Oct. 4, 1949. R. D. TOUTON 2,483,946

UNDERGRATE AIR ADMISSION MEANS FOR LATERAL FEED SOLID FUEL STOKERS

Filed March 30, 1944

3 Sheets-Sheet 1

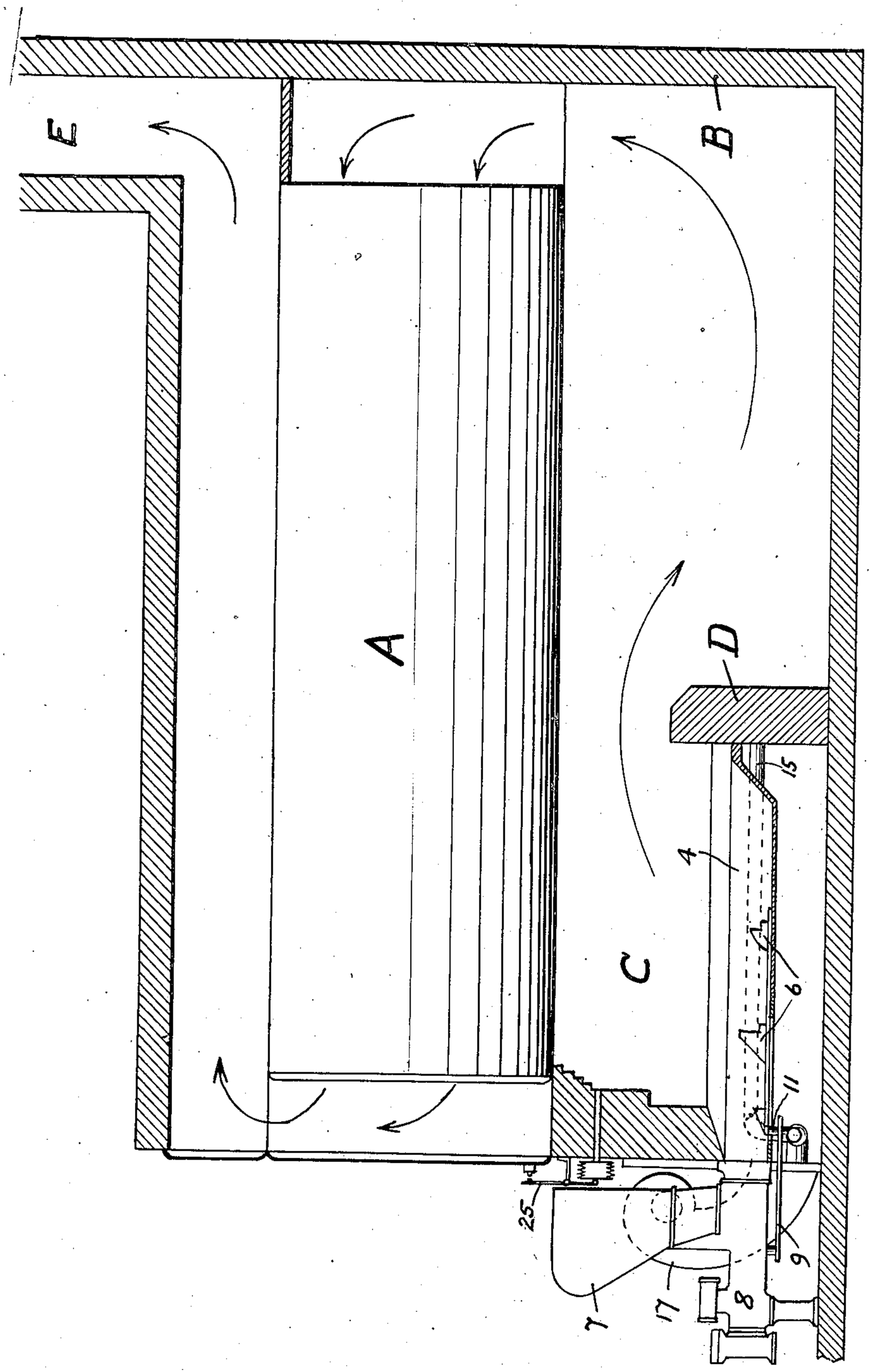

FIG. 1.

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Filed March 30, 1944 3 Sheets-Sheet 2

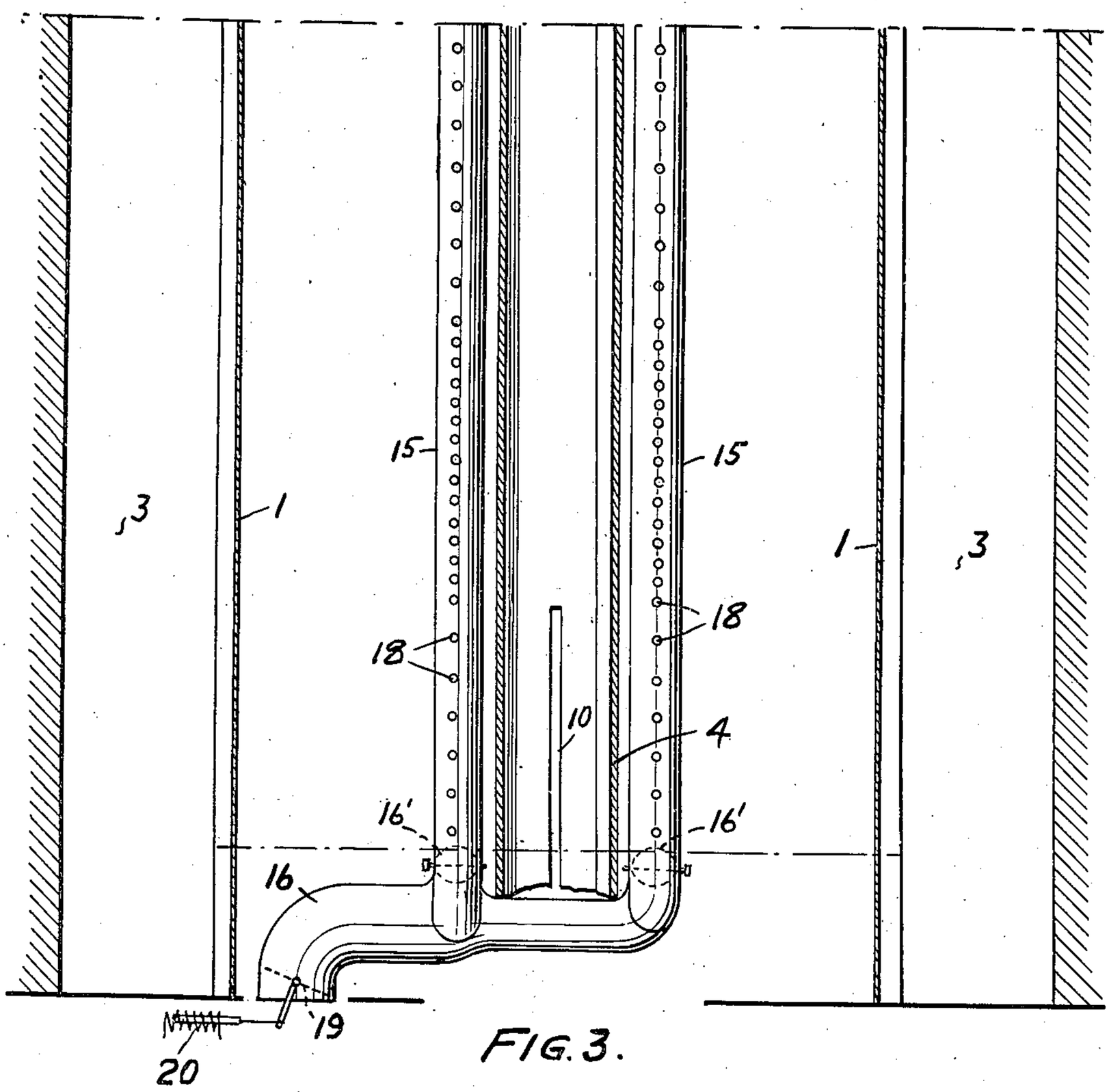

FIG. 3.

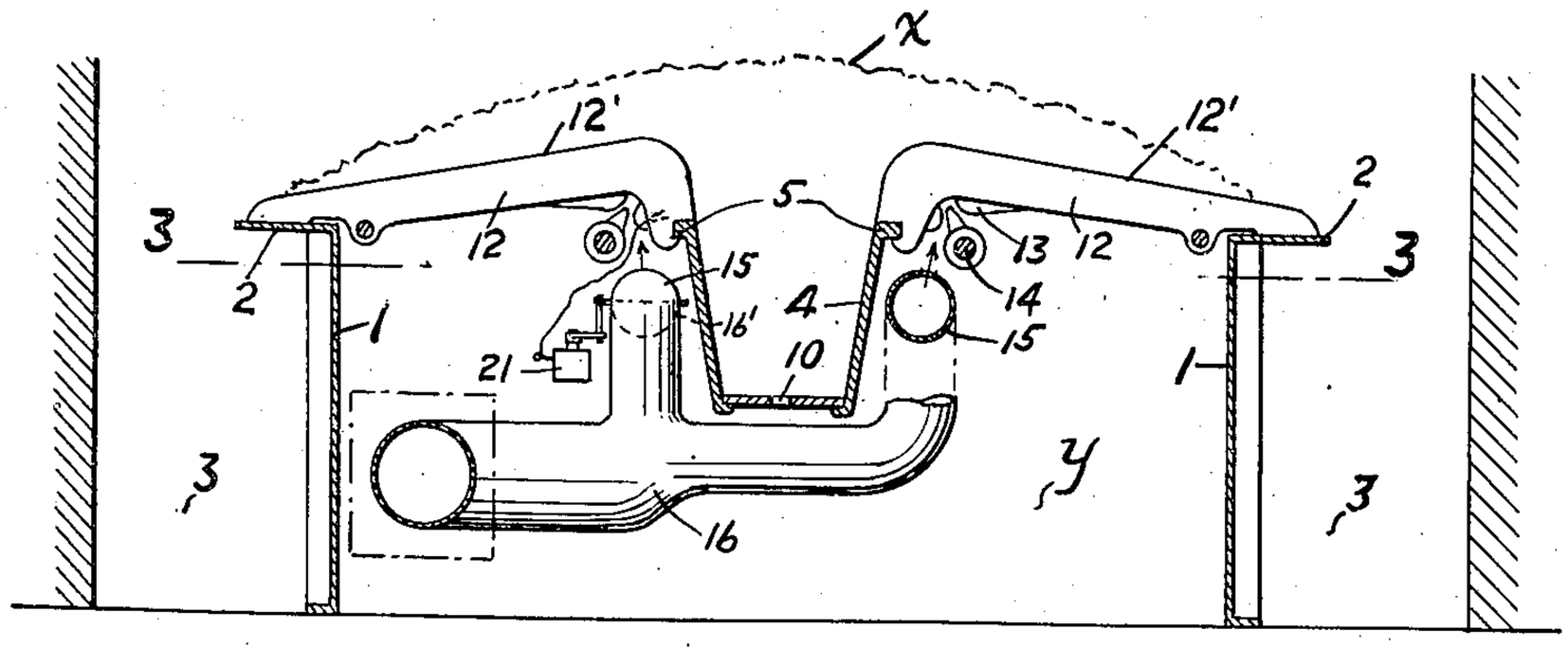

FIG. 2.

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Filed March 30, 1944 3 Sheets-Sheet 3

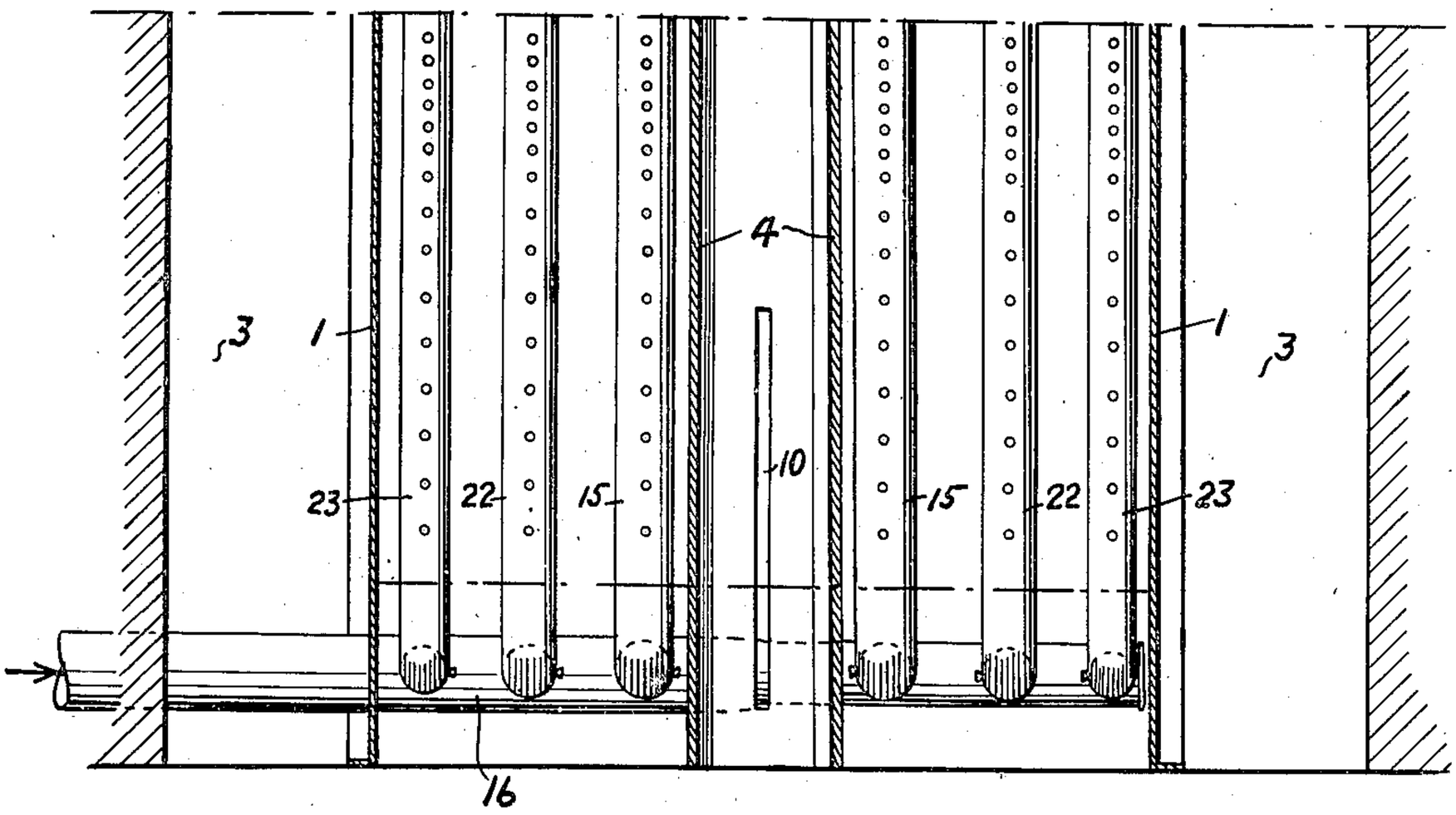

FIG. 5.

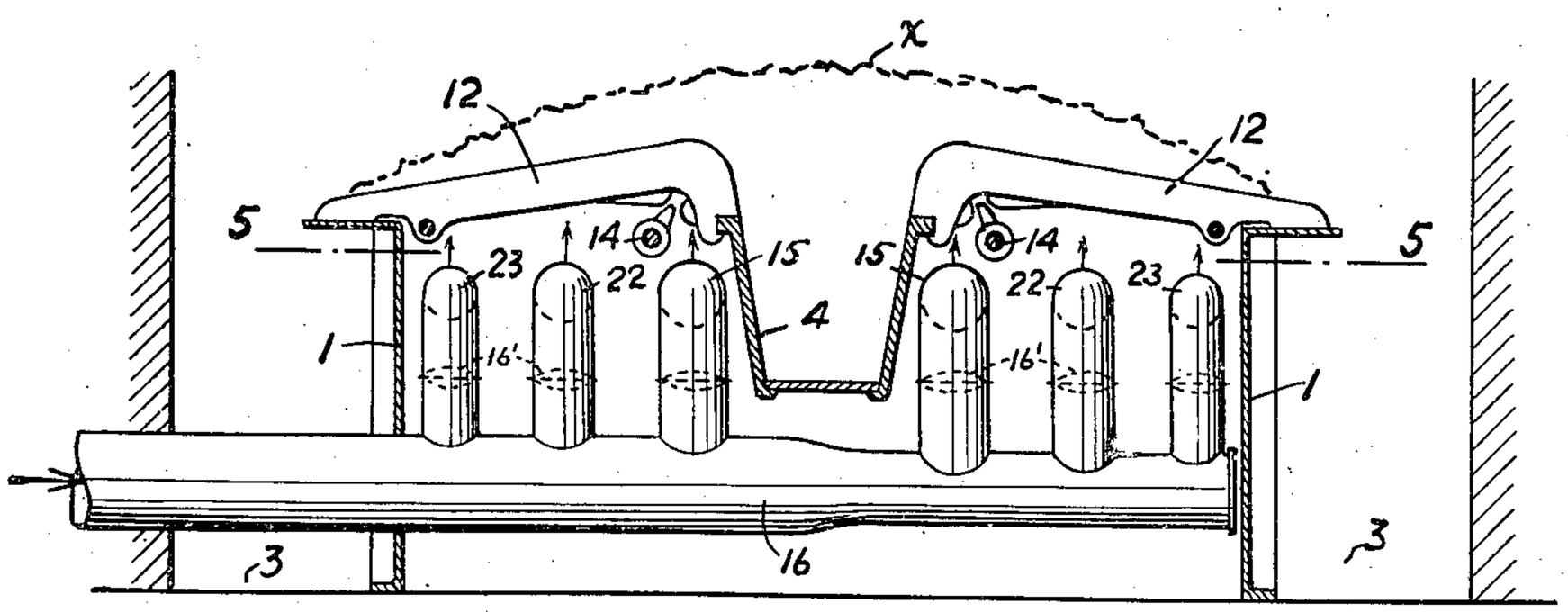

FIG. 4.

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UNDERGRATE AIR ADMISSION MEANS FOR LATERAL FEED SOLID FUEL STOKERS

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5 Claims. (Cl. 110—75)

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This invention relates to a method and apparatus for burning solid fuel, such as, for example, coal, coke, and the like.

More particularly, the method and apparatus according to this invention is adaptable for the burning of solid fuel when supplied to a grate by mechanical means, as, for example, a stoker.

As is well known, when mechanical means, as a stoker, is used for the supply of fuel for burning, it is customary to feed the fuel to grate means arranged so that the fuel will flow thereover to form a fuel bed from the point of feed by the stoker. And it is equally well known to provide air under some pressure beneath the grate means to promote, in cooperation with the stack draft above the fuel bed, the combustion of the fuel.

A structure, typical of structures heretofore used, comprises a series of grate bars arranged to extend downwardly from opposite sides of a hopper into which a stoker feeds fuel and from which the fuel flows over the grate bars to form a fuel bed. Beneath the grate bars is formed an air box into which air is forced by a blower and from which air passes between the grate bars into the fuel bed to promote combustion of the fuel. Adjacent to the ends of the grate bars, remote from the fuel feed hopper, ash pits are provided into which fall the ashes from the combustion of the fuel, it being appreciated that the fuel is fed to the grate bars and travels over the grate bars, the while being consumed by combustion, so that ash is discharged into the ash pit.

In such structure, which is typical in principle and operation to the various structures heretofore known, the fuel bed normally varies in thickness in the extension of the grate bars from the feed hopper to the ash pits, being relatively quite thick adjacent to the feed hopper and being relatively thin adjacent to the ash pits; and such varying thickness is necessary to the flow of the coal over the grate bars. In addition to the fact that the fuel bed normally varies in thickness, it is subjected to wide local variation in thickness in its thinner areas due to the removal of clinkers which form periodically and must be removed to avoid dead spots in the fuel bed.

Due to the variations in normal and local thickness of the fuel bed, it has been observed that the air under pressure in the air box, to which the underside of the whole fuel bed is subjected equally, tends to pass more rapidly through the thinnest areas of the bed than through the thicker areas, and to, as it were, tend to blow through thin areas resultant from the removal of clinker. As a result the combustion of the fuel forming the bed is non-uniform and excessive heat is developed in certain areas, which operates to burn out the grate bars, which must then be replaced at considerable time and expense.

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Now in accordance with this invention, a method and apparatus for burning solid fuel is provided which will be adaptable to mechanical or stoker feeding and which will include the provision of means and such mode of operation as to insure uniform combustion throughout the fuel bed and, at the same time, negative the burning out of the grate bars.

Having now indicated, in a general way, the nature and purpose of this invention, I will proceed to a detailed description, by way of illustration, of an apparatus, and an embodiment thereof, from a description of the operation whereof the method will be made apparent, all with reference to the accompanying drawings, in which:

Figure 1 is a sectional view of apparatus according to this invention in combination with a steam generator.

Figure 2 is a cross-sectional view of apparatus embodying this invention.

Figure 3 is a sectional view on line 3—3, Figure 2.

Figure 4 is a cross-sectional view of a modification of the apparatus shown in Figure 2.

Figure 5 is a sectional view on line 5—5, Figure 4.

Referring more particularly to Figures 1–3, A indicates a boiler, of the fire tube type, supported in brick work B, of any usual or desired construction, to provide passage for hot gases beneath the boiler, from a fire box C, over a bridge wall D, through the fire tubes of the boiler, over the boiler and to a stack outlet E, as indicated by the arrows, Figure 1.

Extending longitudinally in the fire box C is a pair of partition members 1, 1, provided at their upper ends with flanges 2, 2. The members 1, 1 are spaced from each other and from the side walls of the brick work B and define, with the side walls of the brick work B, ash pits 3, 3.

Extending into the fire box and supported therein, intermediate the partitions 1, 1, by the front of the brick work B and the bridge wall D is a fuel feed hopper 4, the edges of which are provided with flanges 5, 5. In the bottom of the hopper is a fuel ram 6, of any usual construction, adapted to be moved back and forth in the feed hopper, to feed fuel thereinto from a supply

hopper 7, by any suitably driven mechanism (not shown) contained in casing 8 and connected to the ram 6 by a link 9, a slot 10 being provided in the bottom of the hopper 4 for the passage of the connection 11 between the ram and link 9.

It will be appreciated that the ram 6, its driving mechanism and its connection therewith comprise a mechanical stoker and may be of any well known construction.

Supported at their ends by the flanges 5, 5 on feed hopper 4 and the flanges 2, 2, on partition members 1, 1, are grate bars 12, 12, which extend oppositely from the hopper 4 to the ash pits 3, 3 and, adapted to receive fuel from the hopper 4, provide supports for fuel beds on opposite sides of the hopper. The grate bars 12, 12 may be of any usual construction providing supporting surfaces 12', 12', which slant downwardly from the edges of the hopper 4 to the edges of the ash pits 3, 3, and will be provided with bosses 13 for engagement with a shaking device indicated at 14.

Extending beneath the inner ends of the grate bars 12, 12 lengthwise of and adjacent to the sides of the feed hopper 4 are conduits 15, 15, which are connected to a manifold 16, the manifold in turn being connected to receive air from a blower 17 located outside of the boiler front.

The conduits 15, 15, as shown in Figures 2 and 3, are provided with upwardly opening spaced apertures 18, the spacing of the apertures, as shown in Figure 3, desirably being closer in the central portion of the conduits than in the end portions. The manifold 16 is provided with a damper 19 for regulation of the flow of air from the blower to the conduits 15, 15 and which may be manually controlled, or, if desired, may be controlled automatically through the medium of, for example, any well known form of electrical, or other power, device, indicated at 20, under control of any well known suitably placed heat responsive element.

The conduits 15, 15 are each provided with a damper 16' by which the flow of air into the conduits, respectively, may be controlled, for example, by means of any well known electrical device 21, controlled by any well known form of heat responsive element, as, for example, a thermocouple, suitably placed, as, for example, between the inner ends of a pair of the grate bars 12, 12. It will be appreciated that, as may be desired, the dampers 16 may be controlled by a single device 21, or they may be individually controlled by providing a separate control device for each of them.

Referring now to Figures 4 and 5, in addition to the provision of the conduits 15, 15, as in the structure shown in Figures 2 and 3, additional conduits 22, 22 and 23, 23 are provided in spaced relation between conduits 15, 15 and the walls 1, 1. The several conduits are connected to a manifold 16, which in turn is connected to receive air from a blower, as blower 17.

The conduits 22, 22 are provided with upwardly opening apertures 18, as in the case of conduits 15, 15, but are of smaller diameter than the conduits 15, 15. And, likewise, the conduits 23, 23 are provided with upwardly opening apertures 18 and are of smaller diameter than the conduits 22, 22. The manifold 16 and the several conduits will be provided with dampers, as described with reference to the structures shown in Figures 2 and 3, and which may be provided with heat-responsive automatic control devices.

The operation of the apparatus according to this invention, as described above, and which involves the method according to the invention, will, it is believed, be apparent. However, assume that a fuel burning bed X is established on the grate bars 12, 12, and that the stoker and blower 17 are in operation.

By virtue of the operation of the stoker, fuel will be fed into hopper 4, will overflow therefrom onto the grate bars and will flow over the grate bars toward the ash pits 3, 3. At the same time, air will flow into conduits 15, 15 and streams of air will flow therefrom through apertures 18 and upwardly into the fuel bed between the grate bars.

The feed by the stoker will be regulated, in the usual manner, so that the fuel flowing downwardly over the grate bars will be consumed on reaching their outer ends, from which the ash will fall into the ash pits.

Now, as will be appreciated, the fuel bed will be of maximum thickness above the feed hopper 4 and will gradually thin out toward the outer ends of the grate bars above the ash pits.

The air stream issuing from the apertures 18 in conduits 15, 15 will hence enter the fuel bed to supply maximum air to promote combustion adjacent to the thickest portion of the bed. At the same time, the air issuing from conduits 15, 15, since it cannot all pass through the fuel bed due to its thickness at the points of delivery of the air will create a positive pressure in the area surrounding the conduits or pressure box or chamber Y beneath the grate bars. Hence, while air is delivered directly from conduits 15, 15 to the thicker portions of the fuel bed, air under the positive pressure existing in the pressure box Y will enter the thinner portion of the fuel bed.

The amount of air supplied to the conduits 15, 15 and discharged through apertures 18, will be controlled by regulation of the dampers 16 and 19.

The air issuing from the apertures 18 in the conduits 15, 15, it will be noted, exerts a cooling effect on the inner ends of the grate bars and on the grate shaking mechanism 14.

The modified structures shown in Figures 4 and 5 will operate as described above with the provision of additional streams of air to the fuel bed from the conduits 22, 22 and 23, 23, through the apertures 18 therein, it being noted that the volume of air discharged from the conduits 22, 22 and 23, 23 will decrease with decrease in the thickness of the fuel bed, since the several conduits are of decreased diameter, the largest being beneath the inner ends of the grate bars and the smallest being adjacent the ash pit walls 1, 1.

By virtue of this invention, it has been found that a fuel bed of desired form with highly efficient combustion can be maintained without the burning out of grate bars due to local overheating, as has heretofore been a common occurrence where, as in prior structures, air is supplied under positive pressure from a pressure box to the fuel bed generally, and consequently passes into the fuel bed in greater volume and hence promotes undesirably rapid combustion in its thinner as compared to its thicker portions, or, as in the case of removal of clinkers, as it were, blows through at the point of clinker removal before the flow of fuel over the grate bar repairs the bed.

What I claim and desire to protect by Letters Patent is:

1. A furnace for burning solid fuel, comprising a front wall, a rear wall, and side walls forming a combustion chamber, a bridge wall extending across said combustion chamber between the front and rear walls, there being an air chamber between the furnace side walls having side

walls extending from the front wall of the furnace to the bridge wall, a fuel feed hopper between the side walls of the air chamber extending from the front wall of the furnace to the bridge wall forming a portion of the top of the air chamber, grate bars extending laterally from the fuel hopper to the side walls of the air chamber, forming the remainder of the top of the air chamber, means for feeding fuel upwardly out of the hopper and onto the grate bars from the hopper, an air conduit extending longitudinally of the air chamber at each side of the fuel hopper spaced below the grate bars, there being air delivery openings in the upper faces of the conduits for delivering jets of air to the grate bars along the sides of the feed hopper and into the fuel as fed from the hopper, and means for delivering air under pressure to said conduits.

2. A furnace for burning solid fuel, comprising a front wall, a rear wall, and side walls forming a combustion chamber, a bridge wall extending across said combustion chamber between the front and rear walls, there being an air chamber between the furnace side walls extending from the front wall of the furnace to the bridge wall, a fuel feed hopper between the side walls of the air chamber extending from the front wall of the furnace to the bridge wall forming a portion of the top of the air chamber, grate bars extending laterally from the fuel hopper to the side walls of the air chamber forming the remainder of the top of the air chamber, means for feeding fuel upwardly out of the hopper and onto the grate bars from the hopper, a plurality of air conduits extending longitudinally of the air chamber at each side of the fuel hopper spaced below the grate bars, there being air delivery openings in the upper faces of the conduits for delivering jets of air to the grate bars along the sides of the feed hopper, and means for delivering air under pressure to said conduits.

3. A device for burning solid fuel comprising means defining a combustion chamber, a fuel feed hopper of greater length than width extending into said combustion chamber, means defining an ash pit in said combustion chamber and parallel to said hopper, grate bars extending laterally from said hopper to said ash pit and arranged to receive fuel from said hopper and for the flow of fuel thereover in a bed of diminishing thickness from the point of receipt of fuel thereon towards the ash pit, means for the supply of fuel to said feed hopper for the maintenance of said fuel bed on said grate bars, means in conjunction with said grate bars defining an air chamber under said grate bars, a conduit in said air chamber having upwardly opening apertures and extending transversely beneath said grate bars lengthwise of and adjacent to said fuel hopper, and means for the supply of air under pressure to said conduit.

4. A device for burning solid fuel comprising means defining a combustion chamber, a fuel feed hopper of greater length than width extending into said combustion chamber, means defining an ash pit in said combustion chamber and parallel to said hopper, grate bars extending laterally from said hopper to said ash pit and arranged to receive fuel from said hopper and for the flow of fuel thereover in a bed of diminishing thickness from the point of receipt of fuel thereon towards the ash pit, means for the supply of fuel to said feed hopper for the maintenance of said fuel bed on said grate bars, means in conjunction with said grate bars defining an air chamber under said grate bars, a conduit in said air chamber having upwardly opening apertures and extending transversely beneath said grate bars lengthwise of and adjacent to said fuel hopper, means for the supply of air under pressure to said conduit, damper means for controlling the admission of air to said conduit, and heat responsive means positioned in said air chamber adjacent to said grate bars for controlling said damper means.

5. A device for burning solid fuel comprising means defining a combustion chamber, a fuel feed hopper of greater length than width extending into said combustion chamber, means defining an ash pit in said combustion chamber and parallel to said hopper, grate bars extending laterally from said hopper to said ash pit and arranged to receive fuel from said hopper and for the flow of fuel thereover in a bed of diminishing thickness from the point of receipt of fuel thereon towards the ash pit, means for the supply of fuel to said feed hopper for the maintenance of said fuel bed on said grate bars, means in conjunction with said grate bars defining an air chamber under said grate bars, a series of conduits in said air chamber, said conduits having upwardly opening apertures extending in a plane in spaced relation lengthwise of said feed hopper, one of said conduits being adjacent to said feed hopper and the next adjacent conduit being of less diameter than said conduit adjacent to said feed hopper and means for the supply of air under pressure to said conduits.

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