H. E. PARSON.

FURNACE FOR BURNING BLAST FURNACE GASES.

APPLICATION FILED FEB. 24, 1906.

958,429.

Patented May 17, 1910.

2 SHEETS—SHEET 1.

Fig. 1.

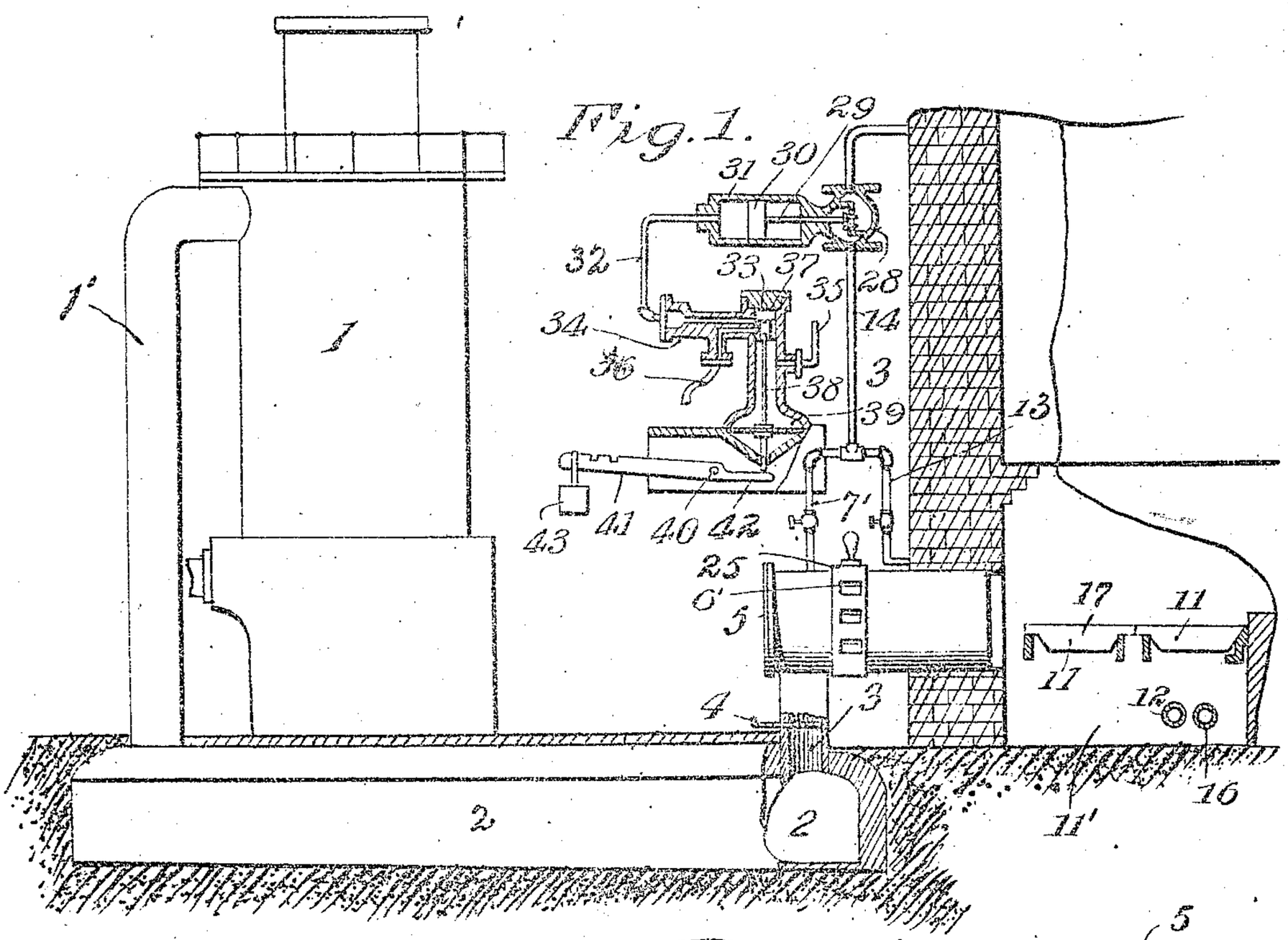
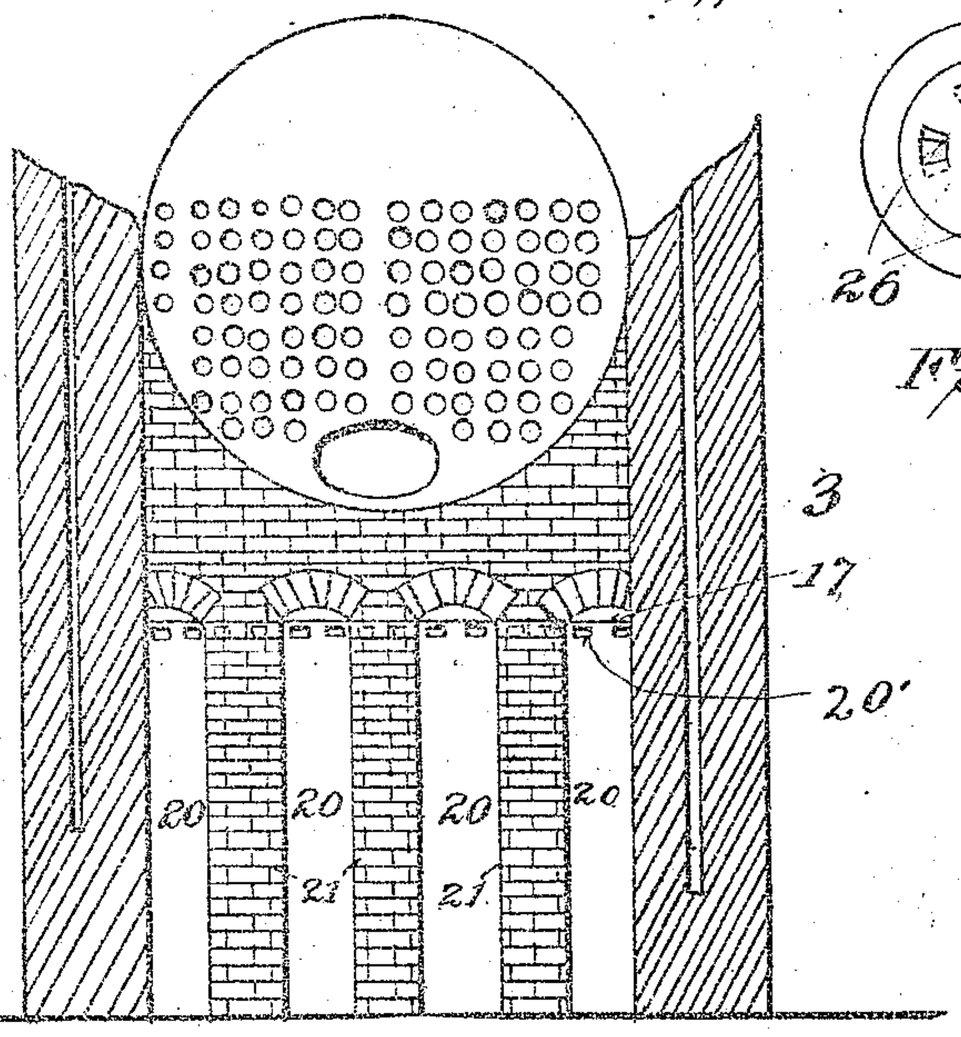


Fig. 4.



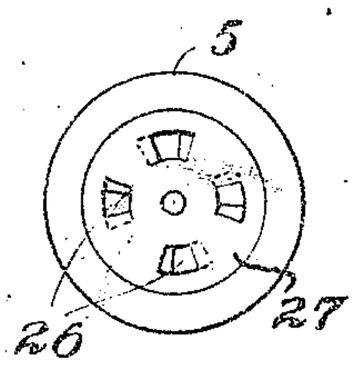


Fig. 5.

Witnesses

Jas. Maurie

E. Bradley

Inventor

H. E. Parson

By Stuart & Stuart

Attorneys

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2 SHEETS—SHEET 2.

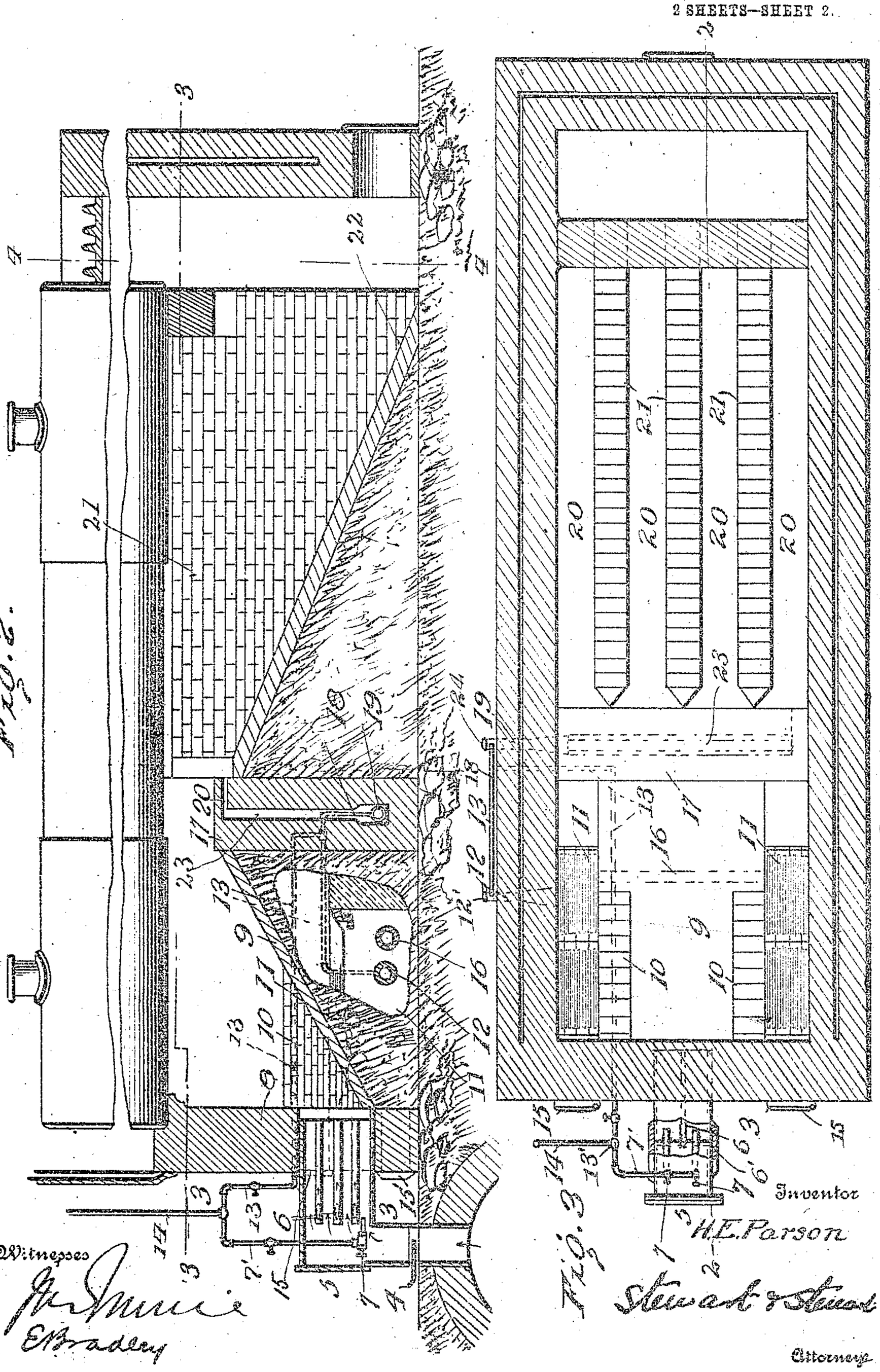

Fig. 2.

Witnesses

H. Smith

E. Bradley

Inventor

H. E. Parson

Stewart & Stewart

Attorneys

UNITED STATES PATENT OFFICE.

HENRY EDWIN PARSON, OF NEW YORK, N. Y., ASSIGNOR TO PARSON MANUFACTURING COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

FURNACE FOR BURNING BLAST-FURNACE GASES

958,429. Specification of Letters Patent. Patented May 17, 1910.

Original application filed June 30, 1905, Serial No. 267,823. Divided and this application filed February 24, 1906. Serial No. 302,766.

To all whom it may concern:

Be it known that I, HENRY EDWIN PARSON, a citizen of the United States of America, and resident of the city, county, and State of New York, have invented certain new and useful Improvements in Furnaces for Burning Blast-Furnace Gases, of which the following is a specification.

My invention relates to a means for operating a boiler or other heating furnace in conjunction with a blast furnace, so that the gases generated in the blast furnace may be economically consumed in the heating furnace to serve as fuel for the latter.

The invention has particular reference to means for enriching the blast furnace gases; for regulating the feed of gases from the blast furnace to the boiler furnace; and for regulating the temperature of the boiler furnace so that the steam pressure in the boiler may be high and uniform in spite of the necessarily varying and uncertain mixture of hydrocarbons, carbon monoxid and other constituents of the blast furnace gases.

Boiler furnaces are necessary adjuncts to blast furnaces. The boiler furnace must supply the steam pressure or power for operating the twyers or blasts of the blast furnace, as well as the power for operating the lifts and all the numerous movable parts used in connection with, or forming part of, the blast furnace. A large percentage of this boiler power is, however, ordinarily absorbed by the blowers for operating the twyers; and the steam used for this purpose should be substantially uniform in pressure if the blast furnace is to operate properly. The most convenient and natural fuel for the boiler furnace is the gas which passes from the stack of the blast furnace. This gas is, however, low and variable in heating value. At times its percentage of those constituent gases which have a moderate heating value, is fairly large; but at other times, during the reduction process which is taking place in the blast furnace, the blast furnace gases are extremely low in heating value. For this reason blast furnace gas, although the cheapest and most convenient fuel available for the boiler furnace, is ordinarily not relied upon or used to any exclusive extent for this purpose.

One object of my invention is a means whereby the blast furnace gas is enriched with a sufficient amount of hydrogen, provided by the decomposition of steam in the presence of incandescent carbon, to transform it, in effect, into a "producer" gas; and whereby it is admixed with a sufficient amount of oxygen, in the form of air, to bring about perfect combustion of the mixture at an extremely high temperature in the boiler furnace.

A next and essential feature of the invention is a means for producing in the boiler furnace a temperature sufficiently high to ignite the incoming mixture of blast furnace gas, steam, and air, and to decompose the steam to liberate the hydrogen. The ignition of the incoming gases I effect in the first instance through a preliminary heating of the boiler furnace by means of grate fires located therein; but when the gases have been so ignited, this function of the grate fires is at an end, for the incoming gas is then ignited by the burning gas already in the furnace, and by certain highly heated refractory surfaces against which the incoming gaseous mixture is projected.

A third, and most important, feature of the invention is a means for regulating the temperature of the boiler furnace; since, without regulation, this temperature must vary with the quality and volume of the blast furnace gas. This feature of the invention I effect by means of the grate fires above referred to. These fires are controlled from a regulator, in turn controlled by the boiler pressure, so that when the boiler pressure drops, due to the drop in the heating value of the blast furnace gas, the regulator acts to blow the grate fires more strongly to increase the heating effect of the latter. The increased temperature of the solid fuel fire, when thus blown, counteracts the diminished efficiency of the blast furnace gases, until the quality of the latter again improves in quality or volume; whereupon the regulator again acts, this time to shut down the blast to the grate fires, thus reducing the heating effect of the latter to counteract the increase in heat from the burning blast furnace gases.

Grate fires have heretofore been used in conjunction with the burning of blast furnace gases, with the object of adding to the small, and in itself insufficient, amount of heat derived from the gases, and to the

end that the total of heat might be high enough to assure the proper boiler power. Such grate fires have not, however, been used nor have they been adapted to be used, essentially to regulate a normally efficient gaseous fuel. Bituminous coal fires have heretofore been used in connection with the burning of blast furnace gases, but because this fuel is high in volatile matter and has other peculiarities objectionable in this connection, it cannot, as heretofore used, be made to regulate the temperature of a boiler furnace burning blast furnace gases. In my invention I preferably use fuel low in volatile matter, such as anthracite coal, coke, or coke braize, for my grate fires. The lower grade of such fuels may be successfully used if a blower of proper type is employed for the grate fire blast. Preferably I do use such low grade fuels because of their cheapness.

The regulator preferably employed by me for controlling the blast to the auxiliary grate fire is of the type described in my United States Patent No. 784,121, dated March 7, 1905. A regulator of this type is indicated on the drawings forming part of the present application, and its operation will hereinafter be briefly set forth.

To further control the combined operation of the boiler furnace and blast furnaces, I provide a regulator adapted to automatically accelerate the feed of the blast furnace gases when the heating value of the same drops, due to change in character or volume of the gases; and vice versa, to automatically decrease the rate of feed of the gases when the heating value of the same increases. This regulator causes more of the blast furnace gas to enter the boiler furnace when the quality of the gas is poor, and less to enter the boiler furnace when its quality is good. It effects its purpose by controlling one or more of the blasts of steam to the boiler furnace. It may be the same regulator which controls the grate fire blast hereinbefore referred to, or it may be an independent regulator.

The apparatus in which the invention is embodied comprises a deflecting surface of refractory material which becomes highly heated in the operation of the boiler furnace, and serves to deflect, mix, and raise to a high temperature the incoming gaseous mixture which is directed against it; and it serves furthermore to cause these gases to mix and burn with the gases from the grate fires. The relative arrangement of the grate fires, the deflector, and the blowers, as well as certain other details of structure to be hereinafter specified, are important features conducive to the successful operation of the invention.

Having outlined the objects and nature of my invention, I will now describe in detail and in connection with the accompanying drawings an apparatus embodying the same.

Figure 1 is a side elevation of the front portion of the boiler furnace, partly in section, showing its connection with the blast furnace. Fig. 2 is a vertical section of the boiler furnace taken on the line 2—2 of Fig. 3. Fig. 3 is a sectional plan of the boiler furnace taken on the line 3—3 of Fig. 2. Fig. 4 is a vertical section of the boiler furnace taken on the line 4—4 of Fig. 2, looking from rear to front. Fig. 5 is an end view of the casing 5.

Referring to the drawings, the blast furnace 1 is shown as having its stack 1′ connected to a subterranean conduit 2. The conduit 2 connects with a vertical tube 3 and through the latter with a casing 5, which opens at its front end into the fire box of the boiler furnace. A valve 4 controls the flow of the gas from the stack of the blast furnace to the casing 5. Within the casing 5, (see Figs. 2 and 3) are three "T" shaped air conducting inlet tubes 6, the cross arm of each "T" opening at both ends 6′ through the casing and communicating with the outside air, and the other arm of the "T" extending longitudinally of the casing parallel to the gas conducting tubes, and terminating at or near the point where the casing opens into the fire box. The inlets 6′ to the tubes 6 may be adjusted to regulate the flow of air therethrough by dampers 25 of any suitable design, as shown in Fig. 1. The casing 5 is also furnished with a supplemental valve 26 in the outer end 27 of the same (see Fig. 5) of any suitable type to deliver, when required, additional air independent of the air inlet tubes 6. Also within the casing 5, below the level of the air tubes 6, and projecting slightly forward of the rear ends of the latter are two steam blowers 7, connected by a pipe 7′ to a pipe 14, which leads to the boiler. The blowers 7 serve to force the blast furnace gases from the conduit 2 and the air from the pipes 6 into the fire-box. The steam thus injected, when decomposed in the fire-box supplies hydrogen to be burned with the other gases, and the air through the inlet 6 supplies the necessary oxygen to effect the combustion of the gaseous mixture.

Opposite the inlet from the casing 5 to the fire-box is a wall 9, which slopes from the top of the bridge-wall 17 downward and forward to the front wall 8 of the furnace, terminating at the latter at a point at or about the level of the bottom of the casing 5. Between the sloping wall 9 and the side walls of the furnace on either side of the sloping wall are grates 11, substantially horizontal. These grates at their rear extend behind the wall 9, as shown in Fig. 2, and at their forward ends are separated from the wall 9 by vertical walls 10. The

walls 10 serve to guide the gases from the grate fires upward so that they do not come into contact with the gases from the casing 5, until the latter have been projected against the wall 9. The wall 9, which in the operation of the furnace is maintained at a high heat, serves to deflect and cause to be mixed the gases from the casing 5, and also deflects these gases into the gases from the grate fires, so that a substantially homogeneous mixture of burning gases is obtained. A blast of air and steam is supplied to the ash-pits 11′ (see Fig. 2), below the grates 11. The blast is primarily injected into the ash-pit of one of the grates and a part thereof then passed to the ash-pit of the other grate by a pipe 16, which extends cross-wise of the furnace under the wall 9, and connects the two pits, as shown in Fig. 3. To provide for this blast, a blower casing 12 (see Fig. 3) opens at one end into one of the ash pits, and at its other end 12′ opens into the outer air. Communicating with the interior of the casing 12 at a point intermediate the ends of the latter and outside of the side wall of the furnace is a steam supply pipe 13. This pipe as shown in Fig. 3 passes first rearward along the outside wall of the furnace, then through the outside wall and through a portion of the bridge-wall, then straight forward under the rear portion of the sloping wall 9 and through one of the walls 10 and the front wall of the furnace 8 to the point 13′, where it joins the steam pipe 14 from the boiler. The grate fires are fed through doors 15 in the front wall of the furnace, and the ashes from the ash-pits 11′ are removed through doors 15′ below the doors 15 in the front wall of the furnace.

The combustion chamber to the rear of the bridge-wall 17 comprises a series of arched chambers 20 (see Figs. 3 and 4) separated by brick partitions 21. The floor 22 of these chambers slopes upwardly from the rear of the furnace to a point near the top of the bridge-wall 17. In the top of the bridge-wall 17, and opening rearwardly toward the chambers 20, are air passages 20′, which supply air for further combustion in the combustion chamber. These passages 20′, as shown in Fig. 2, extend inward to the center of the bridge-wall, where they open into a narrow vertical chamber 23. Extending through one side wall of the furnace is a blower casing 19, which at its inner end opens into the chamber 23, at the bottom of the latter, and at its outer end 24, opens into the outer air. A steam blast is admitted to the casing 24 by a steam pipe 18, which as shown in Fig. 3, connects with the steam pipe 13, and through the latter with the steam pipe 14 from the boiler.

For the purpose hereinbefore set forth of maintaining uniform steam pressure in the boiler, the steam pipe 14 which supplies steam to the grate fire blowers and also to the blowers 7 for feeding or accelerating the blast furnace gas, is connected with the boiler through a valve 28 (see Fig. 1). This valve is similar to the one fully set forth and described in my Patent No. 742,128, to which reference is made in my Patent No. 784,121. The stem 29 of the valve 28 is connected to a piston 30 working in a cylinder 31. The cylinder 31 connects by a steam pipe 32 to a port opening into the cylinder 33 of a regulator 34. Also communicating with the cylinder 33 of the regulator is a steam pipe 35 which is in direct communication with the condenser water under pressure from the boiler. From the cylinder 33 of the regulator there is an outlet port to an exhaust pipe 36. The valve 37 having vertical movement in the cylinder 33 of the regulator controls the port of the pipe 32 to the cylinder 31 of the valve 28, and also the port of the exhaust pipe 36. In one position of the valve 37 water under boiler pressure through the pipe 35 is free to pass through the cylinder 33 of the regulator into the pipe 32, and through the latter to the cylinder 31. The pressure in the steam pipe 14 and in the pipe 32 is therefore substantially the same. The piston 30, however, in the cylinder 31 is of greater area than the valve 28, so that, when the pipe 32 is in open communication with the pipe 35 by means of the passages around the valve 37, the greater cross-section of the piston 30 causes the valve 28 to be held on its seat against the pressure of the steam in the pipe 14 from the boiler. At this time therefore no steam can pass through the valve 28 by way of the pipe 14 to the blowers of the boiler furnace.

The stem 38 of the valve 37 of the regulator is attached to a diaphragm 39 mounted at the base of the regulator cylinder. Pivoted at 40 is a lever 41, one arm 42 of which is also connected to the diaphragm 39, and the other arm of which is weighted as at 43. So long as the boiler pressure is maintained at its proper point, the water under boiler pressure through the pipe 35, acting on the diaphragm 39, holds the valve 37 in its downward position, at which time the port of the steam pipe 32 is open, and the water under boiler pressure from the pipe 35 is free to pass by way of the steam passages around the valve 37 into the pipe 32 to hold the valve 28 on its seat, and thus to prevent passage of steam through the pipe 14 to the blowers. When, however, the rate of consumption of steam exceeds the rate of supply of the same, the boiler pressure falls, and on reaching a predetermined minimum point, the weight 43, acting through the valve stem 38, raises the valve 37 to close the port of the pipe 32 to the interior of the cylinder 33, and opens the pipe 32 by way

of a by-pass in the valve 37 to the exhaust pipe 36, the port of which has heretofore been closed by the valve 37. The pipe 32 is then exhausted through the pipe 36, and the pressure on the piston 30 being relieved, the steam pressure in the pipe 14 is then free to move the valve 28 so that steam passes through the valve 28 and pipe 14 to the blowers. The blowers acting upon the grate fire then raise the temperature of the boiler furnace, and the boiler pressure until the latter, acting through the pipe 35, again depresses the diaphragm against the action of the weight 33 and moves the valve 37 to open the port to the pipe 32 and to close the port of the exhaust pipe 36. When, by reason of the absorption of heat by the boiler the steam pressure again begins to drop, the above cycle of operations is again repeated.

These adjustments are made in practice with great sensitiveness, and regulation within two or three pounds of steam pressure is permanently and automatically secured. By these means the temperature of the boiler furnace remains almost constant, no matter what variation of load there may be; and the efficiency of the boilers and of the gaseous fuel and solid fuel is thereby greatly increased. This automatic regulation also takes care of the fluctuation in quantity and quality of the blast furnace gases, because, when these gases are freely flowing and of good quality, they need no acceleration and no additional solid fuel fire, but as they deteriorate in these respects the apparatus mentioned is ready automatically to take up the loss.

The advantages of the blowers 7, in connection with the regulator, as a means for automatically boosting or accelerating the feed of the blast furnace gases, if necessary, have been pointed out. These blowers as a means for feeding the blast furnace gases have, however, the further advantage over the means heretofore used for this purpose, in that back pressure which from time to time results from the variable and uncertain feed of the gases, as blowing engines ordinarily used, is overcome by these steam blowers, because with the steam blowers there is, whenever required, a positive suction upon the blast furnace gas line.

I claim:

1. In an apparatus for burning gaseous fuel in combination with solid fuel, a fluid heating furnace, a conduit for the gaseous fuel having an inlet into the fluid heating furnace; a support within the furnace for a solid fuel fire, a blower for the solid fuel fire opening into the furnace at a point to direct its blast through the solid fuel fire when the latter is on its support, and means controlled automatically by the fluctuations of pressure of the fluid heated by the furnace to increase the blast through the blower when the pressure falls below a predetermined amount, and to decrease the blast through the blower when the pressure rises above a predetermined amount.

2. In an apparatus for burning gaseous fuel in combination with solid fuel, a fluid heating furnace, a conduit for the gaseous fuel having an outlet into the fluid heating furnace; a blower for forcing the gaseous fuel into the furnace, and means automatically controlled by the fluctuations of pressure of the fluid heated by the furnace to increase the blast through the blower when the pressure falls below a predetermined amount and to decrease the blast when the pressure rises above a predetermined amount.

3. In an apparatus for burning gaseous fuel in combination with solid fuel, a fluid heating furnace, a conduit for the gaseous fuel having an inlet into the furnace, a blower for forcing the gaseous fuel into the furnace, a support within the furnace for a solid fuel fire, a blower for the solid fuel fire opening into the furnace at a point to direct its blast through the solid fuel fire when the latter is on its support, and means automatically controlled by the fluctuations in pressure of the fluid heated by the furnace to increase the blast through the blowers so as to raise the temperature of the solid fuel fire and to accelerate the feed of the gaseous fuel when the pressure of the heated fluid falls below a predetermined amount, and to decrease the blast through the blowers to lower the temperature of the solid fuel fire and decrease the rate of feed of the gaseous fuel when the pressure of the heated fluid rises above a predetermined amount.

4. In an apparatus for burning in combination blast furnace gases and solid fuel, a blast furnace and a boiler furnace, a conduit for the blast furnace gases from the blast furnace into the boiler furnace, a support within the boiler furnace for a solid fuel fire, a blower for the solid fuel fire, opening into the boiler furnace at a point to direct its blast through the solid fuel fire when the latter is on its support, and means controlled automatically by the boiler pressure to increase the blast from the blower when the boiler pressure drops a predetermined amount, and to decrease the blast from the blower when the boiler pressure rises a predetermined amount.

5. In an apparatus for burning in combination blast furnace gases and solid fuel, a blast furnace and a boiler furnace, a conduit for the blast furnace gases from the blast furnace into the boiler furnace, a support within the boiler furnace for a solid fuel fire, a blower for the solid fuel fire, opening into the boiler furnace at a point to direct its blast through the solid fuel fire when the latter is on its support, a regulator

automatically controlled by the boiler steam pressure to increase the blast from the blower when the boiler pressure drops a predetermined amount, and to decrease the blast from the blower when the boiler pressure rises a predetermined amount.

6. A furnace for burning gaseous and solid fuel in combination, having an inlet opening for the gaseous fuel in the front wall thereof, a bridge wall, a wall spaced from an inside wall of the furnace and inclined from a point near the top of the bridge wall to a point of the front wall below the aforesaid opening in the latter, a support for a solid fuel fire in said space between an inside wall of the furnace and the inclined wall therein, and a blower for projecting the gases from the opening in the front wall to the inclined wall to be deflected by the latter so as to unite with the gases from the solid fuel fire on the support.

7. A furnace for burning gaseous and solid fuel in combination, having an inlet opening for the gaseous fuel in the front wall thereof, a bridge wall, a wall spaced from an inside wall of the furnace and inclined from a point near the top of the bridge wall to a point of the front wall below the aforesaid opening in the latter, a support for a solid fuel fire in said space between an inside wall of the furnace and the inclined wall therein, and a blower for projecting the gases from the opening in the front wall to the inclined wall to be deflected by the latter so as to mix with the gases from the solid fuel fire on the support, the bridge wall having therein an air supply passage which opens into the furnace at the top of the bridge wall.

8. A furnace for burning gaseous and and solid fuel in combination, having an inlet opening for the gaseous fuel in the front wall thereof, a bridge wall, a wall spaced from an inside wall of the furnace and inclined from a point near the top of the bridge wall to a point of the front wall below the aforesaid opening in the latter, a support for a solid fuel fire in said space between an inside wall of the furnace and the inclined wall therein, a gas conduit leading to the opening in the front wall, means whereby air may be admitted to the fire box at said opening, and a steam blower for projecting the gases and air from the opening in the front wall to the inclined wall to be deflected by the latter and mixed with the steam from the blower and with the gases from the solid fuel fire on the support.

Signed by me at Birmingham, Ala., this 9 day of February, 1906.

HENRY EDWIN PARSON.

Witnesses:
RUTH S. PATRICK,
GUS GRACE.