

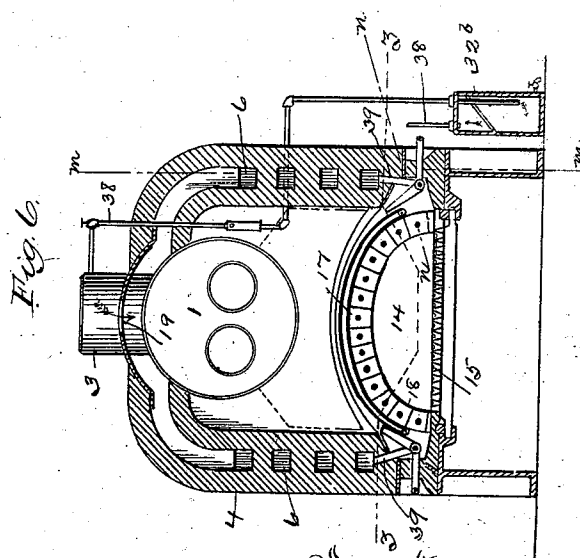
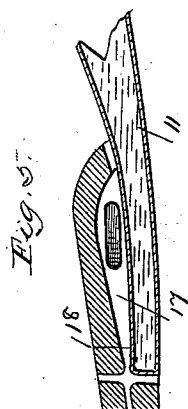
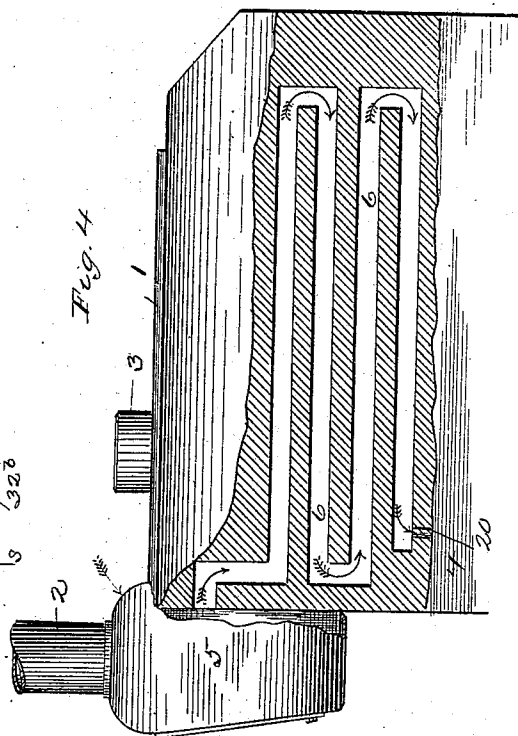
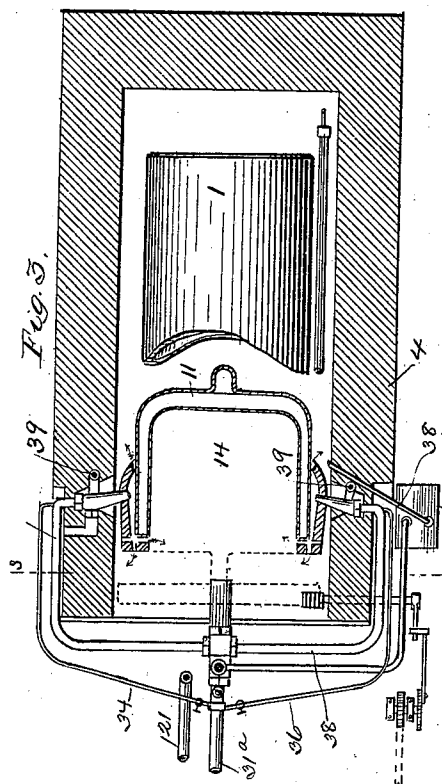
(No Model.)

4 Sheets—Sheet 2.

A. BRYCE.
APPARATUS FOR COMBUSTION.

No. 510,673.

Patented Dec. 12, 1893.



Witnesses:

M. E. Harrison,
J. H. Beal

Inventor,
Andrew Bryce,
by his Attorney,
Wm. L. Pierce

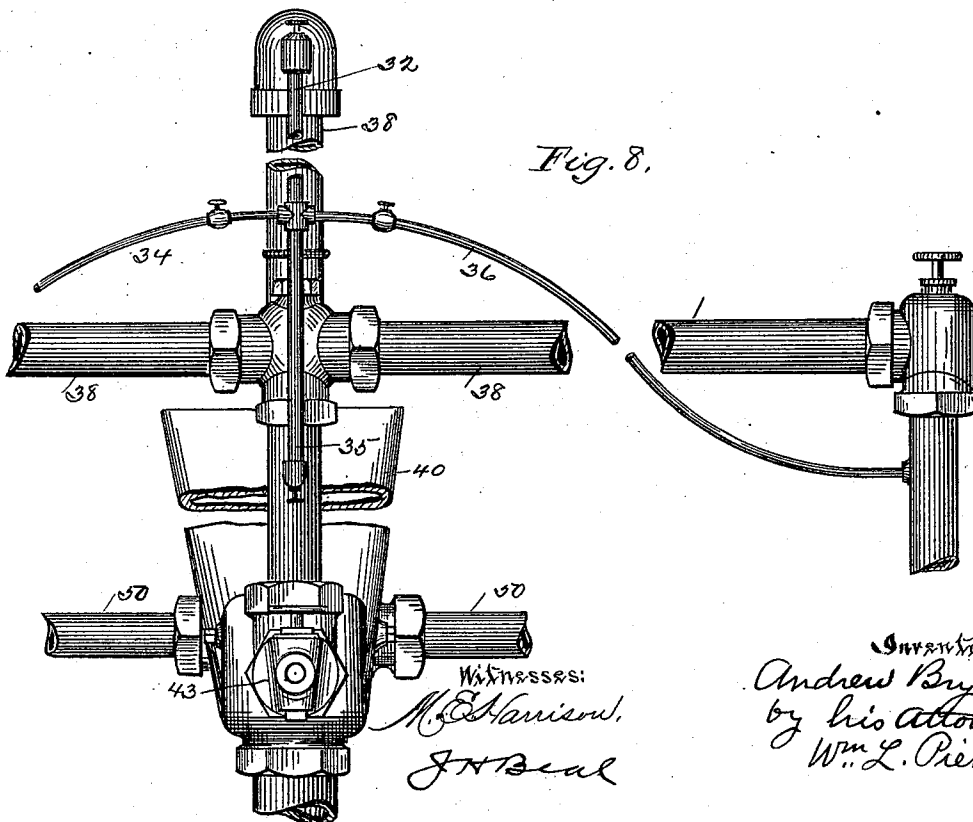
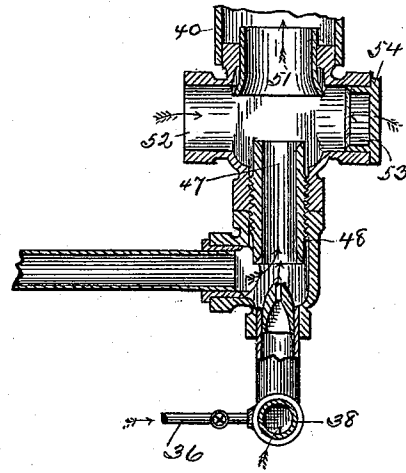
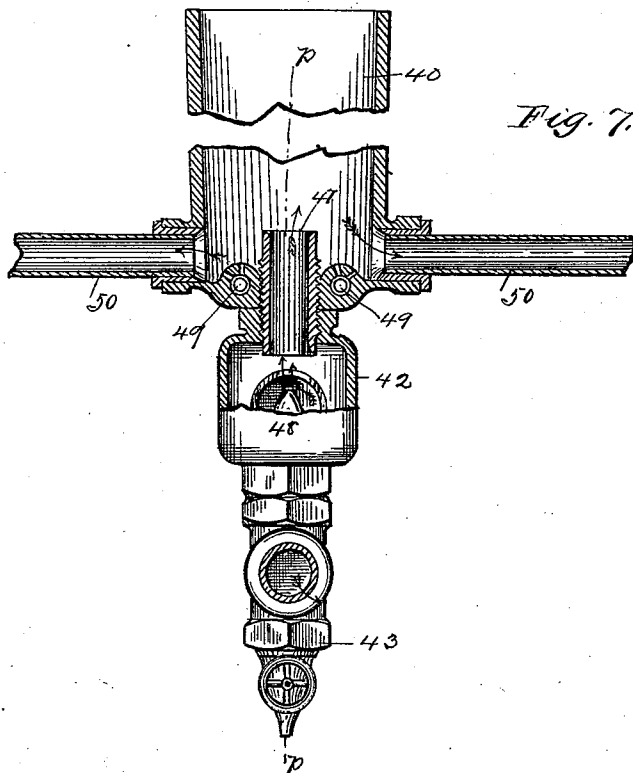
(No Model.)

4 Sheets—Sheet 3.

A. BRYCE.
APPARATUS FOR COMBUSTION.

No. 510,673.

Patented Dec. 12, 1893.



THE NATIONAL LITHOGRAPHING COMPANY,
WASHINGTON, D. C.

Inventor.
Andrew Bryce
by his attorney
Wm L. Pierce

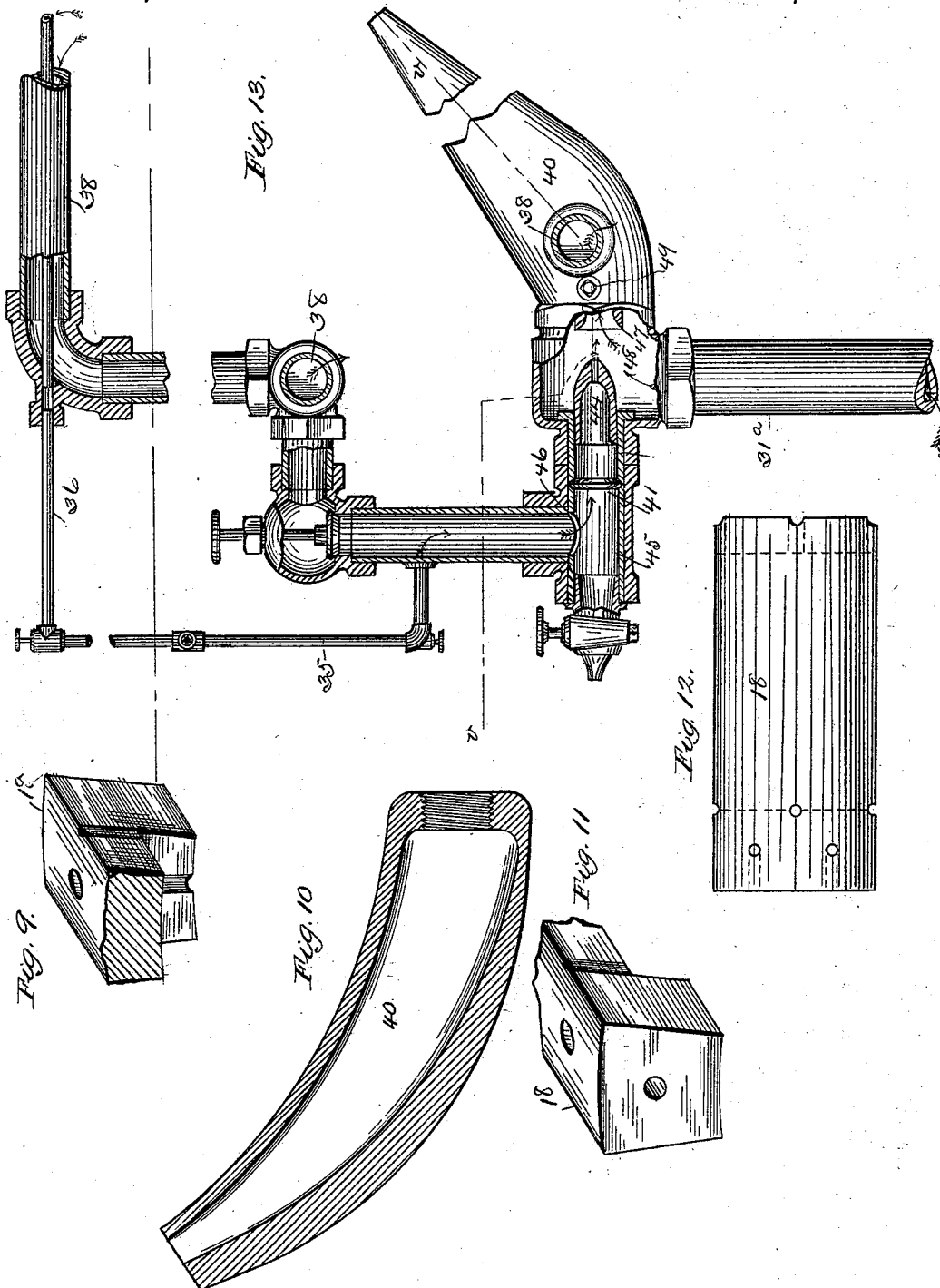
(No Model.)

4 Sheets—Sheet 4.

A. BRYCE.
APPARATUS FOR COMBUSTION.

No. 510,673.

Patented Dec. 12, 1893.



Witness:
A. C. Harrison.
J. H. Beal

Inventor,
Andrew Bryce
by his Attorney
Wm. L. Pierce.

UNITED STATES PATENT OFFICE.

ANDREW BRYCE, OF ALLEGHENY, ASSIGNOR OF NINE-TWENTIETHS TO
CHARLES A. O'BRIEN, OF PITTSBURG, PENNSYLVANIA.

APPARATUS FOR COMBUSTION.

SPECIFICATION forming part of Letters Patent No. 510,673, dated December 12, 1893.

Application filed June 18, 1892. Serial No. 437,231. (No model.)

To all whom it may concern:

Be it known that I, ANDREW BRYCE, a citizen of the United States, residing at Allegheny, in the county of Allegheny and State of Pennsylvania, have invented or discovered new and useful Apparatus for Combustion, of which the following is a specification.

In the accompanying drawings which make part of this specification, Figure 1, is a side elevation partly in section showing my apparatus applied to a boiler. Fig. 2, is a plan showing the hopper, hollow shaft and feed with hot air pipes entering and leaving said hollow shaft. Fig. 3, is a section partly in plan through the furnace on line *z-z* of Fig. 6. Fig. 4 is a view partly in elevation and partly in section on line *m-m* of Fig. 6. Fig. 5, is a sectional plan on line *n-n* of Fig. 6. Fig. 6, is a vertical section on line *s-s* of Fig. 3. Fig. 7, is a sectional plan on line *v-v* of Fig. 13, and also a sectional plan view of one of the auxiliaries. Fig. 8, is a front elevation of the central injector and pipes leading to auxiliaries. Fig. 9, is a perspective broken away rear view of one of the fire arch bricks. Fig. 10, is a vertical central section of one of the injector nozzles. Fig. 11, is a front perspective view of fire arch brick. Fig. 12, is a plan of double brick for fire arch and Fig. 13 is a central vertical section on line *p-p* of Fig. 7.

The purposes of my invention generally stated are directed toward attaining practically perfect combustion in all kinds of furnaces and the consequent prevention of smoke or soot.

In the accompanying drawings which make part of this application I show my method and devices applied to the furnace of an ordinary stationary boiler for illustration, but it is understood that it may be applied to all forms of steam generators.

In the several views 1, is a boiler having a stack 2, and steam drum 3.

4 is the usual brick work of the furnace.

The upper and forward end of the boiler is inclosed in the sheet iron envelope 5 which communicates with hot air flues 6-6 built in both side walls of the furnace.

7, is a mud drum running transversely of

the furnace and supported upon the brick pier 9. It is connected with the boiler by the steam pipe 10. Connected with said drum is the water jacket 11, a longitudinal section thereof being substantially fish-hooked in appearance as seen in Fig. 1. Said water leg has a number of forward extensions 12 connecting with the front water leg 3, which forms the front wall of the furnace above the line of the grate. This water jacket 11, with the extension 12, forms the roof of what I call the inner combustion chamber, 14. The bottom of said combustion chamber is formed by concave grate bars 15, 16.

Over the front end of the water jacket 11 is what I term a spraying conduit 17. This is formed by the line of arched brick 18-18, which are shown in views 9, 11 and 12. These bricks have a very great number of perforations extending in various directions.

Returning now to the sheet iron envelope 5, 19 is the opening for cold air which entering said envelope circulates through the flues 6-6 where it becomes thoroughly heated, by the waste heat, thence out of said flues by the opening 20, thence by pipe 21 seen in Fig. 1, to the far side of a hollow shaft 22 to be subsequently described; thence through said hollow shaft, and thence by pipe 23 to a central injector hereinafter described.

Returning now to the hollow shaft, 22;—this lies at the base of a hopper 23, said hopper being fed by an elevator 24 from bin 25. The hollow shaft 22, is surrounded by a detachable worm 26 adjusted to different longitudinal positions on said hollow shaft by set screws 27. 28-28, are different sized pulleys or other equivalent devices to give variable speeds to the shaft. Attached to said shaft is also a cam 29, with connections leading to the grate bars to automatically shake them. When the worm 26 is set forward toward the pulleys it enters a burr 30 and pulverizes the fuel fed into the hopper; when set back it acts only as a feed and pushes the fuel forward into chamber 31 connecting with hot air pipe 31^a, leading to furnace. This hot air pipe bears along the finely divided fuel to the central ejector.

I will now describe the path of the oil to

the several injectors: 31 is an elevated oil tank. Leading therefrom is pipe 32 which passes through a length of superheated steam pipe 33, where the oil is converted into a vapor, or at least highly heated. Emerging from said superheated steam pipe the oil vapor passes to the central and two auxiliary side injectors by pipes 34, 35 and 36.

The path of the steam is as follows: 37 is the steam drum from which leads a pipe 38 containing wet steam which is superheated in passing through the outer combustion chamber of the furnace and connects with pipe 33 described before. The pipe 33 before described as containing the oil pipe emerges from the front of the furnace and runs in three separate branches to the central and two auxiliary injectors. The auxiliary injectors also receive hot air from the hot air flues through pipes 39, 39'.

The construction of the three injectors is substantially the same so that a description of one will do for all. These injectors are best seen in Figs. 7, 8, 10 and 13. The injector consists of a shell 40, into which is screwed a short pipe length 41, which connects said main shell 40 with a T. 42 having drain cock 43. Into said pipe length 41, is screwed jet 44, which may have a variable opening to increase or decrease the blast power. The drain cock, 43, is screwed inside a plug 45 which has opening 46 which when the plug is rotated communicates with steam pipe and regulates admission of steam into the injector. 47 is a short screw threaded sleeve which connects the shell 40 with a mixer 48. This sleeve 47 by being advanced or drawn back from the jet varies the amount of the blast. 49, 49' are pipes for admitting natural gas when the apparatus is used to supplement a natural gas supply. The mixer 48, has side branches, 50, 50' to distribute the force of the blast to the auxiliary injectors and leave just sufficient force to the blast at the central injector to carry the particles of solid fuel to the far end of the inner combustion chamber. The mixers 48, 48, of the side injectors have an additional member 51 screwed therein making it a compound injector receiving hot air at 52 and cold air at 53, if desired. Otherwise 53 may be closed by a cap 54.

The whole apparatus is provided with a sufficient number of suitable valves to work any part independently.

The operation of my device is as follows: A fire of coke or suitable fuel is made on the grate bars of the furnace and maintained until a head of about five pounds of steam is obtained to start the injectors. Coal preferably "slack" or "dust" fuel, having been delivered into the hopper, if it is necessary I pulverize it there in the necessary amount; if not, I change the pulverizer into a mere feeding device for gaging the quantities of fuel needed to keep up the fires. This is done by a simple re-arrangement of the rotating shaft

or "threaded" device in the hopper. Meantime, the air which has entered the jacket around the boiler and traversed the hot air flues 6—6, has become thoroughly heated and passes by pipe 21 through hollow shaft 22. The coal dust is fed by the worm to the pipe 31^a, and both air and coal pass to the shell 40 of the central injector. Here the jet 44 throws in mingled steam and superheated oil which has entered behind the steam jet as seen in Fig. 13. This steam jet makes a vacuum at shell 40 which causes a strong suction in the pipe 31^a, and causes the steam, oil vapor, hot air and coal particles to pass through the sleeve 47 with the mixer 48. The reduced diameter of the sleeve 47 greatly increases the force of the blast as it enters the mixer 48. From there the force of the blast is lessened and drawn off by suction to the side branches 50, 50' to the auxiliary injectors while the solid particles of fuel are sprayed out from the incandescent mixer 48 in a thin wide stream in the direction given by the tip of the mixer which is directed to strike the central line of the fuel deflector within the inner combustion chamber. The solid particles of fuel have just about enough momentum to carry them to this point. The under surface of the concaved roof of the combustion chamber spreads and scatters them in every direction over the grate upon which is a glowing fire and they are readily and completely consumed. The oil vapor, steam and gases in order to escape from said inner combustion chamber must retrace its length as the entrance and exit are one and the same opening. During these two passages through this area of heated space within this chamber and over the grate, these gaseous vapors become highly heated and ignited and escape in an intense flame from the inner combustion chamber.

In order to avoid dampening the fire I prefer to pass the steam through a steam separator 32^b, of the ordinary type seen in Fig. 6 before it enters the furnace. Meantime the auxiliary side injectors have been supplied with the mingled oil and steam which have been delivered by said injector into the conduit formed by the perforated bricks above the inner combustion chamber. Through the numerous perforations in said bricks this heated oil vapor and steam is delivered in a multitude of fine jets which meet the products of combustion escaping from the inner combustion chamber, mingle with them and pass through the full length of the outer combustion chamber in an intense and smokeless flame and finally escape through the flues to the stack. I may use for suction and blast either (a) a single jet of gas, steam or superheated steam or all combined in one motor jet, (b) or a blast composed of a jet of heated, or superheated oil and steam or superheated steam, combined, as a motor blast, (c) or a combined air or hot air and steam or superheated steam jet as a motor blast, (d) or either

of the individual forces composing either of the said combined motor blasts used interchangeably or severally as motor blasts.

5 The peculiar features of construction of furnace I do not claim in the present application as they constitute the subject matter of an independent application filed by me of even date herewith, Serial No. 437,230, and of a further application filed by me December 23, 1892, Serial No. 456,155.

10 I claim—

1. In a stoking apparatus the combination of a hopper, a rotating hollow shaft at the base of said hopper, a detachable worm surrounding said shaft, devices for setting said worm at various points on said shaft and a burr in which said worm may turn as a pulverizer.

2. In an injector for fuel in furnaces a mixer having a slot like delivery opening at one end, lateral openings at the other to draw off by suction the excess of blast.

3. The combination of a central injector; two side injectors and communicating pipes between the two side injectors and the central injector to draw off from the latter the excess of blast and utilize same in the side injectors.

In testimony whereof I have hereunto set my hand this 7th day of June, A. D. 1892.

ANDREW BRYCE.

Witnesses:

WM. L. PIERCE,
WILLIAM BEAL.