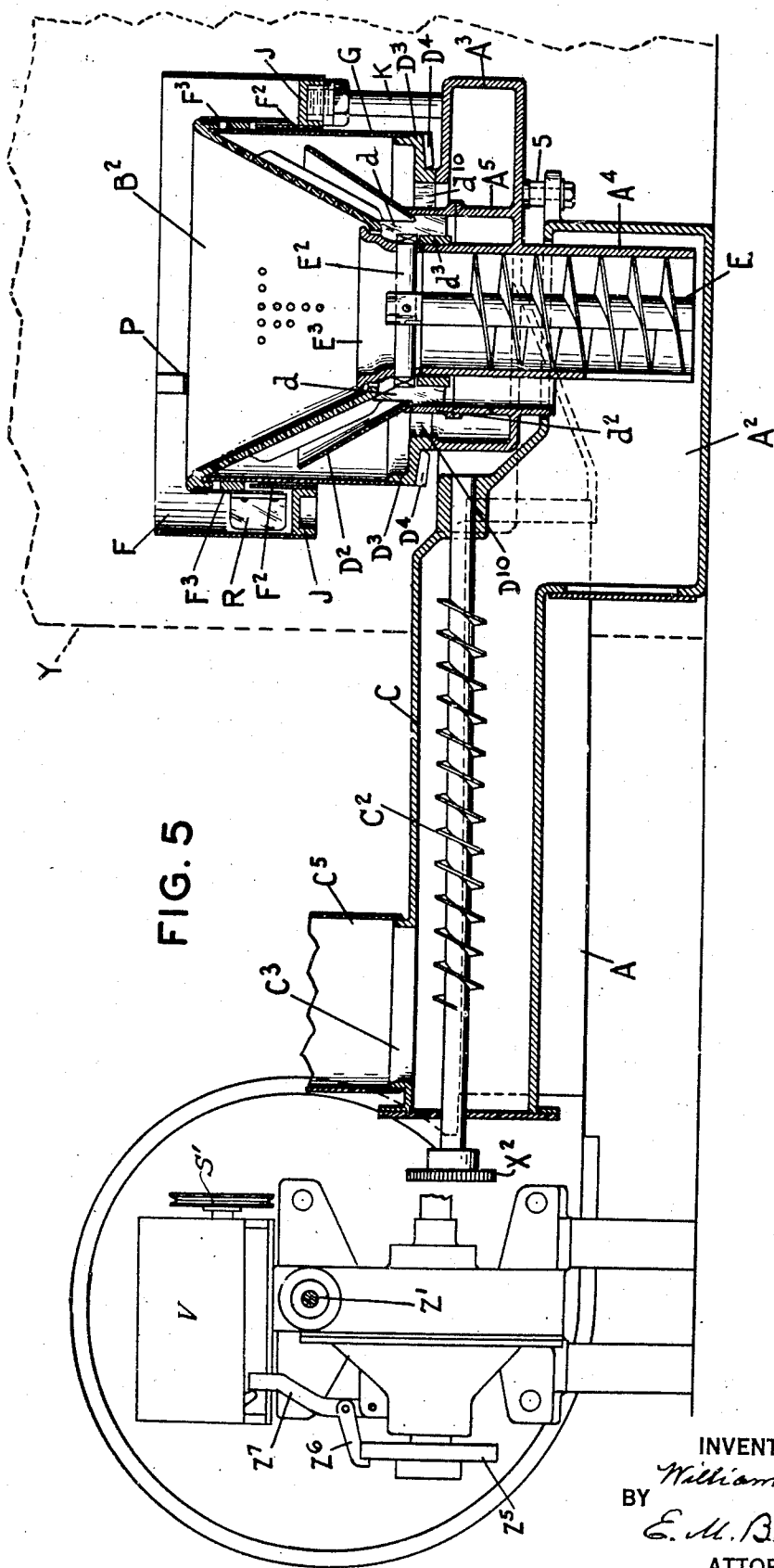
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AUTOMATIC STOKER

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5 Sheets-Sheet 3



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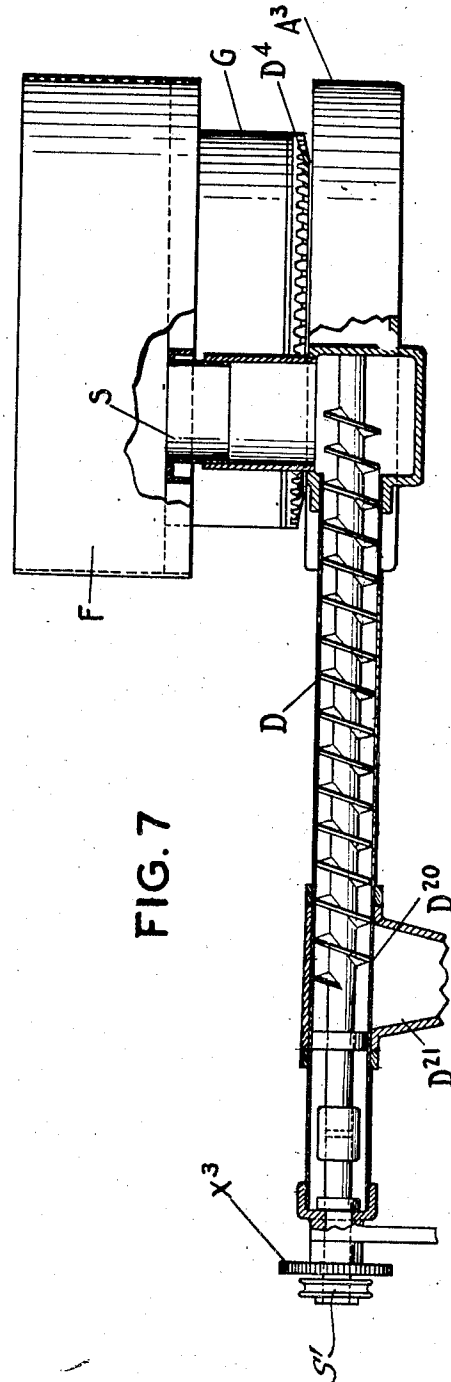
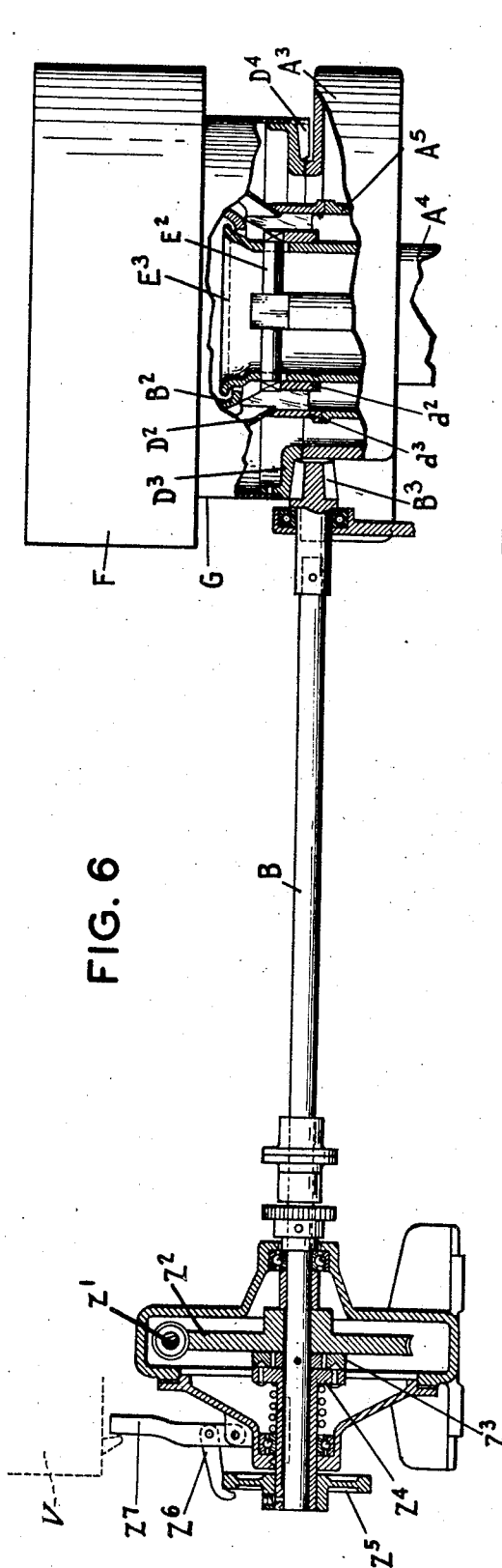
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AUTOMATIC STOKER

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5 Sheets-Sheet 4



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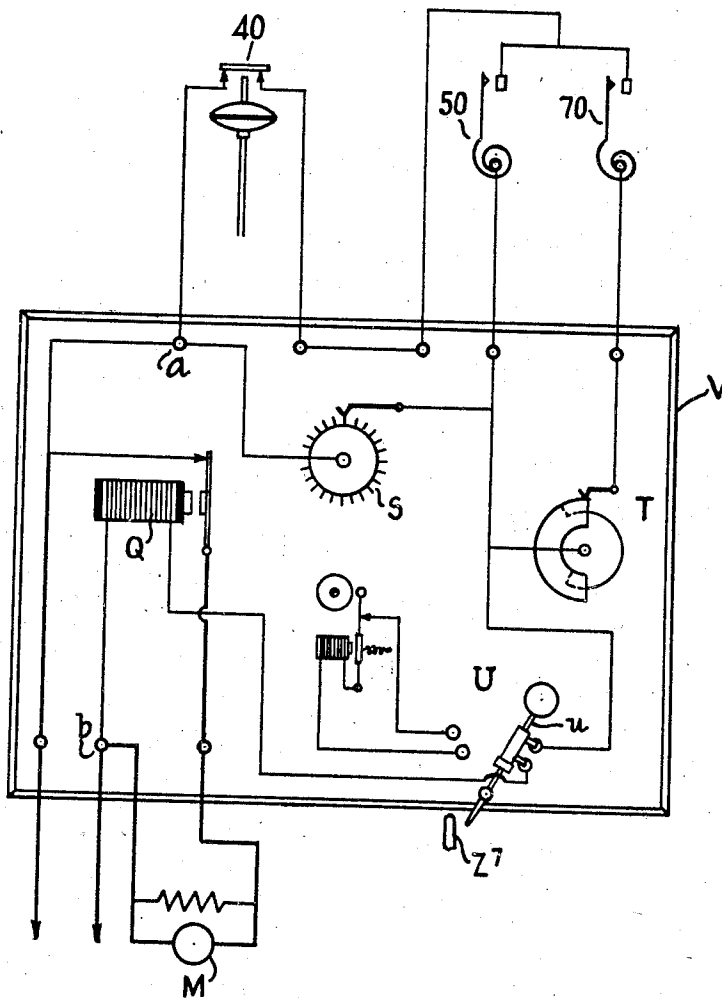
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AUTOMATIC STOKER

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FIG. 8



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UNITED STATES PATENT OFFICE

1,971,035

AUTOMATIC STOKER

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Application October 25, 1929, Serial No. 402,450

15 Claims. (Cl. 110—45)

For a detailed description of the present form of my invention, reference may be had to the following specification and to the accompanying drawings forming a part thereof, wherein

- Fig. 1 is a plan view of my stoker;
Fig. 2 is an end view;
Fig. 3 is an enlarged plan partly in section;
Fig. 4 is a section across the three conduits;
Fig. 5 is a longitudinal section;
Fig. 6 illustrates the main drive and
Fig. 7 the ash removal;
Fig. 8 is a diagram of control circuits.
- My invention relates to a stoker suitable for domestic use by which coal may be fed automatically to the fire-pot of a furnace and the ashes therefrom be automatically removed. I operate the stoker by a motor which drives a conveyor that delivers coal to a chamber under the fire-pot and also keeps the fire-pot and the burning coal therein in slow rotation. From the said chamber a vertical conveyor, operated by the rotating pot, lifts the coal up into the pot through the bottom. The ashes are trimmed from the top of the fire by a stationary scraper into an annular pocket around the outside of the fire-pot from whence they are removed by a conveyor at a level as high as, or higher, than the coal feed. By that means I avoid the difficulty of wet or damp ashes which a conveyor will not transport. Even the flooding of a cellar up to the level of the coal feed will not interfere with ash-removal. The motor also drives a blower which delivers air into a chamber in the upper part of the furnace cast iron base and above the chamber into which coal is delivered by the conveyor. From said air chamber the air passes upward along the outside of an annular baffle plate that surrounds the fire-pot but is spaced therefrom and thence over the top edge of the baffle into the space between the baffle and the fire-pot from whence it enters, through a series of perforations in the fire-pot wall to the burning mass of coal within. The said space, inside the baffle but outside the fire-pot, opens at its bottom into the coal chamber whereby such minor amount of ash as may escape out through the air holes in the fire-pot will drop down on the coal and be therewith reconveyed into the fire. I provide for automatic stopping of the motor in the event of excess heating and also in the event of an overload on the motor by clogging. I also provide for automatic changing from day to night conditions or vice versa at any predetermined hours. I moreover provide against extinction of the fire by over-long stops. This

I do by causing the fire to start up at regular intervals,—say every half hour—for a brief period, regardless of the automatic regulation. These start-up periods are of such lengths and frequency that the fire can not be extinguished by any length of regulative shut-down.

Referring to Figs. 1 and 3 of the drawings, Z represents the motor, which operates four lines of communication with the furnace Y as follows: A is the air supply line; B is a drive shaft for giving slow rotation to the fire-pot; C is the line of coal feed; D is the line of ash-removal.

The base or foundation for the furnace is, as shown in Fig. 5, formed by a box-like casting A² seated on the floor. This forms the coal-chamber into which coal is delivered, from the left, by the coal conveyor C². Supported on A² by a series of short pillars 5 is a second box-like casting A³ which forms the air chamber into which air is delivered, from the left, by the aforesaid air-supply line A, as shown in Figs. 1 and 3. Through the bottom of A³ extends downward a vertical coal-conveyor tube A⁴ which at its lower end is open, on its left-hand side, to receive coal from chamber A². The parts A², A³ and A⁴ are stationary. Surrounding A⁴, but spaced therefrom, is an upstanding flange A⁵ forming an annular pocket from the bottom of which, on the left of A⁴, is an opening down into the coal chamber A². On the upper edge of flange A⁵, rotate the conical fire-pot B² and the conical baffle D² which are spaced apart from each other by ribs d, d, placed at intervals between which air from chamber A³ may flow upward, and which are continued downward by rings d², d³ which are also spaced apart by the said ribs d, d. A cross-bar E² passes diametrically across the bottom of the fire-pot B², in the spout E³, so as to rotate therewith, and this cross-bar passes through an opening in the upper end of the shaft of the vertical conveyor E by which coal from chamber A² is lifted up through tube A⁴ into the fire-pot B². The fire-pot and baffle are rotated by means of a flat bevel-gear D⁴ formed on the under side of a ring D² which is connected, by ribs d¹⁰ to the aforesaid ring d³. The bevel gear D⁴ is engaged by a bevel pinion D⁵ (see Fig. 3) on the end of the motor-driven shaft B aforesaid. Outside of the fire-pot B² and the baffle D², and rotating therewith, is a cylindrical sheet-metal casing G. On the stationary air-chamber A³ are pillars K which carry a stationary ring J that surrounds the cylindrical rotating casing G and forms the bottom of an annular ash pocket of which the cylindrical upright sheet-metal wall F is the outer

side. The inside wall of this ash pocket is formed by a sheet-metal cylinder F^2 of less height which rides against the outside surface of the aforesaid casing G. Overhanging F^2 is a ring F^3 secured to the outside rim of the fire-pot B^2 . Thus the ashes from the top of the fire in the pot drop over the edge of the pot into the said annular ash pocket. To facilitate such overflow of ashes from the fire into the ash pocket, a scraper P is secured to the wall F of the pocket and projects over the rotating fire-pot B^2 . Moreover, a series of radial vanes R project from the aforesaid ring F^3 on the fire-pot into the ash-pocket, and sweep the ashes therein, as the fire-pot slowly rotates, forward till they drop down through a port S (see Figs. 3 and 7) into the receiving end of the ash conveyor D.

The structure, as thus far described, is separable horizontally on the line between the stationary and rotating parts. Therefore it may be readily introduced into any standard boiler framework, such as is indicated by the dotted lines in Fig. 5. The fire-pot may be introduced first, and while temporarily upheld, the castings which are to underlie it may be inserted under it and the fire-pot then lowered to seat thereon.

As is shown in Fig. 7 the ash-conveyor D carries the ashes leftward from the furnace towards the motor till they reach the delivery opening D^{20} , outside of which is a sleeve D^{21} that is provided with a spout and rotates easily on the conveyor tube. By turning this sleeve D^{21} until the spout points downward, the ashes will be dropped into a suitable receptacle, such as a pail; or the pail may be left in position under the spout and periodically removed, together with the ashes accumulated therein, by lifting the spout and so turning sleeve D^{21} . Fig. 4 shows that the ash conveyor D is on the level of the coal conveyor C, which means that the ashes are not, as heretofore, conveyed at the bottom of the stoker where they may become wet by a flooding of the cellar. Thus my stoker remains workable so long as it can feed coal to the fire.

The coal is fed along the conveyor tube C by the motor-driven conveyor C^2 , as clearly appears in Fig. 5. The conveyor tube does not closely envelop the conveyor, but is spaced therefrom a considerable distance, particularly on the under side and opens into the aforesaid coal-chamber A^2 in the base of the furnace. By this means any stoppage of the conveyor C^2 by packing of the coal in tube C is avoidable. The conveyor will always feed coal from the top of any layer of coal that may accumulate under it in the bottom of tube C. On the upper side of said tube is a receiving port C^3 into which the coal is delivered continuously by a chute C^5 leading from the coal bin C^6 (see Figs. 1 and 2). As fast as the coal accumulates in the base chamber A^2 it enters the bottom of the vertical tube A^4 and is lifted upward by the vertical conveyor E into the bottom of the fire-pot. It may be here stated that the stoker herein disclosed is primarily designed to work on fine anthracite coal such as is commonly called "buckwheat" coal; but it is also intended to utilize any type of coal for which it may be found available.

The motor Z stands with its shaft Z^1 at right angles to the aforesaid four lines of communication therefrom to the furnace Y. On said shaft Z^1 is a worm which drives a worm-gear wheel Z^2 on the shaft B (see Fig. 6) and on the opposite end of shaft B is the bevel pinion B^3 that meshes with the aforesaid horizontal bevel-

gear wheel D^4 on the bottom of the rotating fire-pot B^2 . By this double rate of gearing a very slow rotation of the fire-pot is obtained. The worm-gear wheel Z^2 is not made fast on the shaft B, but free to turn thereon. A disc Z^4 having a long sleeve is splined on shaft B so as to rotate therewith although slidable longitudinally thereon. The disc Z^4 is normally spring-pressed against the hub Z^3 of said wheel Z^2 and pins with conical heads projecting from the face of disc Z^4 enter conical pits in the face of the hub Z^3 . Thereby the hub and disc will normally rotate together but will slip on each other, in the event of an overload on shaft B, and the disc, in that event, will be pressed against the force of its spring, longitudinally of shaft B—i. e. to the left in Fig. 6. The tubular hub of said disc Z^4 also carries at its left-hand end a hand-wheel Z^5 . By pulling hand-wheel Z^5 outwardly the worm-gear wheel Z^2 may be manually unclutched from the shaft B, or it will be automatically unclutched therefrom, as just described, in the event of an overload. Thus at any time the hand-wheel Z^5 may be used to turn or oscillate shaft B, as in starting the fire, or to release any clogging of coal or ashes which may be the cause of an overload on the shaft. If the unclutching of B and Z^2 should occur automatically, the outward thrust on disc Z^4 and hand-wheel Z^5 will cause the latter to lift the arm Z^6 of a bell-crank lever and thereby the other arm Z^7 of said lever will open the main switch of the motor Z and stop the motor. The details of the motor circuit and controls will be described hereinafter.

On said shaft B, is a pinion X^1 (see Fig. 1) which meshes with a pinion X^2 on the shaft of the coal conveyor C^2 and said pinion X^2 meshes, in turn, with a pinion X^3 on the shaft of the ash conveyor D. Thereby the hand-wheel control of the shaft B, described above, includes a similar control of the two conveyors.

The controlling agencies for the motor comprise a motor stop responsive to an excess of heating in the system heated by the furnace herein described. It also includes thermostatic control of the motor for day conditions and a similar control for night conditions, a lower temperature being set for the night than for the day time. It includes, moreover, an automatic shift-over from day to night conditions or vice versa at predetermined hours, this being performed by a clock which may be kept automatically wound up by the motor. There is also a periodic start-up of the motor occurring at fixed intervals and continued for a predetermined length of time, regardless of the other controls. This periodic start-up, or revival, of the fire is superposed on the other controls in order to prevent the extinction of the fire by a too-long continued restraint thereof in the course of its ordinary regulations.

All the apparatus for the several controls is contained in a small box represented in Fig. 8, which shows a diagram of the circuits, by the back-board V. In this diagram M is the motor and Q is the control magnet which, when energized, closes the motor circuit and starts the stoker into action. The circuit of this magnet Q, starting at the point a and ending at point b, is controlled by several factors. At 40 is indicated a pressure diaphragm on the steam boiler which, at a predetermined pressure, lifts and breaks the circuit of magnet Q, thereby opening the motor circuit and stopping the stoker. At 50 is a low-degree thermostat, suitable for night

use which—at, say—50 degrees F. will open the circuit of magnet Q and stop the stoker. At 70 is a high-degree thermostat which—at, say—70 degrees F.—will open the circuit of magnet Q and stop the motor. In order to give thermostat 70 control of magnet Q during the daytime, its circuit will be closed—say at 6 o'clock A. M.—by a clock circuit-closer T which at—say 8 o'clock P. M.—will open it again and leave it open till the following morning. When the circuit of thermostat 70 is open the control shifts over to thermostat 50, which may be left permanently in circuit for, even if it should open its contacts at 50 degrees, the magnet circuit would still remain closed at thermostat 70, in multiple with 50, assuming it to be in circuit, until the temperature reached 70 degrees. This shows the advantage of having two separate thermostats for day and night control respectively. The tips of the circuit-breaker T may be of adjustable length, as indicated, in order to adjust the hour at which it will close or open the circuit of the day thermostat 70. At S is a motor-driven circuit-controller which operates constantly through transmission S', to close at regular intervals the circuit of magnet Q by a route which shunts the pressure-controller 40 and both thermostats 50 and 70. Hence controller S will energize magnet Q periodically—say every half hour—and keep it closed for a few moments, depending on the speed of S, regardless of the control exercised by the steam pressure or the thermostats. Thereby the fire will be kept alive however much the agents 40, 50 and 70 may tend to retard it by keeping the stoker inactive. At U is the emergency circuit-breaker in the aforesaid circuit of magnet Q which, as heretofore described, is actuated by the bell-crank lever Z⁶—Z⁷ when that lever is operated automatically by the hand-wheel Z⁵, or manually when said hand-wheel is used to work the stoker manually. A weighted switch lever α carrying a contact-plate normally holds that contact-plate in a position to close the circuit of magnet Q, but when kicked over its dead center by the said bell-crank lever, it breaks the circuit of Q and closes a signal-bell circuit on the opposite side. I do not intend to claim in the present application the detailed construction of these several control agents which act on the circuit of switch-operating magnet Q.

I finally call attention to the connection between the intake side of the blower and the coal bin, by which any desired part of the air going into the blower will be drawn from the upper part of the bin above the coal therein. This insures that all dust or floating particles of coal occurring in the bin will be drawn into the furnace and not allowed to escape into the surrounding atmosphere.

What I claim as new and desire to secure by Letters Patent is:

1. A coal stoker comprising a stationary air chamber, a fire pot rotatably supported by said air chamber, said fire pot having perforated walls, a second chamber surrounding said pot and communicating therewith and also with said air chamber, a baffle within the second chamber and surrounding said fire pot, and means for delivering air into said air chamber, said baffle being so arranged in the second chamber as to direct air from the air chamber into the space between the walls of the second chamber and baffle and thence into the pot through said perforated walls.

2. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air chamber and having a flange rotatively engaging said conveyor tube, means for rotating said fire pot, and a conveyor within said conveyor tube so connected with said fire pot as to rotate therewith.

3. A stoker of the character described comprising a base provided with a fuel receiving chamber, means providing an air supply chamber supported by said fuel chamber, a fire box rotatably supported by said air supply chamber and having a depending coaxial flange, a fuel conveyor tube coaxial with said fire pot and engaging said flange, means for rotating said fire box, a conveyor within said conveyor tube, and means connecting the fire pot and the conveyor above said conveyor tube so that said conveyor is rotated by said fire pot.

4. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said fuel chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air chamber and rotatively engaging said conveyor tube, a gear ring connected with said fire pot, means for applying rotative movement to said gear ring, and a conveyor within said conveyor tube so connected with the fire pot as to rotate therewith.

5. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air chamber and having rotative engagement with said conveyor tube, means providing a supplemental air chamber around said fire box and communicating with said air supply chamber, means for rotating said fire pot, and a conveyor within said conveyor tube so connected with the fire pot as to rotate therewith.

6. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot having an upwardly and outwardly flaring wall, said fire pot being rotatably supported by said air chamber and also rotatively engaging said conveyor tube, a gear ring connected with said fire pot, a casing connecting the top of the fire pot with said gear ring and constructed and arranged to provide a supplemental air chamber communicating with the air supply chamber, driving means engaging said gear ring, and a conveyor within the conveyor tube so connected with the fire pot as to rotate therewith.

7. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air chamber and having rotative engagement with said conveyor tube, means providing a supplemental air chamber around said fire box and communicating with said air supply chamber and rotatable

therewith, a baffle member located in said chamber and surrounding said fire pot, means connecting the baffle member and the fire pot so that they rotate together, means for rotating said fire pot, and a conveyor within said conveyor tube so connected with the fire pot as to rotate therewith.

8. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air supply chamber and rotatively engaging said conveyor tube, means providing a supplemental air chamber surrounding the fire pot and communicating with said air supply chamber, a stationary ring supported by said air supply chamber and having an outer wall coaxial to said supplemental air chamber, and so arranged as to provide an ash chamber, means connected with said pot for removing ashes from said ash chamber, means for rotating said fire pot, and a conveyor within said conveyor tube so connected with the fire pot as to rotate therewith.

9. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air chamber and having rotative engagement with said conveyor tube, means for rotating said fire pot, a supplemental air chamber surrounding the fire pot and movable therewith, said supplemental chamber communicating with the air supply chamber, a stationary ring supported by said air supply chamber and having an outer wall enclosing said fire pot and spaced therefrom so as to provide an ash chamber, means carried by the fire pot for removing ashes from said ash chamber, a scraper connected with the outer wall of the ash chamber and resting on top of the fire pot, and a conveyor within the conveyor tube so connected with the fire pot as to rotate therewith.

10. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air chamber and having rotative engagement with said conveyor tube, a gear ring secured to said fire pot, driving means engaging said gear ring so as to rotate said fire pot, an annular wall connecting the top of said fire pot with said gear ring and constructed and arranged to provide a supplemental air chamber surrounding the fire box and movable therewith and having communication with said air supply chamber, a stationary wall supported by the air chamber and surrounding said supplemental chamber so constructed and arranged as to provide an ash chamber, means movable with the fire pot for removing ashes from said ash chamber, and a conveyor within said conveyor tube so connected with the fire pot as to rotate therewith.

11. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air supply chamber and having rotative engagement with said conveyor tube, said fire pot having an upwardly and outwardly flared body having perforations

therein, an outer wall secured to said fire pot and spaced therefrom to provide a supplemental air chamber communicating with said air supply chamber, a baffle fixedly connected with said fire pot but spaced from and enclosing the same, said baffle being located within said supplemental air chamber and so constructed and arranged as to deliver air from the supplemental air chamber into the space between the fire pot and the baffle and thence into the fire pot through the perforations thereof, means for rotating said fire pot, and a conveyor tube so connected with said fire pot as to rotate therewith.

12. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air chamber and having removable rotative engagement with said conveyor tube, means for rotating said fire pot, and a conveyor within said conveyor tube so connected with the fire pot as to rotate therewith, said fire pot being separable from said air supply chamber and said conveyor tube on a horizontal line.

13. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fixed fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air supply chamber in a position coaxial with said conveyor tube, said fire pot having an opening in the bottom registering with said conveyor tube and having rotative engagement therewith, means for rotating said fire pot, a conveyor within said conveyor tube connected with the fire pot so as to rotate therewith, a blower connected with said air supply chamber, a motor operating said blower and said fire pot rotating means, and speed reducing mechanism between the motor and the fire pot rotating means constructed and arranged to impart a slow rate of rotation of said fire pot with respect to said blower.

14. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fixed fuel conveyor tube leading upwardly from said chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air chamber in a position coaxial with said tube and rotatively engaging the tube, a power shaft having one end engaging said fire pot and constructed and arranged to rotate the same, an air duct having one end engaging said air supply chamber, a fuel supply duct having one end engaging the fuel chamber, said power shaft, said air duct and said fuel supply duct being all extended in parallel lines, a blower connected with the air chamber, a fuel conveyor located in said fuel supply duct, a common motor for operating said blower, said power shaft and said fuel supply duct, and a conveyor within said conveyor tube so connected with the fire pot as to rotate therewith.

15. A stoker of the character described comprising a base provided with a fuel receiving chamber, a fixed fuel conveyor tube leading upwardly from said fuel receiving chamber, means providing an air supply chamber supported by said fuel chamber, a fire pot rotatably supported by said air chamber in a position coaxial with said tube, a motor spaced from said base and said air supply chamber, three independent shafts

extended between said motor and said base and arranged in parallel lines, a fuel feeding means operated by one of said shafts, ash receiving means operated by another of said shafts, the third shaft being constructed and arranged to impart rotative movement to said fire pot, an air supply duct parallel with said shafts and communicating with said air supply chamber, a blower for said air supply duct, said blower and said shafts being all constructed and arranged to be operated by said motor.

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