

Aug. 1, 1939.

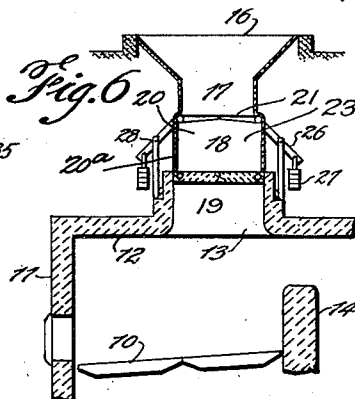
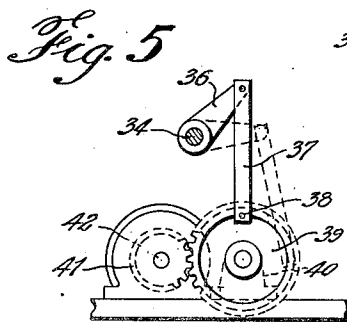
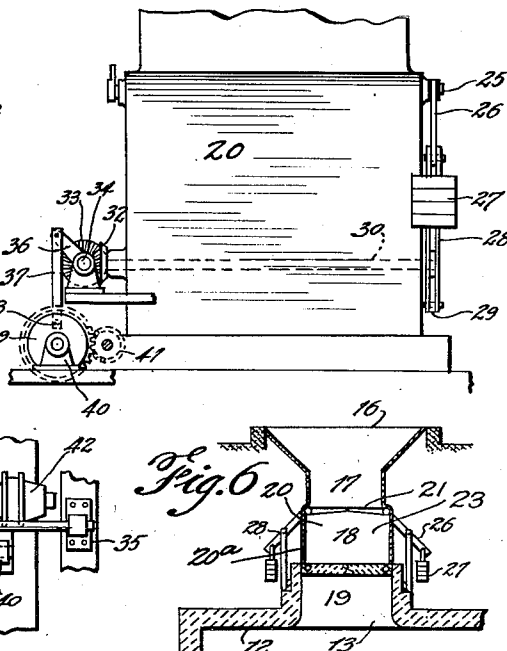
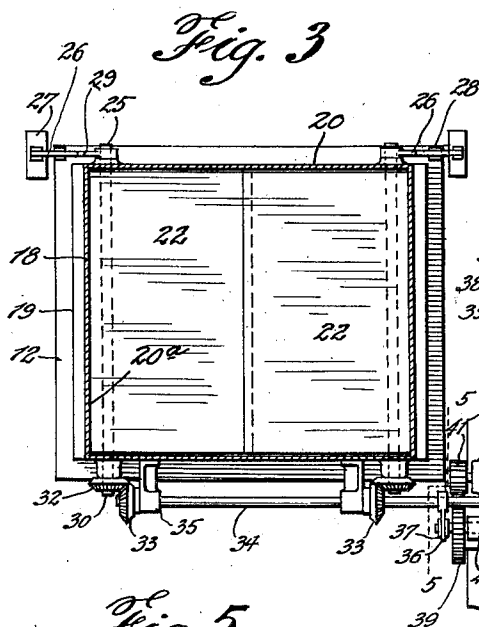
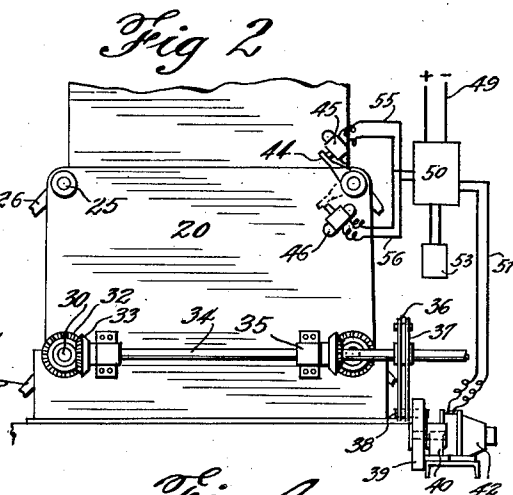
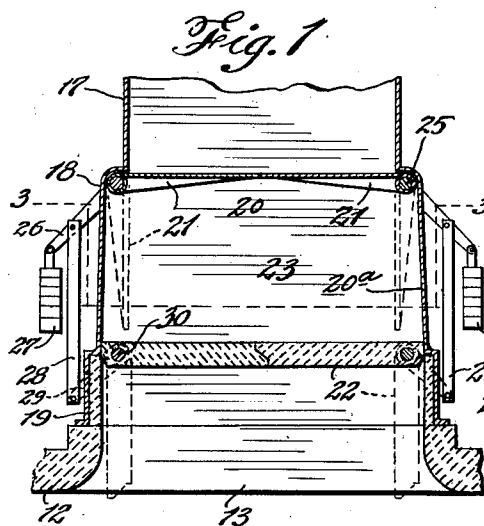
F. C. HOLBROOK ET AL

2,167,653

MECHANISM FOR CHARGING REFUSE-BURNING FURNACES

Filed Feb. 21, 1935

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 7

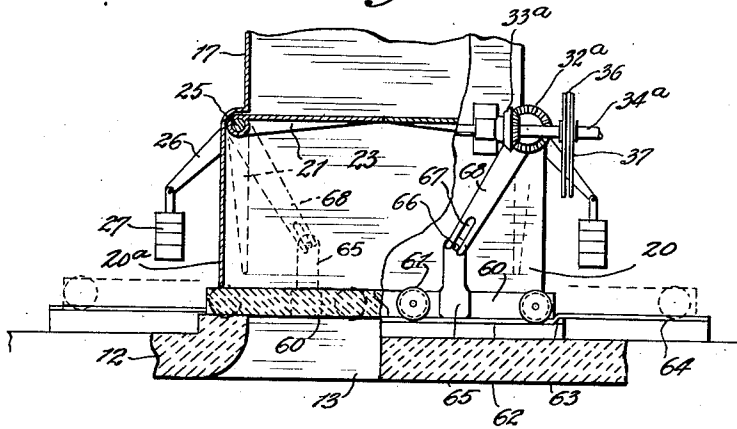


Fig. 8

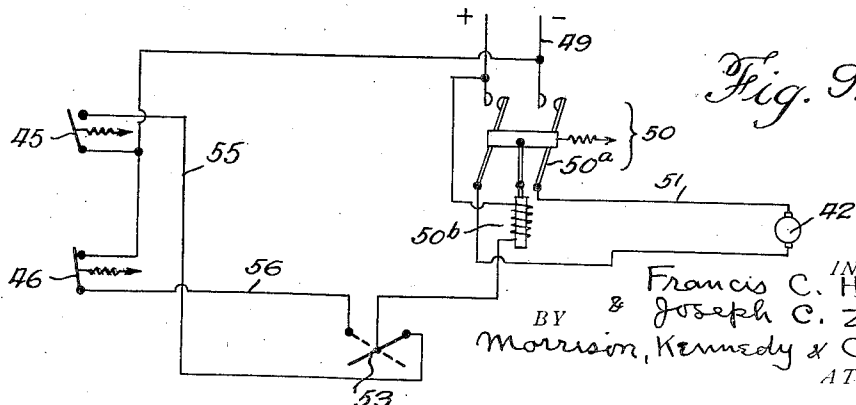
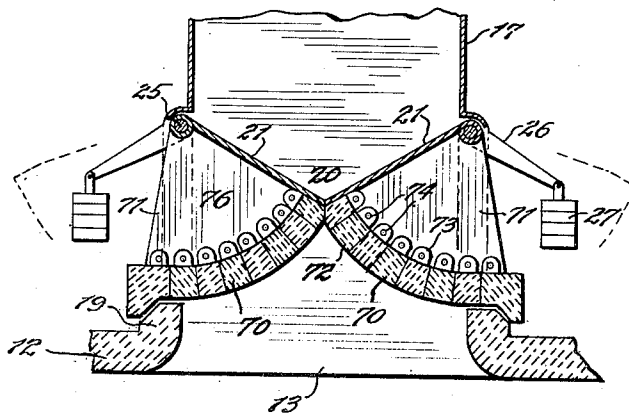


Fig. 9.

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UNITED STATES PATENT OFFICE

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MECHANISM FOR CHARGING REFUSE-BURNING FURNACES

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5 Claims. (Cl. 110-118)

This invention is a novel mechanism for charging refuse-burning or other furnaces wherein the charges are dumped at intervals from above by a descending chute. The invention has been developed especially for the feeding of various kinds of refuse into an incinerator furnace, but has wider commercial applicability.

Refuse is understood as including various kinds of dry refuse or waste, which is combustible, and as well garbage or other kinds of moist or wet refuse. Furnaces or incinerators of this class are largely used for municipal purposes, and the usual type of such furnace comprises a charging chute which delivers from a hopper by gravity into the furnace chamber, with a normally closed charging gate that supports the weight of the refuse or charge which rests above it in the hopper and chute but which is openable for the periodic dumping of the material into the furnace chamber. To aid description the part of the chute which is above the charging gate will be hereinafter considered as part of the hopper.

The general object of the present invention is to afford a furnace charging or refuse dumping mechanism of the class having a normally closed but openable charging gate, which will be efficient and convenient in operation and simple and durable in construction. A further object is to provide a gate operating mechanism requiring low power consumption as compared with those commonly in use. A further object is to afford automatic or semi-automatic action.

Another object of the invention is to afford a charging mechanism wherein the dumping gate, which takes the accumulated weight of the charge, is protected or shielded in an advantageous manner from the destructive heat of the fire in the furnace below, and thus may be composed of iron without being subject to danger of burning away. Other objects and advantages of the present invention will be explained in the hereinafter following description of illustrative embodiments thereof or will be manifest to those conversant with the subject.

To the attainment of the recited objects and advantages the present invention consists in the novel mechanism for charging refuse-burning or analogous furnaces, and the novel features of operation, combination, arrangement and construction herein illustrated or described.

In the accompanying drawings Figure 1 is a vertical section through a charging mechanism for a refuse-burning furnace embodying the present invention with certain parts seen in elevation.

Fig. 2 is an exterior elevation of the mechanism shown in Fig. 1.

Fig. 3 is a top plan view of the same taken partly in section on the line 3-3 of Fig. 1.

Fig. 4 shows the same mechanism in rear elevation, that is looking toward the right side of Figs. 1, 2 or 3.

Fig. 5 is a partial front elevation showing the driving motor and connections.

Fig. 6 in vertical section and right hand elevation shows the charging or feed mechanism hereof applied to a usual type of refuse-burning furnace, or incinerator.

Fig. 7 is a view similar to Fig. 1 showing a modified form of charging mechanism.

Fig. 8 is a view similar to Fig. 1 showing a still further modification.

Fig. 9 is a circuit diagram of the control means partly shown in Fig. 2.

Referring first to Fig. 6, in connection with Figs. 1-5, the furnace grate 10 is shown as located below the main combustion chamber, the front wall 11 appearing at the left side of the figure. The grate is air-supplied as usual and the refuse is dried and burned on the grate, or it might be partially or wholly predried. Auxiliary fuel may be introduced for ignition or combustion.

Above the chamber is the arch or top wall 12 having a charging opening 13 through which the refuse material is dumped into the furnace chamber. To the rear of the grate is shown a conventional bridge wall 14 over which the gaseous products pass on their way preferably to a supplemental combustion chamber, for further combustion, and thence perhaps to a heat utilizing apparatus or boiler, a gas washer, and a stack, or other apparatuses usually employed with incinerator furnaces.

Well above the charging opening 13 of the furnace is the overhead hopper 16, supplied with refuse in any known manner. Below the hopper is a vertical extension 17 which contains a portion of each charge, supported on the charging gate 21, before dumping or feeding into the furnace. Below the hopper portion 17 and gate is a widened continuation or chute 18. These elements are preferably composed of iron; while below them extends a chute portion 19 which is exposed to the heat of the furnace and is composed preferably of refractory material, as firebrick.

The chute therefore delivers from above into the furnace, that is, charges downwardly by gravity to the combustion chamber, so that when the chute is open radiant heat may enter it, as well as the hot gases.

At the foot of the hopper portion 17 and giving support to the refuse charge in the hopper is the refuse feeding or charging gate 21, normally closed but openable for dumping each charge into the furnace. It is shown as consisting preferably of a plurality of gate sections composed of iron, normally closing the chute and supporting the refuse but adapted to shift or swing downwardly, for example to the dotted line positions shown in Fig. 1, for the delivery of each refuse charge to the furnace.

Below the main or charging gate 21 is a shield 22, shown as consisting of a pair of shielding members or sections composed of or faced with refractory material, such as firebrick. The shield 22 is exposed to the heat of the fire and serves to protect the iron main gate 21 from the heat. Between the gate and shield is an insulating air space or cell 23 of substantial volume, and the gate and shield are spaced apart vertically sufficiently preferably to accommodate the main gates when swung downwardly to the dotted positions shown, while the shields swing down into the arch opening 13, as also shown in Fig. 1.

The charging gate may retract or open otherwise than by swinging down. The shield may be of various refractory materials, meaning high heat resistant materials, as firebrick, or certain metal alloys, but preferably not ordinary iron where high temperatures are involved. The retractible shield not only cuts off radiant heat, but preferably is a closed shield which excludes hot gases, and prevents the danger of ignition of material above the main gate.

The function of the refractory shield 22 is to protect and shield the main or iron gate 21 from the intense heat of the furnace, particularly from the radiant heat when the fire is hottest, which may be destructive of exposed iron parts. The shield is not arranged to support or deliver refuse into the furnace, but on the contrary the operation of this invention is to open or retract the shield substantially simultaneously with the main gate, both gate and shield thus dropping to the dotted line position shown in Fig. 1, for emptying a charge into the furnace, and each then resuming its closed position shown in full lines, with an insulating air-cell between. The upper gate merely supports and dumps the charge; the lower one merely shields the upper shield but retracts to clear the chute and permit the dumping.

For mounting the respective gate and shield and effecting the described operations the following illustrative mechanism is shown. The main gate sections 21 are shown mounted on cross shafts 25 fulcrumed in the metal walls of the chute. Each of the cross shafts carries a rockarm 26, and these rockarms preferably are acted upon by counterweights 27 tending to lift the gate into closed position, thereby counterbalancing to any desired extent the weight of the gate and the charge of refuse resting thereon.

The two cross shafts 25 may be rocked in unison, for example through vertical links 28 connecting the rockarms 26 with lower rockarms 29 extending from the exterior ends of cross shafts 30. The shafts 30 may be those which carry the shield gate sections 22 and they have their bearings in the iron walls of the chute. The arms 26 and 29 are substantially parallel so that the upper gate and lower shield will open and close in unison. The entire swing of the rockarms and gate and shield may be in the neighborhood of 90°, between the open and closed positions shown in Fig. 1.

The described mechanism is preferably operated by power, and for this purpose an exterior end of each of the shafts 30 is provided with a bevel gear 32, these bevel gears engaging bevel gears 33 on a longitudinal operating shaft 34 turning in bearings 35. It is therefore only necessary to rock the shaft 34 to effect the opening and closing movements. The operating shaft 34 is provided with a rockarm 36 which, like the rockarms 26 and 28, may swing upwardly and downwardly through about 90° of angle, the gears 32 and 33 having the same number of teeth. A link 37 is shown as extending to the rockarm 36 from a crank pin 38 provided on a disk 39 which may also constitute a gear, and the axle or shaft of which turns in a bearing 40. The portion of the disk 39 between the crank pin 38 and the shaft may be considered as a crank or crank arm. The gear 39 is driven with speed reduction by a pinion 41 on the shaft of a motor 42. The gear is located, preferably below the arm 36, so that when the arm is in its extreme positions the crank is in its dead center positions. The motor may have a built-in worm or other reduction gear. The rockarm 36 is describable as an operating member movable to and fro by the actuation of crank pin 38, and the term crank is intended to include an eccentric, this acting through the link or pitman 37.

By these arrangements, assuming the motor to turn continuously, the pinion 41 and gear 39 would turn continuously, and the various rockarms, rockshafts and gate sections would rock back and forth through 90° as described. The driving motor however is to be operated to stop with the gates in closed position, holding them there until suitably restarted. Preferably also the motor will stop again with the gates fully open, until again restarted for the subsequent closing of the gates, or the restarting might be automatic after a brief timed dwell sufficient to complete the dumping of the refuse.

Owing to the use of the crank 38 and connecting rod 37 for effecting the rocking movements the reversal of the motor is not necessary, and it may be turned always in one direction, but intermittently as described. A great advantage pertains to the crank and pitman arrangement, whereby they are in their upper dead center or aligned position when the gate 21 is closed, so that the load is effectively supported by the crank and pitman without strain or pressure on the driving connections. At both upper and lower dead center all of the gate sections are locked in position.

The control of gate operation may be manual, but preferably is automatic or semi-automatic, and the disclosed control means may be described as follows. On one of the rockshafts 25 is shown a control arm 44, swingable therefore through 90° between closed and open positions of the gates. The control arm 44 cooperates with an upper switch 45 and a lower switch 46 serving to cause the cessation of motor drive as the gates come to their closed and opened positions respectively, see Fig. 2. These switches therefore operate as limit switches, being so positioned as to cause cessation of action when the gates have reached the limit of their upward and downward movements. The switches may be of well known construction, with an outstanding button or contact adapted to be contacted by the control arm 44 for causing, for example, the opening of each switch.

The diagram in Fig. 2 shows line wires 49 constituting a source of energizing current, these leading to a circuit controller 50, adapted for re-

remote control, its interior arrangements and circuits being shown in Fig. 9. It may be located at any convenient point, remote both from the driving motor and the control arm 44. The function of the remote controller 50 is to connect the line wires 49 with the circuit 51 of the motor when the motor is to be driven, and disconnect when the gates reach their stopping positions.

The control operation may be initiated by a manual starting button or switch 53 associated with the controller. Whenever the motor starts into operation the gate mechanism is actuated and the control arm 44 commences to swing either downwardly to open or upwardly to closed position as the case may be. In Fig. 2 the arm 44 is shown as having swung upwardly and operated to open the limit switch 45. This switch is in a local circuit 55 which leads to the controller 50 and is so connected therein that the contact of the arm upon the limit switch button causes the breaking of the connections to the motor circuit 51, and vice versa. The result is that the mechanism stops operation with the gates closed. When the starting button 53 is now operated the resumed action of the motor causes the opening of the gates and the swinging down of the control arm. This first releases the limit switch 45, so that it is in position for the next stopping. The arm 44 finally contacts the limit switch 45 which is connected by a circuit 56 with the controller 50, causing the energizing circuit 51 again to be broken, and the action is stopped with the gates wide open. As stated, the motor may next be suitably restarted to cause re-closing.

Fig. 9 shows a simple wiring arrangement that may be used for control purposes. It agrees in position with Fig. 2, the upper limit switch 45 being held open against its spring and the lower switch 46 closed by its spring. The controller 50 includes a double pole switch 50^a which when closed connects the line wires 49 with the motor 42. It also includes a solenoid 50^b which when energized lifts its core and closes the double pole switch 50^a against an opening spring. The starting switch 53 is shown as a double acting single pole switch. This switch is shown as closed at the right, but the upper limit switch 45 is open, so that no power is being delivered to the solenoid, which had released the double pole switch, and which latter had been opened by its spring, rendering inoperative the motor, with the charging and shield gates closed. If now the starting switch is reversed to the dotted line position the solenoid circuit becomes closed through circuit 56, and the switch 50^a is thus caused to close. Said switch thereupon delivers current to the motor 42 which therefore starts rotation and causes the progressive opening of the gates. When fully open the control arm 44 Fig. 2 contacts and opens the lower limit switch 46, breaking the circuit 56, and causing the opening of switch 50^a and the stoppage of the motor. In the meanwhile the upper limit switch has closed, in readiness for the next reversing operation.

In the modification shown in Fig. 7 the main or charging gate 21 may be similar to that already described, but the refractory shield 60 is shown in a form adapted to retract from closed to open position by a sliding rather than a swinging motion. For this purpose each sliding section 60 is shown provided with rollers 61 running on inner tracks 62. The tracks have a riser or upslant 63 which takes effect on the rollers as they pass from the tracks 62 to the outer tracks 64. By this arrangement as the opposite sliding sections

60 are moved inwardly to closed position they drop slightly so as to become seated on the surrounding parts or rim of the furnace chamber adjacent to the charging opening 13.

For the purpose of retracting the sliding shield 60 to open the chute when the main gates are swung downwardly the following connections are shown. On each sliding section is an upstanding plate or bar 65 carrying a pin 66 which is engaged by the slot or fork 67 formed at the lower end of a swinging arm 68 mounted on the carrying shaft 25 of the adjacent main gate section. In this embodiment the operating rockshaft 34^a is placed substantially at the level of the shafts 25 so that the main gates derive their opening and closing motions directly from the shaft 34^a through the gears 33^a and 32^a, while the shield sections derive their motion from the shafts 25 through the connections 65-68 described. The shield is thus caused to recede and clear the chute in time for the delivery of the refuse from the charging gate.

In the modification shown in Fig. 8 the upper or charging gate 21 may be similar to that already described, but in this case the lower or shielding member 70 is movable on the same mounting as the main gate and in that way is caused to open and close simultaneously with the opening and closing of the upper gate. In this embodiment each section 21 of the main gate, swinging about its supporting shaft 25, is provided with an opposite pair of depending segment plates 71, the lower edge of each of which has mounted upon it a curved arrangement or system of refractory blocks 72 constituting the shield, the outer or lower surface thereof being approximately cylindrical, so that when the main sections are swung downwardly to open position, each of the shield sections swings down and out, so as to clear the chute for the charging operation, while maintaining a substantially closed relation to the refractory lower chute portion 19 which stands up above the top wall 12 of the furnace chamber. The outermost element 72 of each section of the shield 70 is provided at its outer edge with a projection or flange 73^a which may serve both as a stop to limit the closing movement of the corresponding shield section and as a sealing means.

The refractory or firebrick elements 72 may be variously combined and mounted to constitute a shield which shifts or swings simultaneously with the opening and closing of the charging gate. As shown, each of the firebrick members 70 is provided with an inward extension 73 perforated or adapted to receive a system of holding rods 74 supported at their ends in the segment plates 71.

In this embodiment the main gate sections 21 are shown as coming to closed position while still somewhat inclined below the horizontal. Between the main gate sections and the refractory portions of the shielding sections are air cells or spaces 76 serving the same purpose as the air spaces 23 shown in Figs. 1 and 7, affording additional heat insulation for the main gates. Fig. 8 shows in dotted lines the outswung positions of the charging and shielding sections. The counterweight and operating connections may be similar to those illustrated in Fig. 7.

The gates 21, in all embodiments, swing down within the chute 18 between the right and left lateral side walls 20 of the chute, substantially in contact with them. In Figs. 1-6 and Fig. 7 the chute is completed by the front and rear lateral walls 20^a. In Fig. 8 however the walls 20^a are omitted, being unnecessary, as closure is effected

by the fit of the gates 20 and by the fit of the shields 70 with the refractory entrance 19 to the furnace. In all cases the chute is fixed as to its described lateral walls, and is laterally closed either by the fixed walls 20 and 20^a or by the walls 20 and the cooperation of gates and shields with the walls 20 and entrance 19 as in Fig. 8.

We claim:

1. Apparatus for the periodic charging of a furnace, comprising a charging chute and delivering downwardly into the furnace chamber, a fixed hopper above and in alinement with the chute, and a normally-shut charging gate mounted in the chute and supporting the weight of the charge in the hopper and openable by swinging downwardly for dumping each charge into the furnace; and means for opening the gate for each charging operation and thereupon closing it, comprising an electric motor with driven connection for lowering and lifting the gate, a limit means having connections operated by the movement of the gate to extreme position and adapted to render the motor inoperative, and means to restart the motor.

2. Apparatus as in claim 1 and wherein the connections operated by the movement of the gate include a swinging arm movable with the gate and the limit means comprises a limit switch operated by the arm when the gate is completely closed thereby to stop the motor.

3. Mechanism as in claim 1 and wherein the motor is of a kind that turns in one direction only, with crank connections to the gate, arranged so that the crank is in dead center when the gate is shut, a circuit controller operating upon the circuit to the motor to open or close it, and said limit means comprising two limit switches, one operated by the full closing and the other by the full opening of the gate, to operate the controller to stop the motor, and a restarting means to re-establish the circuit to the motor.

4. Mechanism for the periodic charging of a furnace, comprising a charging chute having lateral walls at two opposite sides and delivering downwardly through the furnace entrance, a hopper above and constituting a continuation of the chute, and a charging gate comprising an opposite pair of sections swingingly mounted in the upper part of the chute, normally shut to receive and openable by downward swinging about horizontal axes for dumping each charge into

the furnace; and in combination therewith a movable shield of high heat resistant material comprising an opposite pair of sections swingable about substantially the same axes as the gate sections; said shield sections being each adapted to extend from the inner portion of the corresponding closed gate section downwardly and outwardly into closing relation to the furnace entrance, thereby to afford a protective air cell or space between the gate and shield, and to maintain the chute substantially closed at the two sides that are not closed by said opposite lateral chute walls, and means for opening the gate and shield sections for each charging operation and thereupon closing them; the furnace having adjacent to its entrance an upstanding extension or flange at each of the two sides closed by said shields, and each shield section having a downwardly extending projection or flange adapted to engage such upstanding extension when the gate sections are shut, thereby to act both as a stop for the closing movement and as means for producing an effective seal at each side.

5. Apparatus for the periodic charging of a furnace, comprising a fixed charging chute delivering downwardly into the furnace chamber, a fixed hopper above and constituting a continuation of the chute, and a normally-shut charging gate mounted swingably in the chute to receive and support the weight of the charge in the hopper and swingable downwardly for dumping each charge into the furnace; and in combination therewith an arcuate shield of high heat resistant material below the gate in a position to afford an air cell or space between the gate and shield, said shield being normally in shut position for shielding the gate from the furnace fire but mounted in the chute to swing downwardly about the same axis as the gate and being thereby openable with the gate to render the chute clear for delivery of charge by the gate to the furnace, and operating mechanism for swinging downwardly about said axis both the gate and shield for each charging operation; the furnace having an upstanding extension closed by the shield and the shield having a downward extension adapted to engage such upstanding extension when the gate is closed, thus to seal the chute.

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