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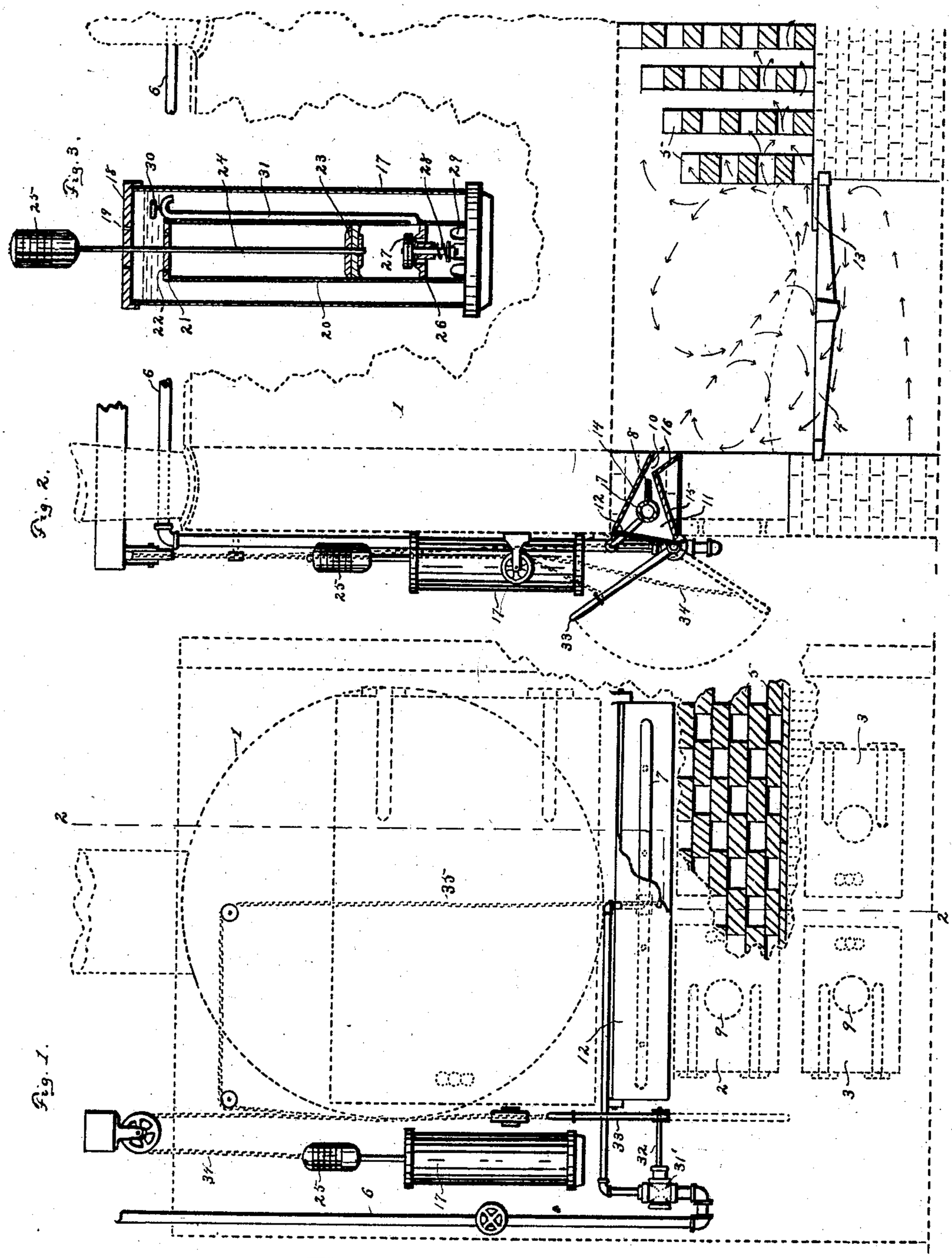
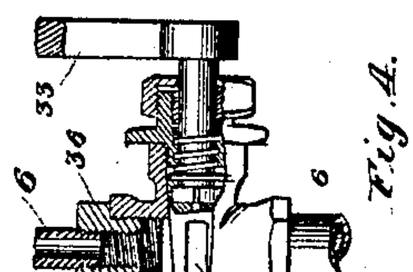
E. HONESS.

DEVICE FOR SECURING MORE PERFECT COMBUSTION.

APPLICATION FILED MAR. 27, 1901.

NO MODEL.





Witnesses.
Pearl B. Garrett.
Lillian L. Enoch.

Inventor.
Edwin Honess.
By D. E. Foulz
Atty.

UNITED STATES PATENT OFFICE.

EDWIN HONESS, OF CLEVELAND, OHIO.

DEVICE FOR SECURING MORE PERFECT COMBUSTION.

SPECIFICATION forming part of Letters Patent No. 720,695, dated February 17, 1903.

Application filed March 27, 1901. Serial No. 53,145. (No model.)

To all whom it may concern:

Be it known that I, EDWIN HONESS, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented a new and useful Improvement in Devices for Securing More Perfect Combustion, of which the following is a specification.

This invention relates to devices for promoting the proper combustion of fuel, especially in boiler-furnaces, and has for its objects the production of a device of this character which is cheaper and simpler in construction, more easily applied to old furnaces, and which is more effective in its operation than those heretofore employed. These objects I attain by the use of the mechanism shown in the accompanying drawings, which show my preferred form applied to a boiler-furnace, in which—

Figure 1 represents the front end of a boiler having my improved device attached thereto. Fig. 2 is a sectional elevation of the front portion of the boiler, the same being taken on line 2 2 of Fig. 1. Fig. 3 is a sectional view through the center of the regulator; and Fig. 4 is a sectional view through the steam-valve and pipes leading thereto, showing the means for maintaining the blast until the valve is practically closed.

Similar reference characters designate corresponding parts throughout the several views of the drawings.

It is well known that in order to get perfect combustion at all times in a furnace it is necessary to so control the admission of the air that the proper amount of oxygen will be present with the carbon to chemically unite with the same. If an insufficient amount of oxygen is present, the carbon will escape in the form of smoke or soot and a great loss of fuel with a consequent low efficiency will result. If too much air is admitted, the fire may burn too rapidly, and much of the heat will go toward heating up the useless surplus air. Moreover, if the air is not sufficiently heated in a boiler-furnace it will cool the boiler-tubes as it passes to the stack, thus giving variations of temperatures therein, which will cause the tubes to contract and expand and finally result in the destruction of the boiler. It is therefore very important, as viewed from the standpoint of coal consumption, as well as from that of efficiency and durability of the boiler, that the admission of air should be nicely and exactly controlled at all times. The amount of air necessary varies, however, with the condition of the fire. Thus when fresh coal is added great quantities of gases are driven off and a correspondingly large amount of air must be furnished; otherwise the loose or easily-detached particles of carbon will escape as dense clouds of smoke. Later, however, when these easily-detached particles are driven off and the fire becomes incandescent a greatly-diminished volume of air will suffice. It therefore becomes necessary to provide a regulating device which will regulate the admission of the air to suit the requirements at any particular time. It is also important to direct the currents of air properly, else the oxygen will not meet the carbon at the proper time for combustion, and the unheated air passing through the furnace and tubes will cool the same, and thus do harm.

While I consider my invention as being especially valuable when applied to boiler-furnaces and for that reason have shown it as so applied, I do not desire it to be understood that I consider it limited to furnaces of this character.

In the drawings, 1 represents in dotted lines a boiler, which may be of any desired pattern, the same being suitably mounted. Also shown in dotted lines are the fire-doors 2 and the ash-pit doors 3.

4 represents the grate-bars, and 5 the bridge-walls. These bridge-walls are of the peculiar honeycomb structure shown in the drawings, the front walls being lower than the rear, which is built up practically to the boiler. This is a very desirable structure and is necessary to the proper operation of my apparatus, as I shall hereinafter make plain.

In order to get the proper draft when fresh fuel is added, I conduct steam from the boiler through the pipe 6 to the front end of the fire-box. While it is preferable to use live steam, exhaust-steam or even compressed air may be employed instead. This pipe 6 is connected at its lower end to the center of a larger pipe 7, which extends transversely across the front end of the fire-box and is closed at both

of its ends. Projecting from the front of this pipe are short nozzles 8, which are suitably spaced and are directed toward the fire-box. From these nozzles the steam from the pipe 6 is forced into the furnace. The air is admitted both above and below the grate-bars 4 through the doors 2 and 3 or through the dampers therein, the latter being indicated by the dotted circles 9. Under normal conditions the greater quantity of air is admitted below, as in passing through the grate-bars it comes into more intimate contact with the fuel than it would if admitted above the same. The draft naturally tends to carry the combustible gases, as well as the smoke, upwardly from the grate-bars, and when a fresh quantity of fuel is added the space above the same is suddenly filled with such gases and particles of detached carbon, so that it is necessary to force a quantity of air into this space to consume the same. This air is drawn in with the steam from the nozzles 8 through an elongated slot or opening 10 in the front wall of the fire-box. This slot forms the most constricted portion of a chamber 11 in said wall, the front end of which is closed by a door 12. This door is hinged at its upper edge to the front of the boiler, and preferably stands at a slight incline thereto, so that it will rest by gravity over the front of the chamber 11, and thus exclude all air. When it is desired to inject air into the fire-box, the door is opened and the inrushing steam acting as an injector will draw the air in with it. Now it is not only necessary to have the proper amount of air in the furnace at all times, but it is also necessary to have it so directed and distributed that it will meet and combine with the combustible gases and the particles of carbon which are floating therein. Moreover, air must constantly be supplied to the fuel on the grate-bars. It is a matter of common knowledge that the air which is admitted below the grate-bars rushes in with great velocity. Partly for this reason and partly because of the resistance which the fuel offers to its upward movement the air passes entirely to the rear end of the ash-pit before its momentum is arrested. In furnaces of ordinary construction it then ascends through the grate-bars, which results in consuming the fuel just in front of the bridge-wall, while that near the front of the furnace has only begun to burn. Thereafter until fresh fuel is added the air, meeting with little resistance at the rear of the furnace, passes readily through the grate-bars at this point, and as it has not come directly in contact with the fire it is still cold, and consequently cools the bridge-wall. In order to avoid this result, I place a dead-plate 13, of non-combustible material, such as fire-clay, over the rear ends of the grate-bars, just in front of the bridge-wall. Now when the air is admitted below the fire it still rushes to the rear of the ash-pit; but instead of passing directly up through the grate-bars it turns back toward the front, its momentum in this direction being sufficient to carry it past the mere edge of the plate 13 and to distribute it more thoroughly through the fire. In order to assist in the distribution of this air and also to furnish the fuel with its proper supply and at the same time to set the air and the combustible gases above the grate-bars into circulation or agitation, so that they will become thoroughly mixed, I direct the air and steam from the slot 10 and the nozzles 8, so that they will strike the fuel just in front of the dead-plate 13. The great velocity of the air will drive it partially at least into the fuel, creating a downward pressure in the region in front of the plate 13, and this will prevent the passage of the air from below through the fuel in this region. Furthermore, the rush of the sheet of steam and air through the fire-box sets the air, the gases, and the smoke below the same into eddies, as indicated by the arrows, which also assists in causing the air from below to move well to the front of the fire before it passes through it. While the blast of steam and air is blowing, therefore, the fire at the front of the furnace is supplied mostly from the air which enters through the ash-pit. That region in the fire-box above the sheet of air and steam is also filled with eddies of air, smoke, and gases, which rush in a direction opposite to those on the other side, this being also shown by arrow-heads. It will thus be seen that the gaseous contents of the fire-box are in violent commotion while the steam and the air are being injected, which must result in bringing the oxygen of the air, the combustible gases, and the loose particles of carbon into intimate relation. In spite of this admixture of gases, however, and the unusually thorough combustion which results therefrom some of the loose particles of carbon would be carried off unconsumed if the ordinary bridge-wall were employed, for when these pass out of the region of intense heat they cannot be oxidized. In order to extend this region and also to detain these particles therein until consumed, I use the peculiar form of bridge-walls hereinbefore described. These walls are not only honeycombed, but the open spaces therein are staggered, so that the gases move in a tortuous passage, and no particle of carbon can get through without first coming in contact with some closed portion of the walls. Now these walls, being surrounded with hot gases and the flames from the furnace, become themselves intensely hot, so that the particles of carbon coming into contact with them are converted into combustible gases, which are then oxidized. As indicated by the arrow-heads in the drawings, much the greater quantities of air and the gases of combustion pass through the bridge-wall not far above the dead-plate. This is because the blast of steam and air is directed toward this general region and because the eddies in the upper part of the fire-box tend to carry the air away from this part of the bridge-walls.

None of the air can reach this part of these walls without first passing through a region of intense heat, and even then the probabilities are that it will be caught in the eddies and whirled about in the furnace before it passes through to the stack. For these reasons the air that reaches the upper part of the bridge-walls is very hot, and the carbon particles which it carried are practically all consumed, so that a thick wall is not needed there. I therefore gradually lower the walls from the rear to the front, which leaves a region next to the boiler that is almost free from the network of bricks of which the lower part of the bridge-walls is formed. This structure also facilitates the draft. In order that the front wall will not be knocked over by the fuel and the steam-blast, I preferably make it thicker than the remaining walls, as shown.

The fuel as it is thrown into the furnace naturally forms a pile, such as is indicated by the dotted lines above the grate-bars in Fig. 2, this pile being thinnest in the region where the blast strikes it and thickets where it is piled in a heap on the dead-plate. This is due to the momentum on the coal, which tends to carry it back to the bridge-walls, and also to the force of the steam and air jets. Now it is very desirable to have the coal heap up in front of the bridge-wall in this manner, for it prevents the air which is drawn in with the steam from passing directly through the bridge-walls, which would greatly diminish the circulation of the air in the furnace and would also cool off the bridge-walls and prevent the oxidation of the carbon particles that may have entered them. It also forms a deflecting-surface for the air, which turns it upwardly in front of the bridge-walls, and thus promotes the circulation of the air. Furthermore, the coal on the dead-plate is protected from the air from below, and for this reason the lower and rear portion of it is slowly consumed. However, the front portion of this heap is almost in the direct line of the air-blast, and consequently burns with a fierce heat. This heat is sufficient to partially coke the coal to the rear, thus converting it into a tough gummy mass which becomes incandescent and burns quietly. This mass of coke serves as a sort of screen to catch the particles of carbon which are blown into it by the blast of air and to hold them until they are consumed. It has been shown that with the violent circulation of the air few particles of the carbon can reach the upper part of the bridge-walls before being consumed. In like manner comparatively few of such particles can pass through the pile of coke on the dead-plate, and such as do pass are quickly oxidized in the bridge-walls, which, especially in this region, are intensely hot.

The sheet of air and steam is directed to the desired region by the deflecting-plate 14, which lines the upper wall of the chamber 11. The lower wall is lined with plates 15 and 16, which stand at an angle with each other, so as to form, with the plate 14, the narrow slot or opening 10, heretofore described. If preferred, the plate 16 may be omitted. It is for only a comparatively short time after fresh fuel has been added that it is desired to continue the blast of steam, for if continued longer it will result, as stated, in waste of fuel, in the cooling of the furnace, and in the deterioration of the boiler-tubes due to contraction and expansion. It is impracticable, however, for the fireman to give his constant attention to the device, and for this reason I have provided the same with a regulator or controller, which automatically shuts off the blast of steam and air. This regulator is shown in the drawings at 17 and is illustrated in detail in Fig. 3. It consists of an outer casing, which is filled with water almost to the top and which is covered by the flanged lid 18, the lid being provided with holes 19, so that the air may pass freely in and out. The regulator is suitably supported at the front of the boiler. Within the outer casing and under the water contained therein is a smaller tube or cylinder 20, which is also provided with a cover 21, having holes 22, through which the water may flow in and out. Moving back and forth within this cylinder is a piston 23, the rod 24 for which passes upwardly through the covers 19 and 21. The upper end of the piston-rod is provided with a weight or a series of weights 25, which force down the piston when it is permitted to move. Near the bottom of the cylinder and suitably secured therein is a spider 26, which forms a support, the guide, and the seat for the valve 27. This valve has a stem which projects down through the central hub of the spider, below which it is provided with a helical spring 28, which by expanding against a nut on the lower end of the stem normally holds the valve closed. The water is admitted into the cylinder 20 through openings 29 in its lower end. When the piston is moved to the upper end of the cylinder, it will be followed by the water, which enters through the openings 29 and lifts the valve 27 off its seat. The water will continue to flow until the space below the piston is completely filled. If now the piston is left free to move, it will settle down just as rapidly as the water below it will permit. If the water cannot escape at all, the piston cannot move. The escape of the water is controlled by the stop-cock 30 in the pipe 31, which opens into the cylinder just above the spider 26 and extends upwardly alongisde the cylinder, ending near the upper end thereof with its end under the water in the outer casing. The rapidity of descent of the piston depends upon the amount which the cock 30 is opened, and as this can be perfectly controlled it is evident that the downward movement of the piston can be perfectly regulated. Now this piston is caused to control the admission of the steam

and air through the slot 10 in a manner which I shall now describe.

The steam-pipe 6 is provided at some convenient point with a valve 31′, which has an extended stem 32. Secured to this stem is a hand-lever 33, by moving which the valve may be opened or closed. This lever is connected with the piston-rod 24 by means of a chain, rope, or cable 34, so that as the piston settles down in the cylinder 20 the valve will be gradually closed. Connected with the door 12, which, it is remembered, controls the admission of the air to the chamber 11, is a similar chain, rope, or cable 35, the opposite end of which is joined to the chain 34 at a point above the lever 33. As shown, these chains pass over suitable sheaves or pulleys, so that they may exert their pulls in the proper direction. When the lever 33 is in its upper position, as shown, the valve 31′ and the door 12 are closed, and neither steam nor air is admitted through the slot 10. When, however, fresh fuel is to be added, it is necessary that the blast of air and steam be turned on, and to do this the operator pushes down on the lever 33 and turns it to the position shown in dotted lines. This movement of the lever results in not only opening the steam-valve 31′, but in simultaneously opening the door 12, thus admitting both the air and the steam. The piston 23 and the weights 25 are also lifted by the same movement and the water in the regulator at once flows by the valve 27, thus filling the cylinder under the piston. The stop-cock 30 having been set to permit the water to escape through the pipe 31 at the desired speed, the piston will settle down accordingly when the lever 33 is released. As has been previously explained this movement of the piston gradually closes both the steam-valve 31′ and the door 12, so that in a predetermined time, governed by the stop-cock 30, the steam and air are shut off. By this time, however, the more volatile gases and the more easily-detached particles of carbon have been consumed and the fire has become incandescent, so that a further admission of steam and air could result only in harm and in loss of efficiency. In this connection it may be stated that inasmuch as the same water is used over and over again there is no waste or loss resulting from the operation of the regulator. In order that the full force of the steam-blast may be maintained until the valve 31′ is practically closed, I use a valve which has a capacity much greater than that of the pipe between it and the nozzles 8.

From Fig. 1 it will be seen that that portion of the pipe 6 leading to the valve 31′ is larger than the portion between the valve and the nozzles. In Fig. 4 I have shown a section through the pipes and the valve. The smaller pipe is joined with the valve through an intermediate bushing 36. 37 is the plug, and 38 the opening therethrough for the steam. This opening is as large in area as that through the lower pipe. From this it will be seen that the carrying capacity of the valve is so much greater than that of the smaller pipe that the steam maintains its full pressure in the latter until the valve is almost closed or until the piston has almost ceased to descend.

To avoid the admission of air into the cylinder 20 when the piston is raised, I bend the pipe 31 so that it terminates below the surface of the water in the outer cylinder.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a furnace, a bridge-wall, grate-bars, means for admitting air below said grate-bars, a dead-plate covering the rear ends of said bars, and means for supplying and directing a blast into the region just in front of the dead-plate, said dead-plate and said blast acting to prevent the air under the same from passing through the grate-bars except toward their front ends.

2. In a furnace, as a means for detaining and consuming the particles of carbon which have escaped consumption in the fire-box, a plurality of bridge-walls, each made of a honeycomb structure, the openings in one wall being out of line with those in the adjacent walls, said walls being gradually heightened from the front to the rear, for the purposes described.

3. In a furnace, as a means for promoting combustion, grate-bars, a dead-plate covering the rear ends of said bars to protect the fuel lying thereon from the air-currents below the same, a bridge-wall, and means for supplying and directing a blast into the furnace just in front of the dead-plate so that the fuel is heaped thereon, thus protecting the bridge-wall from said blast, and also deflecting the currents of air and gases so that they circulate in the furnace, substantially as described.

4. In a furnace, as a means for promoting combustion, grate-bars, a plurality of bridge-walls of honeycomb structure, the openings in one wall being out of line with those in the adjacent walls, a dead-plate covering the rear ends of the grate-bars to protect the fuel thereon and also the bridge-walls from the air-current in the ash-pit, and means for supplying and directing a blast into the furnace in front of the dead-plate so that the fuel is heaped thereon and is coked by the intense heat in front, and serves as a screen to detain the particles of carbon which would otherwise escape into the bridge-walls.

5. In a regulator for controlling the rapidity of a movement, an outer casing containing a liquid, an inner cylinder covered with said liquid, a piston mounted for movement within said cylinder, means for raising said piston to displace the liquid above the same, a valve below the piston to admit liquid to the cylinder as the piston is raised, a pipe communicating with the cylinder between the piston and the valve and having its opposite end under the liquid, means for causing the piston to exert a pressure on the liquid to

force it out through the pipe, and a valve within said pipe to regulate the rapidity of the escape of the liquid through the same so that the descent of the piston may be perfectly controlled.

6. In a device for promoting the proper combustion of fuel, a fire-box, a steam-pipe, nozzles for injecting the steam from said pipe into the fire-box, a valve having an extended stem in said steam-pipe, a hand-lever secured to the valve-stem for opening and closing the valve, a piston connected with said hand-lever so that when the lever is depressed and the valve opened, the piston will be lifted, weights on said piston to cause the same to descend and thus close the valve, and means for regulating the speed of descent of the piston.

7. In a device for promoting the proper combustion of fuel, a fire-box, a chamber in the furnace-wall in front of said fire-box, a steam-pipe leading into said chamber, nozzles for injecting the steam from said pipe into the fire-box, a valve having an extended stem in said steam-pipe, a hand-lever secured to the valve-stem for opening and closing the valve, a door for closing the said chamber to shut out the air when the said valve is closed, a piston connected with said hand-lever and said door so that when the hand-lever is depressed to open the valve the piston will be lifted and the door opened, weights on said piston to cause the same to descend and thus close the valve, and means for regulating the speed of descent of the piston so that the steam-valve and the door will remain open as long as desired.

8. In a device for promoting the proper combustion of fuel, a furnace, grate-bars in said furnace, a plurality of honeycombed bridge-walls, the open spaces in one wall being out of line with those in the adjacent walls, a chamber in the front wall of the furnace, a steam-pipe leading into said chamber, said pipe having a valve, nozzles for injecting the steam from said pipe into the furnace, a door at the front of said chamber to control the admission of air thereto while the steam-jets are blowing, means for causing the air and the steam admitted through said chamber to strike the fuel some distance in front of the bridge-walls so that the fuel will be piled in front of said walls to exclude the cold air therefrom and also to promote the circulation of the gases in the furnace, and means connected with the valve in said steam-pipe and also with the door to said chamber whereby the same are gradually, simultaneously and automatically closed after the steam and air have been blowing for the desired length of time.

9. A furnace, a bridge-wall, a dead-plate, a chamber in the front wall of said furnace, a deflecting-plate lining the upper wall of said chamber, and means for injecting steam and air against said deflecting-plate, the plate being placed at such an angle that the steam and air are caused to strike the fuel in front of the dead-plate.

10. In a device for promoting the combustion of fuel, a fire-box, a steam-pipe through which steam is led to said fire-box, a valve in said steam-pipe, and a regulator for automatically and slowly closing said valve, the valve being of much greater capacity than the steam-pipe, in order that the pressure in the pipe may remain constant until the valve is practically closed.

11. In a furnace, grate-bars, a plurality of honeycombed bridge-walls, a dead-plate covering the rear ends of the bars, and means for supplying and directing a blast into the region in front of the dead-plate, for the purpose specified.

12. In a furnace, a fire-box, an ash-pit, grate-bars, a dead-plate separating the rear portions of the fire-box and the ash-pit, and means for supplying and directing a blast into the region in front of the dead-plate, for the purpose specified.

13. In a furnace, as a means for promoting combustion, grate-bars, a bridge-wall, a dead-plate immediately in front of said wall to protect the wall from the cold air in the ash-pit, and means for supplying and directing a blast into the furnace in front of the dead-plate so that the fuel is heaped thereon, for the purpose specified.

14. In a furnace, grate-bars, a plurality of honeycombed bridge-walls, a dead-plate immediately in front of the first wall, and means for supplying and directing a blast into the region in front of the dead-plate, for the purpose specified.

In testimony whereof I affix my signature in the presence of two witnesses.

EDWIN HONESS.

Witnesses:
RALPH R. ROOT,
CLARK S. SOMERS.