E. C. MILLS.

FURNACE FOR STEAM BOILERS.

APPLICATION FILED APR. 14, 1910.

1,041,325.

Patented Oct. 15, 1912.

3 SHEETS—SHEET 1.

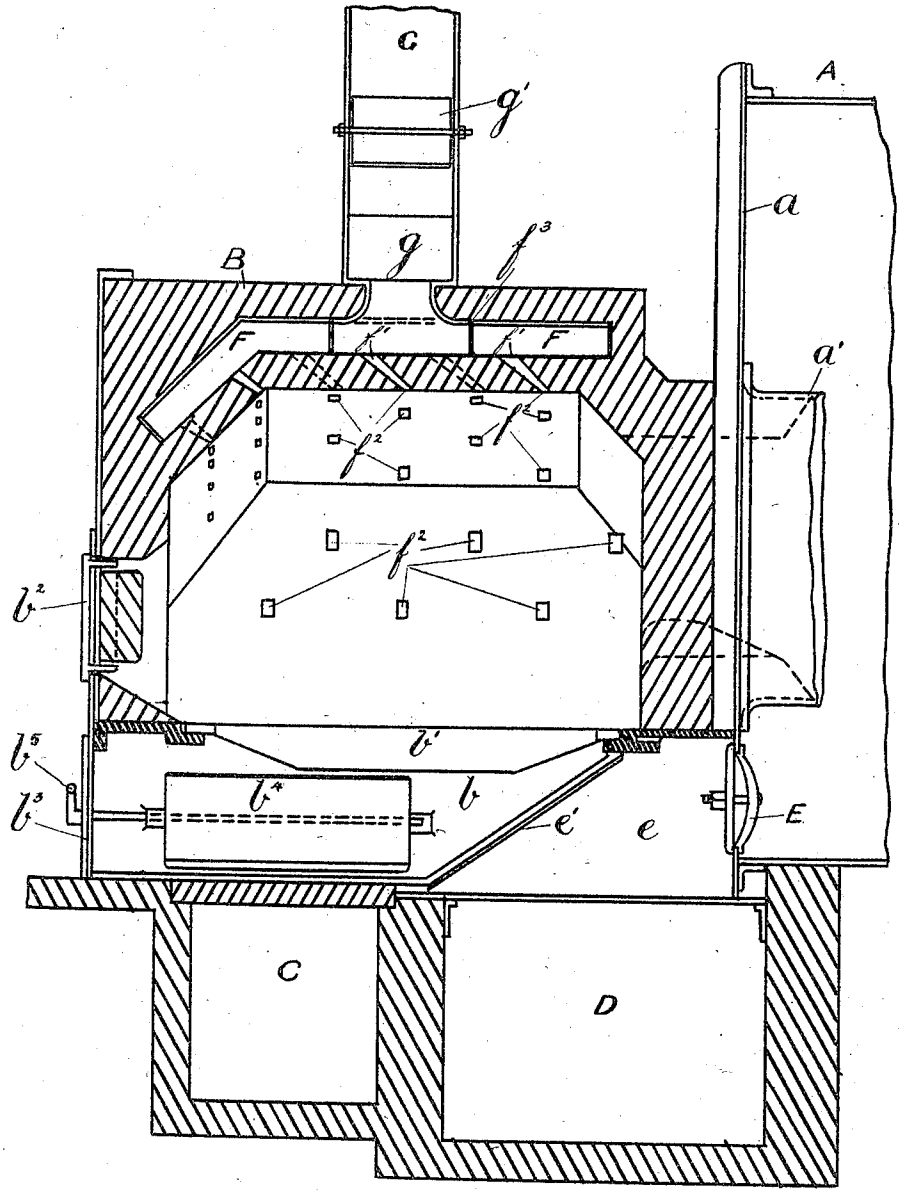

FIG. I

WITNESSES

W. P. Burke

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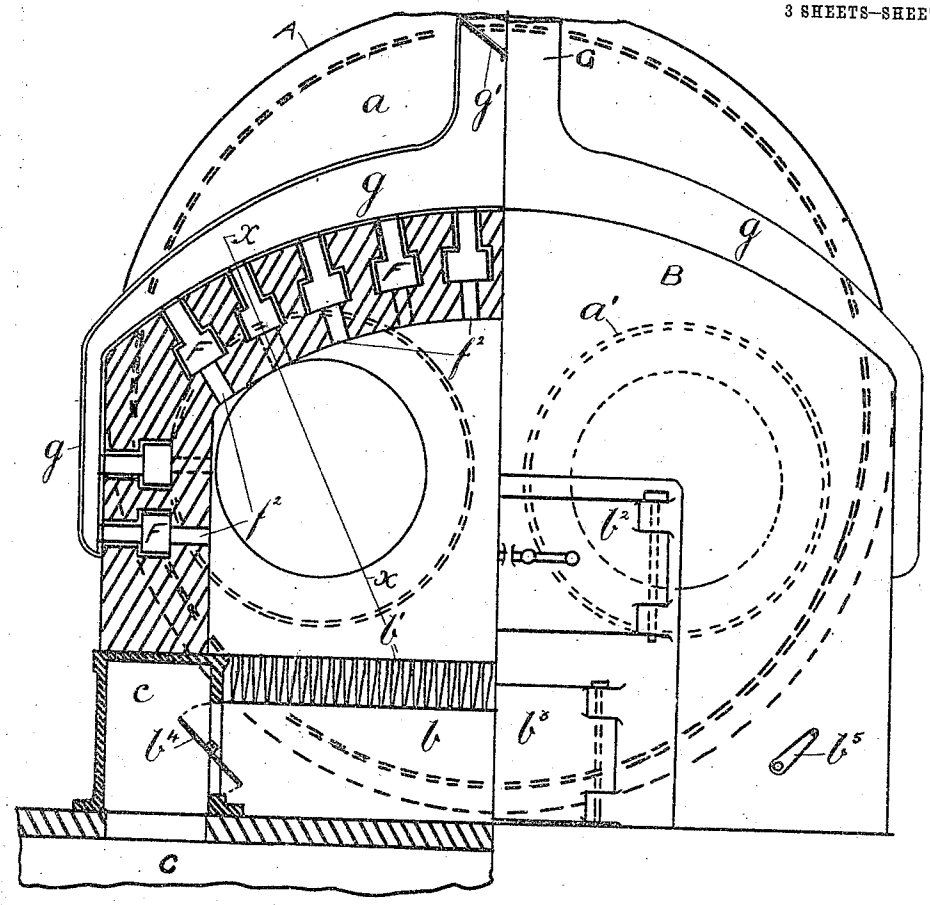

FIG. II

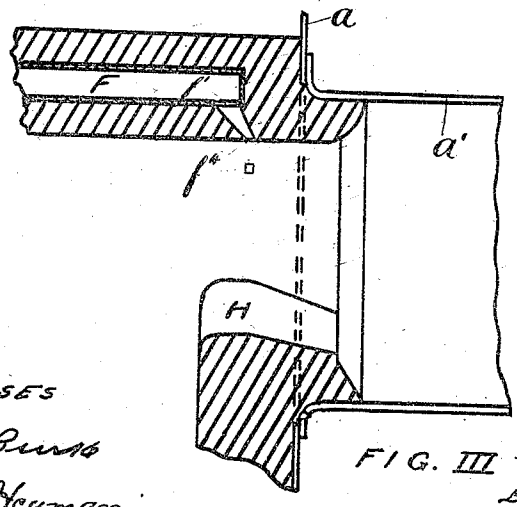

FIG. III

WITNESSES

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3 SHEETS—SHEET 3.

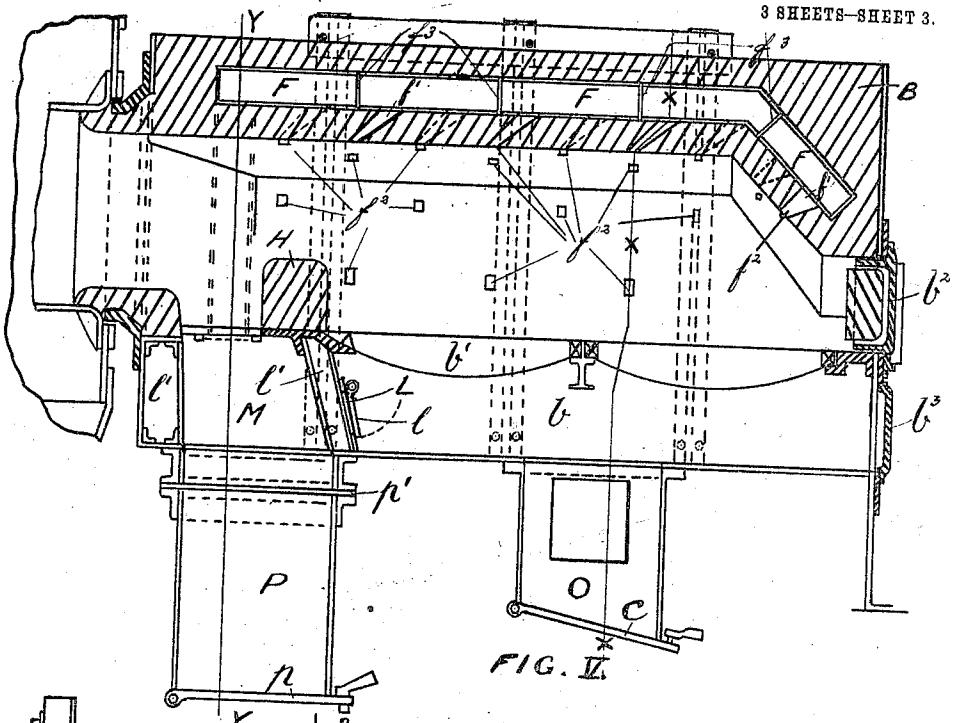

FIG. V.

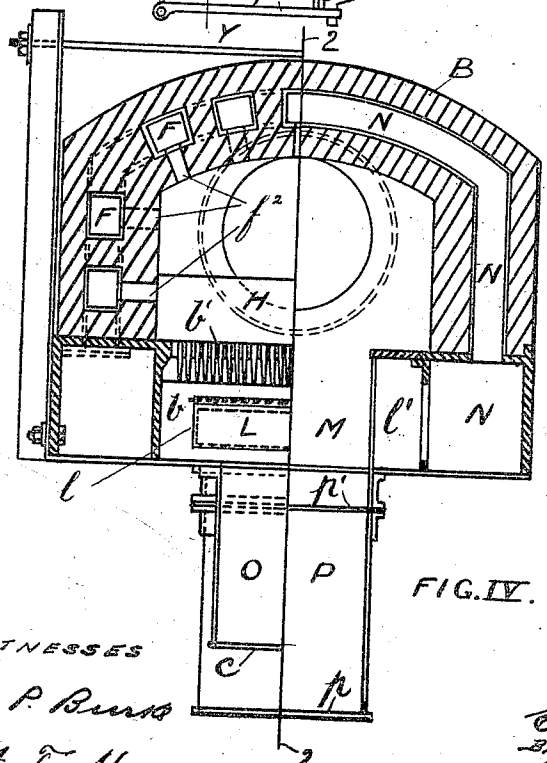

FIG. IV.

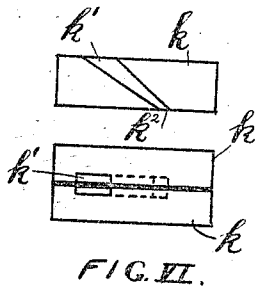

FIG. VI.

WITNESSES

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UNITED STATES PATENT OFFICE.

EDGAR CONISTON MILLS, OF MANCHESTER, ENGLAND.

FURNACE FOR STEAM-BOILERS.

1,041,325. Specification of Letters Patent. Patented Oct. 15, 1912.

Application filed April 14, 1910. Serial No. 555,408.

To all whom it may concern:

Be it known that I, EDGAR CONISTON MILLS, consulting mechanical engineer, a subject of the King of the United Kingdom of Great Britain and Ireland, and resident of Manchester, in the county of Lancaster, England, have invented new and useful Improvements in Furnaces for Steam-Boilers, of which the following is a specification.

My invention aims at the recovery of heat usually lost in radiation through the linings of external furnaces for steam boilers and also at promoting secondary combustion; and it consists in the main of a system of cells or pipes formed or embedded in the lining or walls of such furnaces, through which air previously partially heated or not is circulated and finally delivered by suitable orifices into the furnace chamber over the fuel bed. When such air is admitted over the firebed the delivery orifices are preferably inclined in the direction of the draft and are placed in such positions as best to bring the air into intimate contact with the volatile gases and carbon monoxid so as to promote their combustion. Some of such orifices can be placed over or in or behind the "bridge" or still further in the flue.

My invention is also equally applicable to furnaces whose air supply is obtained either by chimney draft, "induced" fan draft, by front fan draft or by steam induction jets.

In the case of external boiler furnaces, mechanically fed or otherwise, having "clinker pits", I utilize the otherwise waste heat in the clinker by surrounding it with a chamber through which air is passed on its way to the before described cells or pipes. By this means extremes of temperature in the fire-brick cells or pipes are avoided.

In the accompanying drawings Figure I is a longitudinal section of an external furnace constructed in accordance with my invention shown as applied to an ordinary two-flue "Lancashire" type of boiler. Fig. II gives a half cross section and half front elevation of the same. Fig. III is a part longitudinal section taken through the center of one of the boiler internal flues, *i. e.* on the line *x x* Fig. II. Fig. IV is a cross section of a furnace suitable for a single flued boiler and for boilers of the type described and illustrated in the U. S. Patent #989,270, granted April 11th, 1911 to J. H. Lester and myself, the half-sections being taken on lines *x x* and *y y* Fig. V. Fig. V is a longitudinal section of the same, taken on the line 2 2 Fig. IV. Fig. VI shows detailed views in plan and elevation of the bricks *k* having recesses formed therein.

Similar letters or figures of reference in the various figures refer to the same parts.

A is a boiler shell with its front plate *a* and internal flues *a' a'*. The brickwork furnace B formed with sides and arched roof, having ashpit *b*, firebars *b'* and firing door b^2 is built externally to and in front of the boiler A. The ashpit may be open for natural draft or closed as shown by the door b^3 when a "front" fan is used, in which case the draft is regulated by the wing valve b^4 admitting air from the underground air duct C by the side box *c* as seen in Fig. II. The wing valve b^4 is operated by the lever b^5 either by hand or automatically by the firedoor when opened and closed.

D is the ordinary blow-off pit, and access to it and the cleaning out door E is obtained by the space *e* resulting from the formation of the ashpit *b*, which, as shown, is terminated by the inclined plate *e'*. This plate, however, forms no part of my present invention.

Cells or pipes F are formed or embedded in the brickwork of the walls and roof of the furnace B. Each of the longitudinal cells F is connected by a branch to an outer distributing pipe or trunk *g* which in turn is connected to a supply duct G in which is mounted a controlling wing valve *g'* operated automatically or otherwise.

From each of the cells F a suitable number such as three or more outlets *f'* are formed and coincident with each of them an inclined orifice f^2 is provided in the inner brickwork lining. The cells are preferably made in short lengths and not jointed, the joints f^3 being left slightly open to allow of freedom of expansive movement. They may be made of iron or other suitable metal or of specially molded fireclay or other refractory material. The nozzles or orifices f^2 are inclined in the direction of the travel

of the furnace gases toward the outlet to the flue or flues a'. The orifices are placed above the fuel bed as shown.

In some cases it is desirable to deliver air over or even beyond the firebridge and this is shown in Fig. III in which the orifice or orifices f^4 are shown situated so as to deliver air above and beyond the bridge H.

The air supplied to the cells by the duct G may be impelled by a fan or may be induced by natural or other draft and it may be cold or partially heated before it enters the cells. Thus in the construction shown in Figs. IV and V the air for the cells is drawn through and from the ashpit b by way of the aperture L controlled by the valve l or from other suitable source, the ashpit b and aperture L taking the function of the duct G, Figs. I and II. It is then passed through the space l' surrounding the clinker pit M from which it abstracts heat and thence passes by passages N, which are preferably provided on both sides of the clinker pit M, to the cells F. By this means the air is heated by waste heat before it enters the cells, the object and advantages being otherwise similar to those already described. In this form the box O is provided under the ashpit for extracting the ashes by the door c and the box P for extracting the clinker by the door p while the door p' is closed. By this means the clinker can be extracted while the furnace is at work.

The nozzles f^2 are formed as shown in Fig. VI. Two bricks k k are molded each with a recess tapered one way as shown or it may be tapered in depth as well, but in any case the outlet k^2 is smaller than the inlet k'. The two bricks are built in with their recesses adjoining so as to form one through tapered passage. The object is to maintain a good outlet velocity and to allow a lower velocity in the cells and passages.

The operation of the invention is as follows:—The total heat of both primary and secondary combustion may be divided into radiant heat and conveyable heat. Most of the former and some of the latter is not directly available in the boiler flues for evaporative purposes, as it is taken up and dissipated by the furnace brickwork in the case of ordinary external brick furnaces. In my invention the radiant heat absorbed by the inner layers of the lining is thereby transformed into conveyable heat and is largely transmitted to the air in the cells F and nozzles f^2. This air is then at such temperature as to make it eminently suitable for secondary combustion for which purpose it is used by passing from the nozzles f^2 into the interior of the furnace, a further advantage being that the main body of the brickwork is protected from excessively high temperatures.

In hand fired furnaces the air permitted to enter by the nozzles is controlled by the valve g' to suit the excessive variations in the demand for oxygen for secondary combustion; and in furnaces more regularly supplied with fuel by mechanical or other appliances the quantity of nozzle air is necessarily less in total quantity, but will be at a higher temperature, and always proportionate to the demand. The air supplied by way of the ashpit by means of valve b^4, Fig. II, is carefully controlled to an amount which leaves some demand for further overfire air which readily combines with any carbon monoxid gas escaping from the body of the fuel. Thus the combustion is completed without meeting with cooling surfaces, and the intensely hot gases pass with little or no heat loss into the boiler flues, there to give up their heat to the water. With such furnaces the diameter of the internal flues of boilers of the Lancashire type may be considerably reduced.

The external furnaces herein described are applicable to any form or type of steam boiler and also for use with or without forced, induced or other method of obtaining draft.

I am aware that air spaces and separate cells in brickwork settings surrounding internal furnaces have previously been used, also that heated air from them has been passed into the said furnaces for combustion purposes above and into the fire and from and beyond the bridge, and that in external furnaces passages for air have been formed in the brick settings, but

Having now described my invention and in what manner the same is to be performed, I declare that what I claim as new and desire to secure by Letters Patent is:—

In combination, a steam-boiler, a furnace external to said steam-boiler for providing heat for steam generation in such boiler, a casing for said furnace having walls and roof inclosing a chamber forming by its lower part a fuel-chamber to hold a fire-bed and by its upper part a secondary combustion-space for secondary combustion above the fire-bed in said fuel chamber so that both the fuel chamber with the fire-bed therein and the secondary combustion-space for secondary combustion are wholly free of contact of water-cooled plates and having within the walls and roof a plurality of air-cells each extending in the direction of and for the greater part of the length of the furnace from front to back and spaced from one another and with a plurality of orifices for each air-cell extending from the air-cells to which they are respectively connected and entering into the secondary combustion space in the chamber and above the fire-bed in the fuel-chamber therein and means to conduct air to the said air-cells whereby air will pass to said air-

cells and being heated therein by absorption of heat, will pass thence through said orifices into the secondary combustion-space for secondary combustion above the fire-bed in the fuel-chamber in said chamber.

In testimony, that I claim the foregoing as my invention, I have signed my name in presence of two witnesses, this sixth day of April 1910.

EDGAR CONISTON MILLS.

Witnesses:
HOWARD CHEETHAM,
RUTH MAGDALENE WILSON.