

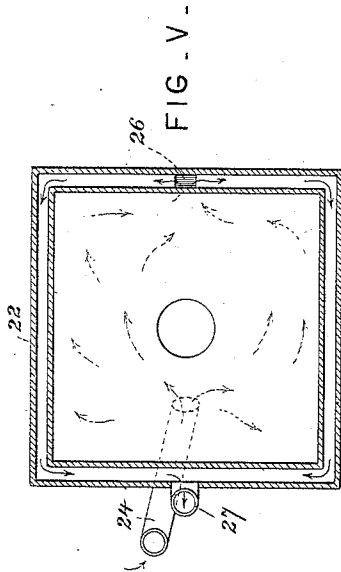
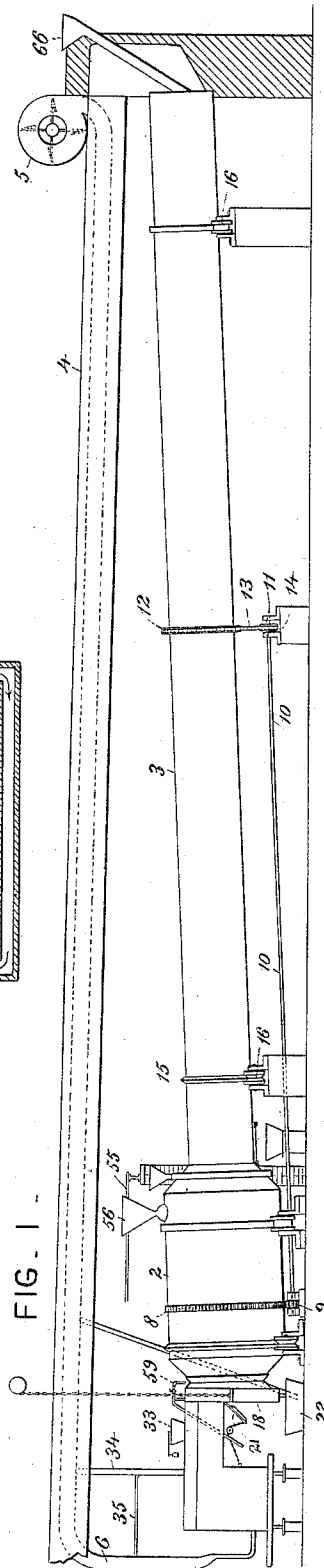
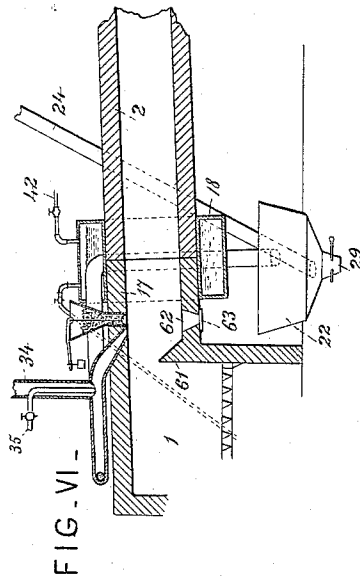
(No Model.)

3 Sheets—Sheet 1.

G. DURYEE.
REVOLVING ROASTING FURNACE.

No. 430,929.

Patented June 24, 1890.



Attest:
Geo. T. Smallwood.
f. A. Hopking

Inventor
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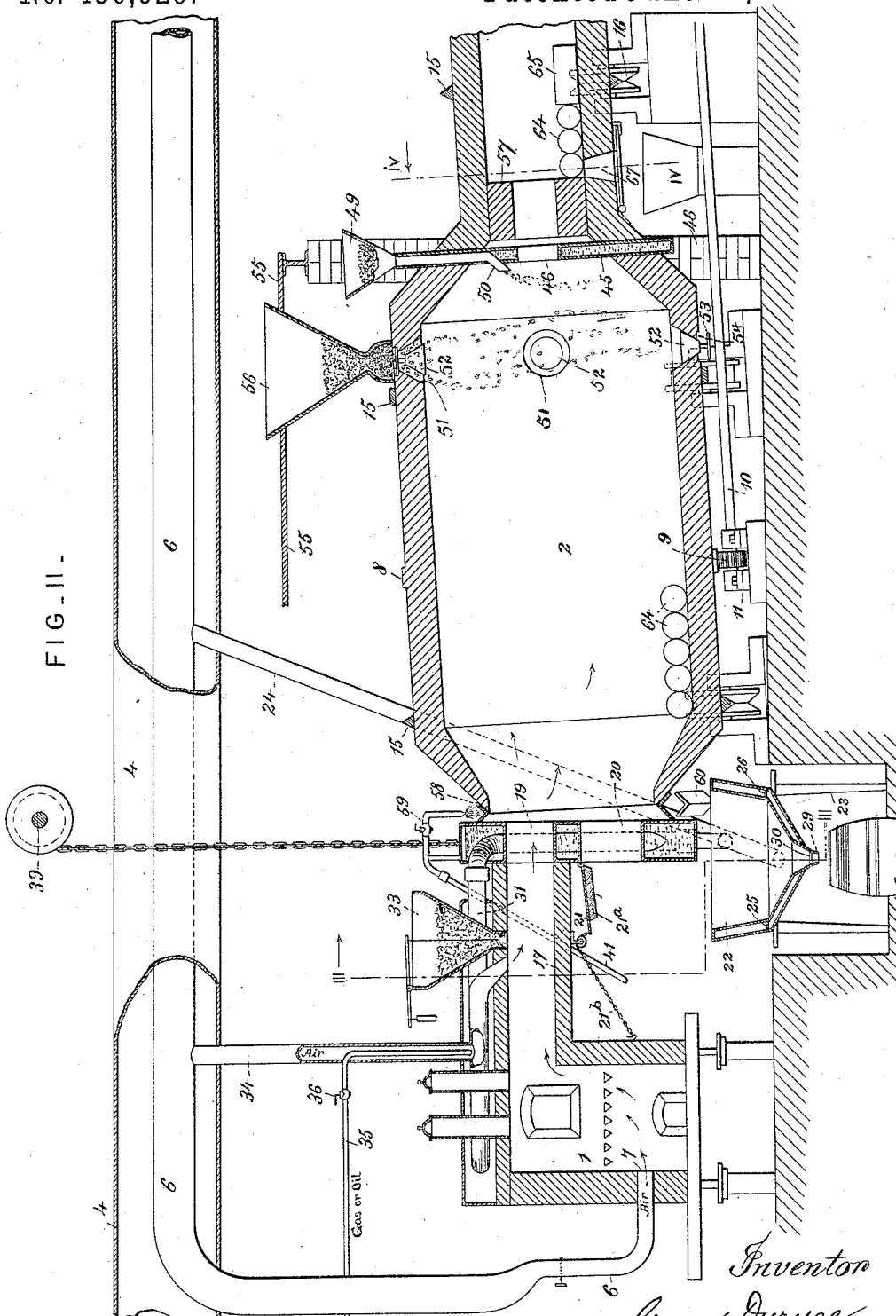
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UNITED STATES PATENT OFFICE.

GEORGE DURYEE, OF ORANGE, NEW JERSEY.

REVOLVING ROASTING-FURNACE.

SPECIFICATION forming part of Letters Patent No. 430,929, dated June 24, 1890.

Application filed May 16, 1889. Serial No. 310,984. (No model.)

To all whom it may concern:

Be it known that I, GEORGE DURYEE, a citizen of the United States, residing at Orange, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Revolving Roasting-Furnaces, of which the following is a full, clear, and exact specification.

My invention relates more particularly to the class of furnaces adapted for use in the manufacture of cement, burning of carbonate of lime, aluminates, ores, metals, and chlorides; and it consists in features of novelty hereinafter fully described with reference to the accompanying drawings, and particularly pointed out in the claims.

The invention is designed as an improvement over the furnaces shown, described, and claimed in my Letters Patent numbered 236,561 and 236,562, granted January 11, 1881, for improvements in "blow-pipe revolving furnaces" and "metallurgic furnaces," respectively.

Referring now to the accompanying drawings, Figure I represents a side elevation of my improved apparatus, the uptake or stack being omitted. Fig. II is a vertical longitudinal section of the lower end of the apparatus, taken on the line II II, Fig. III. Fig. III is a transverse section taken on the line III III, Fig. II, looking in the direction of the arrow. Fig. IV is a transverse section taken on the line IV IV, Fig. III, looking in the direction of the arrow. Fig. V is a detail sectional plan of the receptacle for incandescent or burned material, hereinafter described, taken on the line V V, Fig. III; and Fig. VI is a modification hereinafter described.

Like the device described in my Patent No. 236,561, the present apparatus has a fuel-furnace 1, which is connected with a revolving cylinder 2, which latter communicates with an elongated pipe or cylinder 3. Leading from the upper end of the cylinder 3 is a smoke-flue 4, which extends back to the front end of the apparatus, where it meets the uptake or chimney. (Not shown.) Extending through this flue 4 from the fan or blower 5 is an air-flue 6, which extends downwardly at the front of the fuel-furnace and terminates in a nozzle 7 under the grate. The cylinder 2

is provided with a peripheral rack 8, with which engages a pinion 9, mounted upon a shaft 10, journaled at each end in boxes 11.

Thus far the apparatus is substantially like that described in my patent just referred to; but in this apparatus the cylinders 2 3 are perfectly independent of each other, though revolved in unison by reason of peripheral teeth 12 on the cylinder 3 being engaged by gear-wheels, or, as shown, by the sprocket-chain 13, which latter is driven by a small sprocket-wheel 14, mounted on the shaft 10. The wheel 14 and pinion 9 may be so proportioned as to drive both cylinders at the same rate of speed. The cylinders are supported by means of peripheral bands 15, having knife-edges resting between pairs of grooved rollers 16, as fully shown at Fig. III.

Situated between the mouth of a neck 17, leading from the fuel-furnace 1, and the lower end of the cylinder 2 is a water or air jacket 18, which fits snugly against the end of said neck and is provided with an opening 19, through which the products of combustion pass from the fuel-furnace into the calcining-cylinder 2 or blooming-cylinder, if for iron-working, and just below this neck it is provided with a doorway 20, having a door 21, to facilitate the removal of the material from this cylinder 2 when necessary, which material is discharged directly into a large receptacle 22, supported in any desirable manner, as by pillars 23. This receptacle is provided with an air-space at its sides and bottom, with which connects a pipe 24, leading downward from the main air-flue 6. This pipe, it will be seen from Fig. III, extends into the space at the bottom of the receptacle below a partition or flooring 25, which has, as shown at Fig. V, an opening 26 on the opposite side, which latter admits air to the space around the sides of the receptacle. The exit 27 being on the opposite side to this opening 26, the air will have traversed the entire space between the walls of the receptacle before it reaches the discharge-pipe 28; or a central air-flue from 6 up through the heated material instead of around the circumference may be used; or, again, it is obvious that the air-heating space may be formed by providing the bottom and sides of the receptacle 22 with a

coil of pipe in the usual manner. The purpose of this arrangement, it will be seen, is to heat the air passing through the said space by means of the hot material, which is drawn 5 through the doorway 20 and discharged into the receptacle, and at the same time to cool the finished product or material, so that it may shortly after burning be drawn through the opening 29 in the bottom into the barrels, 10 such opening being guarded by a suitable valve 30.

In my former patents referred to I describe the manner of heating the air by passing air through pipes or flues from a chamber in the rear of the cylinder; but that arrangement 15 does not heat sufficiently for the successful treatment of lime and cement.

As shown in Figs. II and III, the pipe 28 extends upwardly through the water-jacket 20 18 and is connected at its upper end to a horizontal flue 31, which extends through the lining of the fuel-furnace ceiling, then a short distance to the front of the furnace, and then bends upon itself and terminates in a nozzle 25 32, extending through the upper side of the neck 17, just in front of a hopper 33, containing charcoal and common salt for supplying carbon to the flame when necessary, as described in my former patents.

Extending upwardly from the main air-flue 30 6 is another branch flue or pipe 34, which connects with the flue 31 just in front of the nozzle 32, and extending into this flue or pipe 34 and terminating at its connection with the 35 flue 31 is a fuel-pipe 35, guarded by cock 36, which pipe may lead from a gas or oil supply. From this arrangement it will be seen that the draft entering through the nozzle 7 under the grate will accelerate combustion of the 40 fuel on the grate, the products of which will pass through the neck 17 and there be met by the spray of oil and hot air or gas and hot air issuing from the nozzle 32 in the direction of its current, and thus produce what I have 45 termed in my aforesaid Patent No. 236,561 a "blow-pipe flame," producing intense heat in the cylinders 2 and 3. When the air is heated in the receptacle 22, as described, the whole or nearly the whole of the heat is utilized, as 50 the cold air quickly absorbs the heat from the finished material, allowing it to be removed from the receiving chamber or receptacle directly to the mills (not shown) in case of Portland cement and to the barrels in case 55 of lime-burning, thus avoiding the long exposure to the air necessary in the mode heretofore practiced.

In order to prevent the plates of the water-jacket 18 burning out, I prefer to cover the 60 exposed surface with a fire-proof compound, such as described in my Patent No. 236,561, and, indeed, all parts of the apparatus, including the flues and the interior of the cylinders, may with advantage be coated with 65 this substance. In order, however, to afford access to the interior of the cylinder 2 for this purpose, it is desirable that the water-

jacket 18 should be removable, and to accomplish this I construct it as follows:

Referring to Fig. III, on opposite sides of 70 the water-jacket are two lugs or ears 37, to which are attached heavy chains 38, adapted to be wound upon a windlass 39, supported above the furnace in any desirable manner, and the exit-pipe 27 from the receptacle 22 is 75 provided with a large coupling 40, in which is seated the lower end of the pipe 28, so that when the water-jacket is moved upward the connection will be broken without damage to the parts, and the pipes 41 42, which 80 respectively supply and draw off the water or air from the jacket, are provided with couplings 43 44, respectively, whereby they may be disconnected readily. Situated between 85 the upper end of the cylinder 2 and the lower end of the cylinder 3 is a second water-jacket 45, which is provided with a central opening 46 for the passage of the products of combustion and the gases into the cylinder 3. This 90 water-jacket, however, may be supported upon ledges on pillars 47 by means of brackets 48. Situated in the upper side of this jacket is a hopper 49, which has a flat mouth 50, extending downward through the water-jacket and emptying through its side into the cylinder 2. 95 The cylinder 2 is provided with a number of conical ports or valve-seats 51, which are guarded by inwardly-opening conical valves 52, having cross-bars 53, adapted to rest in counter-sinks 54 on the outside of the cylinder. Supported above the cylinder 2 by means of iron or 100 wood work 55 is a hopper 56, whose lower end or mouth fits snugly against the cylinder directly in line with the said ports, so that as the cylinder revolves the ports will be brought one by one under the hopper, and the valves 105 dropping open will permit the material to discharge in substantially a continuous stream into the cylinder. The valves, it will be seen, close when they are in their downward or 110 lower position. In these two hoppers 49 56 I prefer to keep a constant supply of crushed carbonate of lime, when lime is to be manufactured, which, falling through the current of the products of combustion in this com- 115 minuted state, will be partly decomposed before it falls to the bottom of the cylinder 2.

As the cylinders 2 3 are considerably inclined, it is necessary to provide at their 120 lower ends means for preventing the downward movement of the material, which at times is very friable. For this purpose I provide at the lower end of the cylinder 3 an internal fire-brick ring 57, and I make the ends of the cylinder 2 conical, whereby a 125 basin is formed.

For treating fusible materials the lower end of the cylinder 2 is provided with a V-shaped band 58, which rests against and is secured to the water-jacket 18, and into which band 130 discharges a spray from a branch 59 of the water-pipe 41. This spray is for the purpose of cooling the slags and other deposits forming at this point, and as the cylinder re-

volves the brittle slag is cut off, thus avoiding large deposits at this juncture, which would tend to choke up the cylinder and retard its revolution. A trough 60 may be arranged under the V-shaped band 58 for conveying off the waste water. The lower half of the band 58 is wider than the upper, so as to compensate for the difference between the respective distances between the jacket and cylinder at top and bottom, the lower end of the cylinder turning in the band.

In the modification shown at Fig. VI the water-jacket 18 has the form of an annular chamber surrounding the neck 17 of the fuel-furnace 1 and the lower end of the cylinder 2, which, however, in this instance is not provided with conical ends, but is perfectly cylindrical. The material working down this cylinder will bank against the bridge-wall 61, and may be withdrawn through the opening 62, provided with a valve or slide 63. I have discovered that in this water-jacket sufficient steam is generated to supply the engine for driving the cylinders, and to put such jacket to this additional use it will of course be necessary merely to connect the exit-pipe 42 with the steam-chest of any suitable engine.

The door 21 in the jacket 18 is semicircular, as shown in Fig. III, and is protected on its inner surface by means of fire-brick coating 21^a. The door may be held open by a chain 21^b, passing over a pulley secured to the lower side of the neck 17 and made fast to a hook, as shown in Fig. II, or the door may be a water-jacket door.

In the treatment of different ores, as well as for the manipulation of iron, copper, and chlorides, this form of apparatus I have found essential, as with the hot blast a very high degree of heat can be attained and the action of oxidizing or reducing flames as well as the action of different fluxes at heats varying from 3,000° to 4,000° Fahrenheit. In these experiments I have found in the treatment of lime and a mixture of clay and lime that by an essentially-different process and mode of working carried on in a furnace analogous in principle and construction with those described in my patents above referred to, but materially different in adapting a hot blast, I am enabled to subject the different carbonates of lime to a powerful oxidizing-flame, while the heat is not diminished from extinguishing the flame by the rapid generation of carbonic-acid gas evolved from the carbonate of lime passing down the cylinder. I have also ascertained that a cold blast of air across the flame in the fuel-furnace described in the above-named patents would give 4,000° heat ten to twenty feet up the cylinder, the flame being fifty feet long, and as soon as the carbonate of lime was fed the length of the flame was reduced forty feet and the heat diminished less than 2,000° the same distance up the cylinder. I have further discovered that the fine shell marls, of which immense deposits are now lying idle, can be made avail-

ble by burning them in my furnace, producing fine finishing-lime in powder or lime for poor lands at convenient points and at low cost. In other forms of kilns these fine limes cannot be burned, owing to the fact that their packing in the kiln obstructs the operation of the firing and driving off carbonic acid. In this furnace Portland cement can be made by mixing the proper proportion of clay with these fine lime marls and made into wet slip and fed into the furnace, or both previously dried and mixed and then fed in a dry condition.

When a cold-air blast is used instead of the hot blast it will be found that some cores of limestone will be left improperly burned; but air heated up from 500° to 700° is effectual in thoroughly decomposing the stone.

Portland cement when chemically made is a double silicate of alumina and lime and owes its valuable properties to high heat; but as heretofore made (without fluxing) from ten to twenty-five per cent. is wasted by overheating or too low heat and mechanical (not chemical) combination. As described and claimed in my application, Serial No. 305,407, filed March 30, 1889, for improvements in the process of manufacturing cement, the use of one hundred to one hundred and fifty pounds of fluor-spar per ton of crude material will give a grade of cement that will stand from two hundred and fifty to three hundred and fifty pounds tensile strength at the end of seven days without cracking, while the same mixture without fluor-spar and produced at the same heat will crack badly, such indicating the lack of true chemical combination. To make this test, the furnace was raised to a white heat at the lower end with a flame fifty feet long, a mixture of four tons of limestone and one ton of clay, both dried and well mixed, was fed, and in one hour after the feeding was begun clinker began dumping out at the lower end of the cylinder, imperfect in form, with some powder, this being the cement which stood the lowest test. This trial was followed by the same mixture, with the addition of one hundred and twenty-five pounds of fluor-spar per ton of the mixture to flux the silicate. The burned clinker from the lower end contained no powder, but balls varying from one-fourth of an ounce to eight ounces each, uniform and heavy, while the color was that of true Portland cement—greenish gray. The quality of lime burned in this furnace was found to be equal to the wood-burned lime, the oxidizing-flame having burned out all the sulphur and any iron that may have been in the stone.

I have further ascertained that ten to fifteen tons of air per day are consumed in my large furnaces for treatment of thirty to fifty tons carbonate of lime. Therefore a large fan-blower driving this amount of air and the previous heating of the air are vital features of my invention for drying purposes, &c.

For the treatment of washed chalk in the

manufacture of whiting a large amount of air with small amount of oil, so as to keep the heat down under 600° Fahrenheit, is essential. In the lower ends of the cylinders 2 3, I place
 5 a number of stone balls or bowlders, which may be round, as shown at 64, or cylindrical, as shown at 65, and which weigh from five to twenty pounds each. As the cylinders revolve, these balls or bowlders will continuously roll upon the material and grind it to
 10 fine powder, and in the case of lime-manufacture masons' finishing-lime is turned out at a nominal cost, as there is no handling of the lime from the crusher until it reaches the bar-
 15 reling-floor (not shown) below the cylinder.

Of course it will be understood that I do not confine the apparatus which I have described to the manufacture of cement or lime; but it may be used where any other furnace
 20 of this character is applicable, and it may also be used where it is desired to carry on two processes simultaneously—such, for instance, as the manufacture of lime or cement in the lower cylinder, while in the upper cylinder the escaping carbonic-acid gas is utilized
 25 in the production of crude carbonate of soda.

In experiments with this furnace, described in my Patent No. 236,561, I found that chloride of sodium in contact with carbonic-acid
 30 gas at a heat of 400° Fahrenheit parted with its chlorine and took up carbonic acid, forming crude carbonate of soda; and now when burning lime the vast amount of carbonic-acid gas evolved may be utilized in the cylinder 3 in converting salt into carbonate of
 35 soda. Salt in solution or damp may be fed into the cylinder 3 through the funnel or hopper 66, and by the time the charge has
 40 worked down to the ring 57 it is converted into carbonate of soda, and may then be withdrawn by removing the conical valve 67, which is held in place by a latch 68 and secured to the cylinder by a link 69, the
 45 valve-opening being provided with a bar 70, extending across it flush with the interior of the cylinder and adapted to fit in a complementary recess in the end of the valve, so
 50 that when the valve is removed the balls will be prevented from rolling into the opening and choking it up. The water-jacket 45 may be also utilized as a boiler, if desired, by connecting one of the pipes 71 72 with a suitable engine or steam-dome, one of such pipes being
 55 utilized as a water-supply.

I am aware that it is old and well known to inject gas and oil with air into furnaces or kilns for cement-burning, &c., and I do not claim the same.

60 Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. The combination, with the furnace and a cylinder, of an air or water jacket interposed between said furnace and cylinder and
 65 having an opening for the passage of the products of combustion from the furnace into

the cylinder, a receptacle for hot material, having an air-heating space, and a pipe extending from said space through said jacket
 70 and discharging into the furnace, substantially as set forth.

2. The combination, with the furnace, of the air-flue discharging into said furnace, a fluid-fuel pipe opening into said flue, a revolvable cylinder, a water-jacket situated between said furnace and cylinder and having
 75 an opening for the discharge of the products of combustion into said cylinder, and a receptacle for hot material, having an air-heating space connected with said flue, substantially as set forth.

3. The combination, with the furnace 1, having the neck 17, the cylinder 2, and a hot-air flue 6, of an air or water jacket interposed
 85 between said neck and cylinder and having an opening for the passage of the products of combustion, the air-flue 31, having the nozzle 32, discharging into said neck, the flue 34, connecting said flues 6 31, the fuel-supply pipe
 90 discharging into or at the end of flue 34, a receptacle having an air-heating space, and a flue connecting said space with flue 31, substantially as set forth.

4. The combination, with the revolvable cylinder 2 and a fuel-furnace, of a water-jacket
 95 interposed between said cylinder and furnace and having the opening 19, connecting said cylinder and furnace, and a doorway 20, a receptacle having hollow walls forming an air-heating space, an air-flue connected with said
 100 air-heating space and discharging into said furnace, and a fluid-fuel-supply pipe discharging into said air-flue, substantially as set forth.

5. The combination, with a furnace, of the revolvable cylinder 2, having openings provided with conical valve-seats arranged in its periphery, valves fitted to said seats and having
 110 the cross-bars 53 on the outside of the cylinder, and a hopper arranged over said openings and resting against said cylinder, said cylinder having the countersinks 54, for the reception of said bars, substantially as set forth.

6. The combination, with the furnace and the revolvable cylinder, of balls or bowlders arranged in said cylinder, said cylinder having a valve-guarded opening and a bar 70
 120 across said opening, substantially as and for the purposes set forth.

7. The combination, with the fuel-furnace and the cylinders 2 3, arranged end to end and in communication with said furnace, of water-jackets interposed between said cylinders and between the cylinder 2 and fuel-furnace, and having openings for the passage of
 125 the products of combustion, substantially as set forth.

8. The combination, with the fuel-furnace
 130 and the revolvable cylinders 2 3, arranged end to end in communication with said furnace, of stationary water-jackets interposed between said cylinders and between said fur-

nace and cylinder 2 and having openings for the passage of the products of combustion, substantially as set forth.

9. The combination, with the revoluble cylinders 2 and 3 and the furnace communicating therewith, of a water-jacket interposed between said cylinders and having the opening 46, forming communication between said cylinders, a hopper arranged above said jacket and having a neck or mouth extending through it and opening into one of said cylinders, substantially as set forth.

10. The combination, with the fuel-furnace, the cylinder 2, having a conical end, and the water-jacket interposed between said cylinder and furnace, of the V-shaped band 58, secured to said water-jacket and embracing the end of said cylinder adjacent to said jacket, and a water-spray adapted to play upon said band, substantially as set forth.

11. The combination, with the furnace and the revoluble cylinder 2, of a vertically-movable water-jacket interposed between said furnace and cylinder and a windlass or other

device for elevating said jacket, substantially as set forth.

12. The combination of the fuel-furnace 1, having the neck 17, the revoluble cylinder 2, the water-jacket interposed between said cylinder and furnace-neck, and having the opening 19, forming communication between said cylinder and furnace, and doorway 20, affording access to said cylinder, the receptacle 22, having the air-heating space, the blast-flue 6, the pipe connecting said blast-flue with said air-heating space, a pipe 28, leading from said air-heating space through said water-jacket, a nozzle in the upper side of said neck connecting with the said pipe 28, a fluid-fuel-supply pipe extending into said nozzle, and the blast-nozzle 7, arranged to discharge into the front of the fuel-furnace, connected with the flue 6, substantially as set forth.

GEORGE DURYEE.

Witnesses:

LOUIS PFINGSTAZ,
GUSTAV KEHR.