H. LUCKENBACH.

FUEL ECONOMIZING APPARATUS FOR FURNACES.

APPLICATION FILED JUNE 26, 1908.

924,805. Patented June 15, 1909.

Fig. 1.

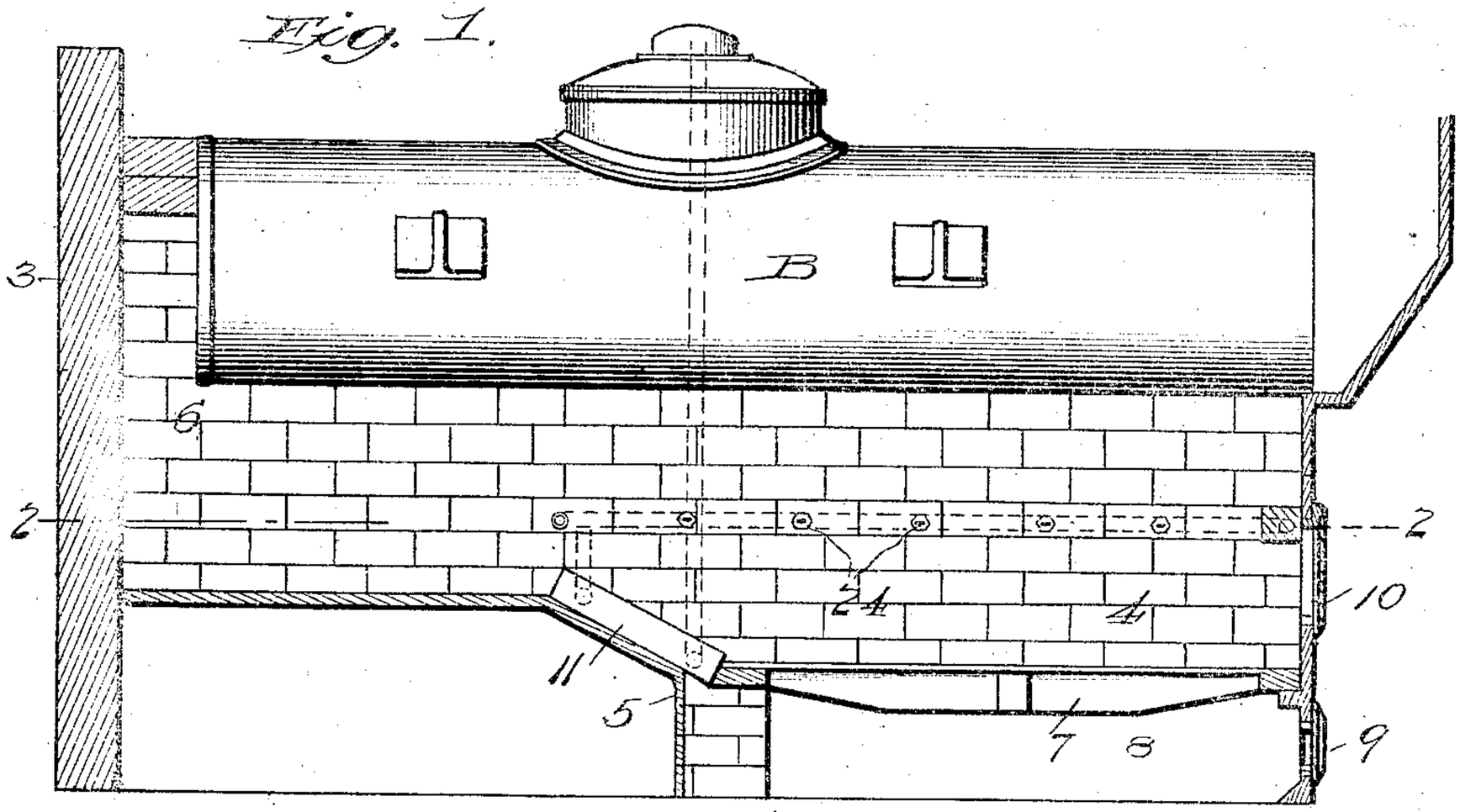


Fig. 2.

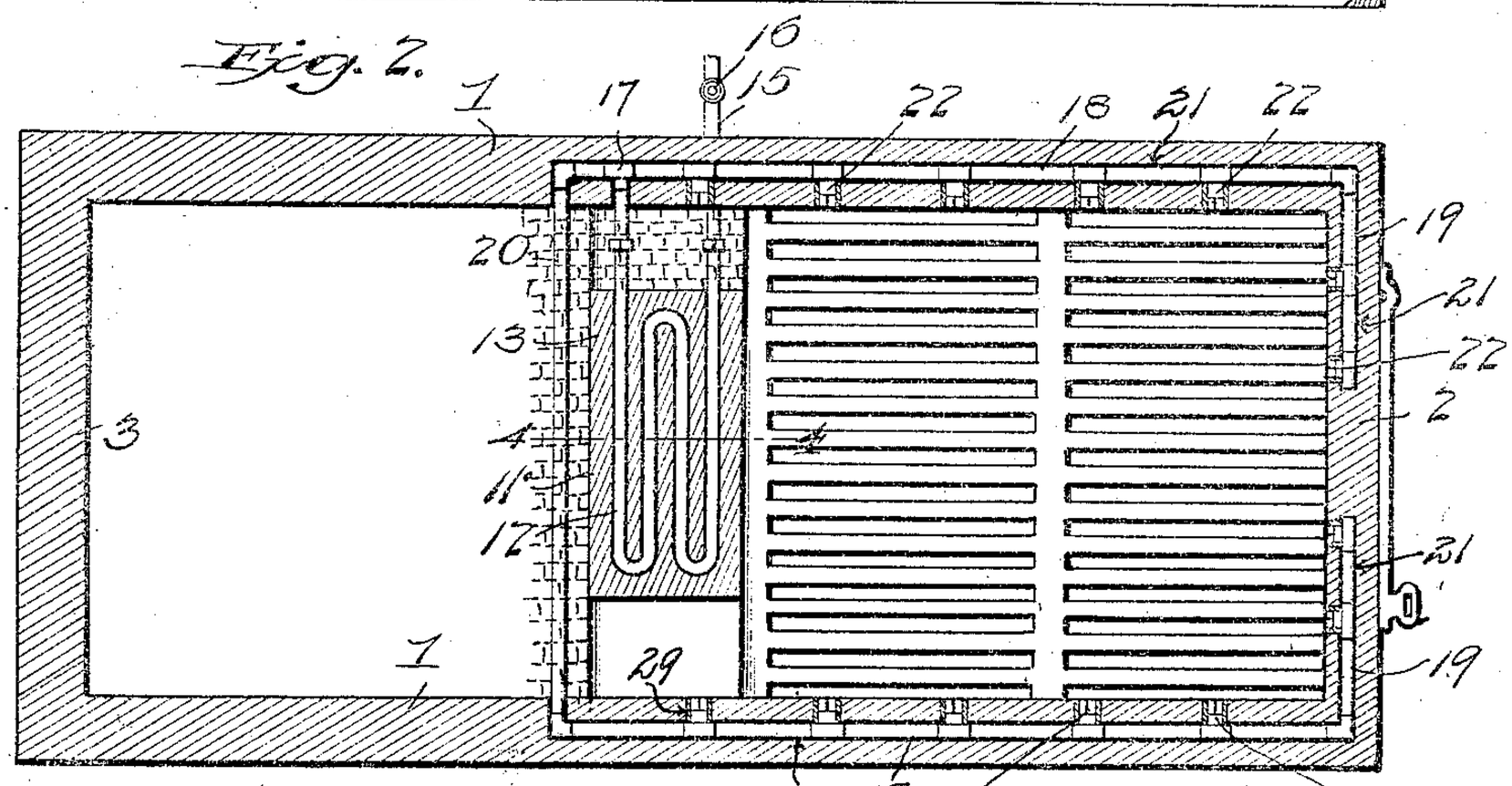


Fig. 6.

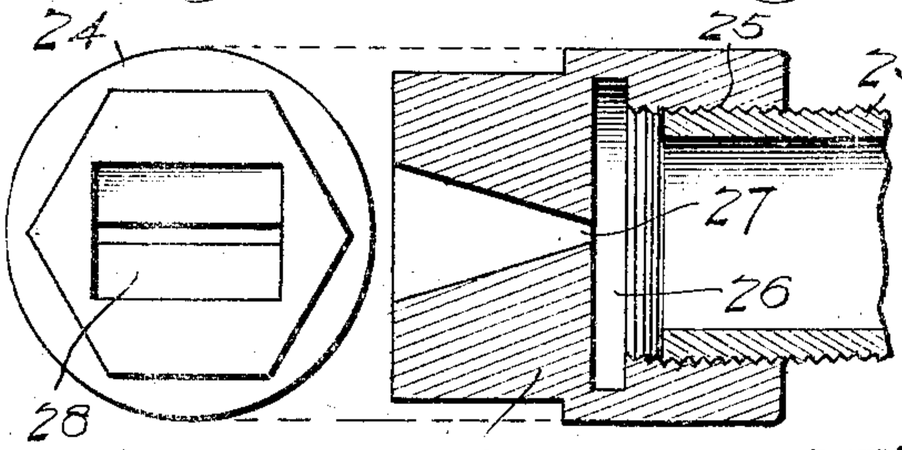


Fig. 5.

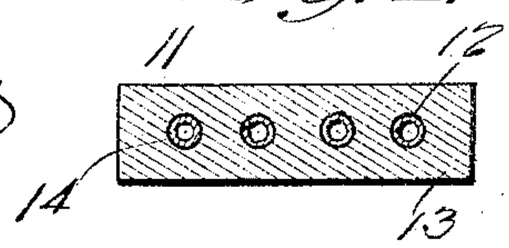


Fig. 3.

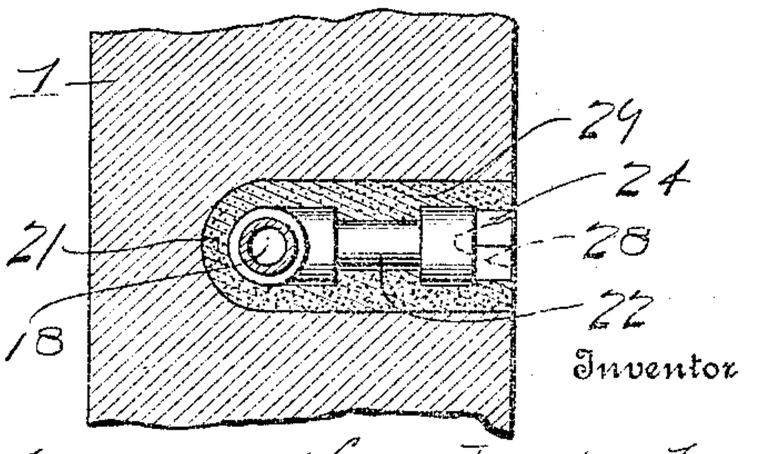


Fig. 4.

Witnesses

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# UNITED STATES PATENT OFFICE.

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## FUEL-ECONOMIZING APPARATUS FOR FURNACES.

No. 924,805. Specification of Letters Patent. Patented June 15, 1909.

Application filed June 26, 1908. Serial No. 440,427.

*To all whom it may concern:*

Be it known that I, HARRY LUCKENBACH, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented certain new and useful Improvements in Fuel-Economizing Apparatus for Furnaces, of which the following is a specification.

This invention relates to fuel economizing apparatus for boiler furnaces, and has particularly in view improved means for effecting a more perfect combustion in the fire box of a furnace with the result of increasing the fire box temperature, and decreasing the amount of unconsumed carbon and hydrocarbon products which pass to and out of the stack, thus materially reducing the smoke emitted from the stack.

A distinctive feature of the present invention resides in the provision of an apparatus capable of suddenly expanding steam from a small jet to a larger volume and simultaneously superheating the same to a temperature above 630° Fahrenheit, and also to continuously maintain this superheating temperature to place the steam in a hot dry condition very susceptible to ready decomposition. Also, the invention contemplates an apparatus comprising means for conducting the expanded and superheated steam, without induction of, or contamination with, air, to points at the sides of the fire chamber entirely above the fire, and there jetting the steam from the aforesaid points horizontally into the fire chamber above the fire and into contact with the liberated carbon, and with the heated air which passes through the fuel, thereby causing decomposition of the steam, and a new hydrogen-burning combustion above the fire. In this connection, it is the purpose of the present invention to utilize heated air admitted through the fuel so that, when the hot dry steam meets the liberated carbon above the fire, there is produced a new combustion above the fire at a sufficient degree of temperature, such as 2700° Fahrenheit and over, to burn the hydrogen, thus securing a more complete and perfect combustion in the fire box than has heretofore been possible.

A further object of the invention is to equip the apparatus with an improved form of distributing nozzle for discharging the hot dry steam through the inner faces of the fire box walls.

With these and many other objects in view, which will more readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination, and arrangement of parts hereinafter more fully described, illustrated, and claimed.

The essential features of the invention, involved in carrying out the objects above indicated are necessarily susceptible to structural modification without departing from the scope thereof, but a preferred embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a vertical longitudinal sectional view of a boiler furnace equipped with the improved fuel economizing apparatus contemplated by the present invention. Fig. 2 is a horizontal sectional view thereof on the line 2—2 of Fig. 1. Fig. 3 is an enlarged detail sectional view illustrating the method of sealing the distributing pipes and nozzles in the walls of the fire box. Fig. 4 is a detail cross sectional view of the special form of superheater employed, the line of section being indicated by the line 4—4 on Fig. 2. Fig. 5 is a detail sectional view of a preferred form of delivery nozzle utilized for jetting the decomposed steam into the fire box above the fire. Fig. 6 is a detail projected end view of the improved nozzle.

Like references designate corresponding parts in the several figures of the drawings.

The improved apparatus contemplated by the present invention may be associated with any approved type of boiler furnace, but for illustrative purposes there is shown in the accompanying drawings an ordinary steam boiler B occupying the usual position within the furnace casing, which embodies in its organization the usual side walls 1—1, the

front wall 2, the rear wall 3, the fire box 4, the bridge wall 5, and the outlet 6 for the products of combustion which pass to the stack. The fire box 4 is equipped with any preferred construction of grate 7 overlying the ash-pot 8, which latter is provided with the usual clean-out and draft door 9, while the fire box is fitted with the ordinary fuel door 10. All of these elements are common and well known parts of a steam boiler furnace, and no claim is made thereto herein, but at this point, attention is called to the fact that a natural draft is maintained through the grate for the usual combustion so that sufficient oxygen passes through the fire to maintain constantly the high temperature conditions hereinafter referred to as necessary to render effective and practical the new combustion above the fire, which new combustion involves the burning of the hydrogen from the decomposed steam.

The fuel economizing apparatus, forming the basis of this application, includes as an essential and necessary element thereof, a superheater, designated in its entirety by the number 11. This superheater is intended to be exposed directly to the heat of the fire in the fire box, and to that end may be arranged in various positions, but preferably and conveniently in an inclined position on the bridge wall so as to be directly in the path of the fire and heated products of combustion. The construction of this superheater is an important part of the present invention, the same essentially consisting of a continuous length of steam piping 12 having no joints and bent into a coil of suitable form, said coil being inclosed in a solid body or block of iron cast in a molten state about the coil. The great conductivity of this block or body of iron absorbs the heat from the fire, which is in turn transmitted to the piping 12 embedded therein, said piping being preferably protected, originally, by a covering of fire resisting clay or equivalent material, as indicated at 14 in Fig. 4, at the time the iron body or block is cast about the same. This construction is perfectly capable of withstanding the full heat of the fire without melting of the iron, and in practice it has been found that the block or body of iron 13 reaches a state of incandescence which insures the maintenance of such a heating of the steam piping 12 of the superheater as to keep up in the latter a temperature above 630° Fahrenheit, which is above the degree of temperature at which steam is placed in a hot dry condition very susceptible to ready decomposition.

Steam is fed to the superheater coil 12 through a feed pipe 15 connecting with the steam dome of the boiler or equivalent source of supply and which is preferably provided with a needle or equivalent controlling valve 16. Thus live steam, is conducted directly from the boiler to the superheater and in the latter is subjected to the action above described.

The outlet terminal of the superheater coil 12 is suitably coupled, as at 17, to a horizontally arranged distributing pipe essentially consisting of several pipe sections respectively embedded in the side and front walls of the furnace fire box 4. As shown in the drawings, the said distributing pipe includes the opposite side wall pipe sections 18—18 embedded in the side walls of the fire box, the front wall pipe sections 19—19 embedded in the front walls 2 of the fire box, and a transverse rear connecting pipe section 20 which is coupled to and connects the side wall pipe sections 18 at their rear ends, thus completing a pipe frame which may be said to entirely encircle the fire box, within the walls thereof, at a suitable level above the grate. Each pipe section 18 and 19 is thoroughly protected and sealed from air by being incased in a protective jacket 21 of fire resisting clay or equivalent material, and at suitable intervals the side and front sections of the distributing pipe are provided with short delivery nozzles 22, each of which essentially consists of a nozzle stem 23 coupled to and communicating with the distributing pipe and a discharge head 24 preferably having a threaded adjustable connection 25 with the tubular nozzle stem 23. The discharge head 24 is preferably formed therein with a feed chamber 26 which communicates with a contracted outlet orifice 27 provided at its inner end with an outwardly flaring and preferably rectangular distributing mouth 28 which reaches to the outer end of the discharge head 24. The said outer end of the discharge head 24 is arranged flush with the inner surface of the wall, and hence the narrow outlet orifice or slit 27 for the nozzle is located well back of and protected from the inner surface of the wall which is exposed to the fire, with the result of keeping said orifice or slit free and open at all times irrespective of whether the wall itself fuses or not, all of which is of material and practical importance in an apparatus of this character.

As best shown in Fig. 3 of the drawings, the various nozzles are also effectually sealed and protected within the fire box walls by coverings 29 of fire resisting clay or equivalent material.

The various nozzles 22 are arranged at a sufficient elevation above the grate surface so as to be located wholly above the plane of the fire ordinarily maintained on the grate 7 so that the steam is jetted horizontally into the combustion chamber above the fire causing the liberated oxygen of the steam to readily unite with the liberated carbon and hydrocarbon producing a new combustion above the fire at a sufficient degree

of temperature for the burning of the hydrogen, thus securing a very thorough combustion in the fire box, as has been evidenced in practice by a decidedly lower stack temperature than ordinarily prevails in the stacks of boiler furnaces.

The above action is permitted and rendered possible by the fact that a natural draft is maintained for the regular combustion so that sufficient draft comes through the fire to insure constant high temperature conditions in the combustion chamber by maintaining the released carbon and hydrocarbon at a temperature where they will unite with the decomposed steam. Also, there is no valve between the superheater and the nozzles, thus preventing moisture remaining in the superheater, and avoiding possibility of any increase in pressure between the superheater and the nozzles.

It will further be understood that through the medium of the needle or equivalent controlling valve 16, the inlet of steam to the superheater is so throttled that the steam is suddenly expanded within the superheater from a small jet to a larger volume, and in its highly expanded condition is subjected to the high temperature above indicated, viz: above 630° Fahrenheit, thereby placing the same in the aforesaid hot dry condition susceptible to ready decomposition, so that when the steam in that condition meets the liberated carbon and the heated air above the fire in the fire box, a complete decomposition of the steam takes place and a new hydrogen-burning combustion occurs above the fire with the result of securing a very complete and perfect combustion in the furnace.

From the foregoing, it is thought that the construction, operation, and many advantages of the herein described apparatus will be readily understood without further description, and it will also be understood that various changes in the form, proportion, and minor details of construction may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

I claim:

1. A fuel economizing apparatus for furnaces, comprising means for suddenly expanding steam from a small jet to a larger volume and simultaneously superheating the expanded steam to a degree of temperature sufficient to place the steam in a hot dry condition susceptible to ready decomposition, means for conducting the expanded and superheated steam without induction of, or contamination with, air to points at the sides of the fire chamber entirely above the fire, means for admitting air through the fuel to be heated thereby, and means for jetting the hot dry steam from the aforesaid points horizontally into the fire chamber above the fire and into contact with the liberated carbon and heated air, causing complete decomposition of the steam, and a new hydrogen-burning combustion above the fire.

2. A fuel economizing apparatus for furnaces, comprising means for suddenly expanding steam from a small jet to a larger volume and simultaneously superheating the expanded steam to a degree of temperature beyond 630° Fahrenheit to place the steam in a hot dry condition susceptible to ready decomposition, means for conducting the expanded and superheated steam without induction of, or contamination with, air to points at the sides of the fire chamber entirely above the fire, means for admitting air through the fuel to be heated thereby, and means for jetting the hot dry steam from the aforesaid points horizontally into the fire chamber above the fire and into contact with the liberated carbon and heated air, causing complete decomposition of the steam, and a new hydrogen-burning combustion above the fire.

3. In a fuel economizing apparatus for steam boiler furnaces, the combination with the fire box and a natural draft therefor, of a superheater exposed to the fire and comprising means for continuously maintaining a degree of temperature sufficient to place the steam in a hot dry condition susceptible to ready decomposition, a distributing pipe receiving the steam from the superheater and having sections embedded and sealed from air in the walls of the fire box, and a plurality of delivery nozzles coupled to each distributing pipe section and also sealed from air and embedded in the fire box walls, each distributing nozzle having an outlet orifice for jetting the steam in the combustion chamber at a point above the fire therein.

4. In a fuel economizing apparatus for steam boiler furnaces, the combination with the fire box and a natural draft therefor, of a superheater exposed to the fire and consisting of a pipe coil and a solid iron casting closely enveloping said coil and comprising means for continuously maintaining a degree of temperature sufficient to place the steam in a hot dry condition susceptible to ready decomposition, a distributing pipe receiving the disintegrated steam from the superheater and having sections sealed by fire resisting material within the fire box walls, and a plurality of delivery nozzles connected with each distributing pipe section likewise sealed by fire resisting material in the fire box walls, all of said delivery nozzles being arranged to jet steam into the combustion chamber horizontally above the fire.

5. In a fuel economizing apparatus for steam boiler furnaces, the combination with the fire box and a natural draft therefor, of a superheater, a distributing pipe connected

with the superheater and surrounding the fire box and embedded in the walls thereof, and a plurality of delivery nozzles also embedded in the fire box walls entirely within the plane of the latter, and connected with the distributing pipe sections, each nozzle being provided with a discharge head having a distributing mouth and a contracted outlet orifice or slit at the inner end of said mouth, said distributing mouth flaring outwardly from said orifice or slit toward the inner surface of the fire box wall.

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

HARRY LUCKENBACH.

Witnesses:
JAMES P. DAVENPORT,
IDA M. BRETHAUER.