(No Model.) 2 Sheets—Sheet 1.

A. DON & J. SANDS.

FURNACE.

No. 411,984. Patented Oct. 1, 1889.

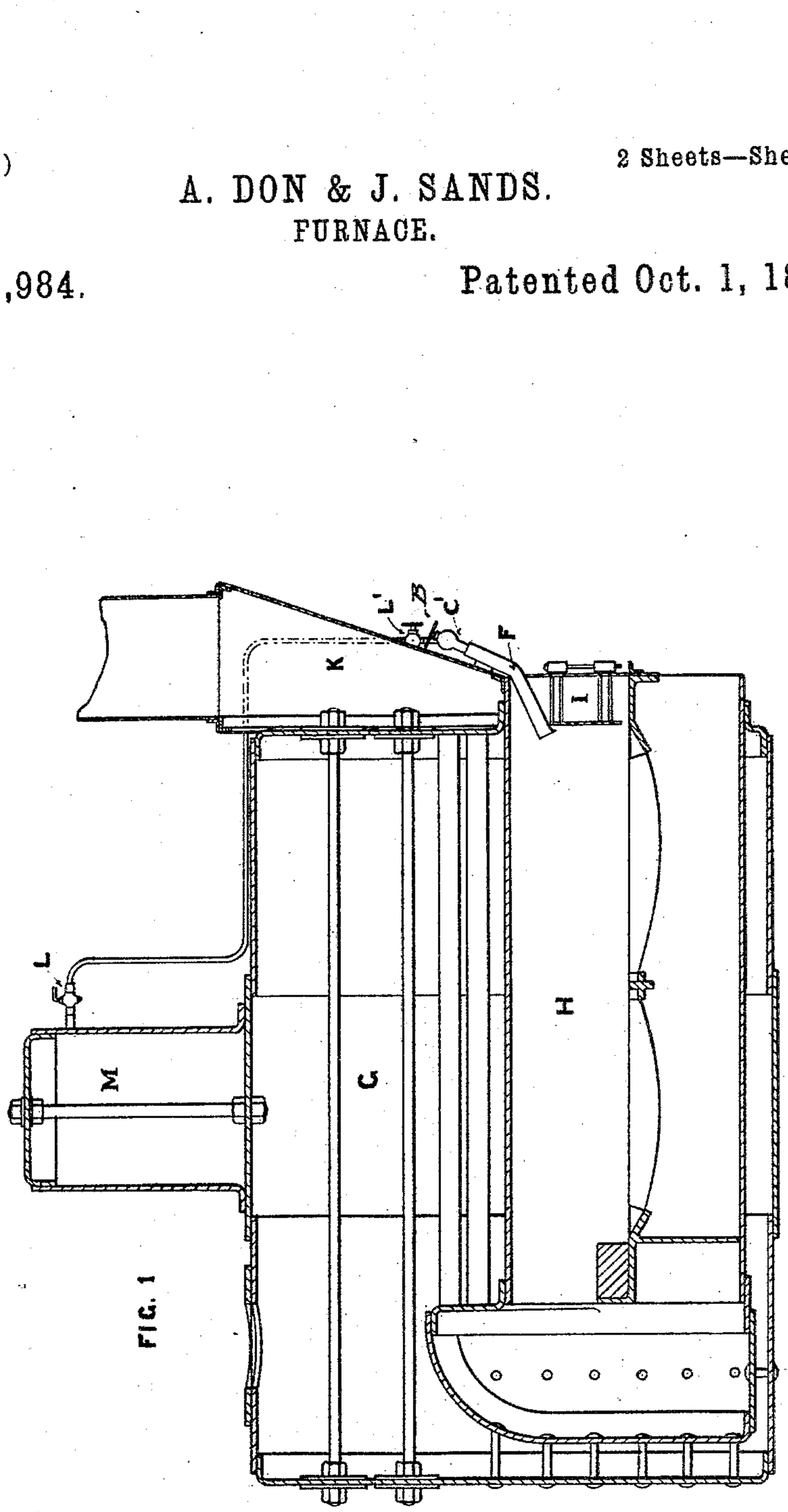

FIG. 1

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(No Model.) 2 Sheets—Sheet 2.

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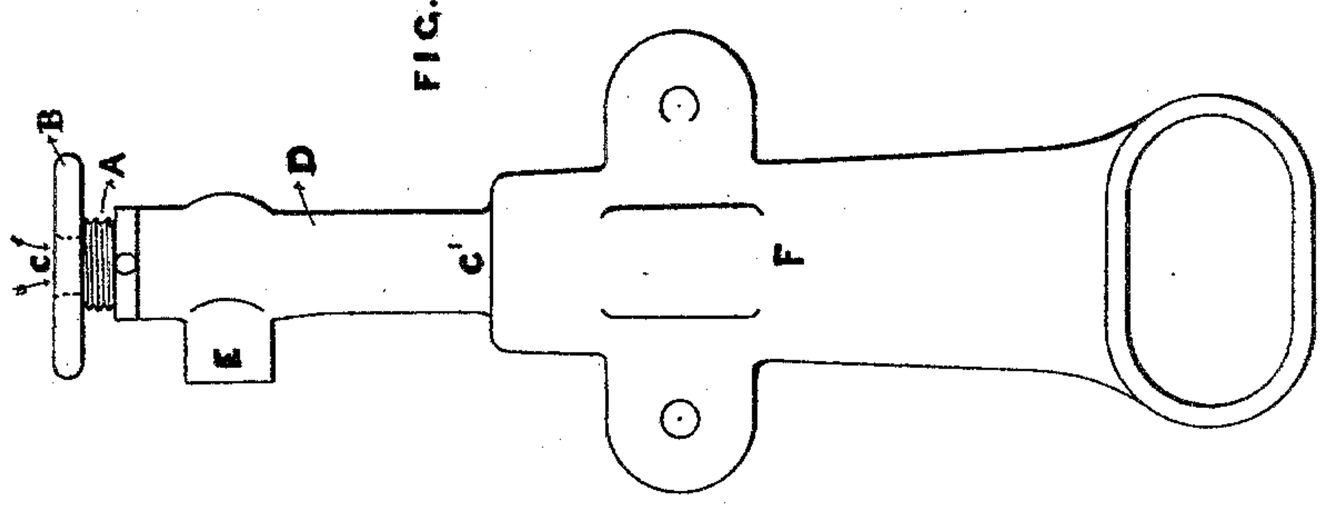

FIG. 1

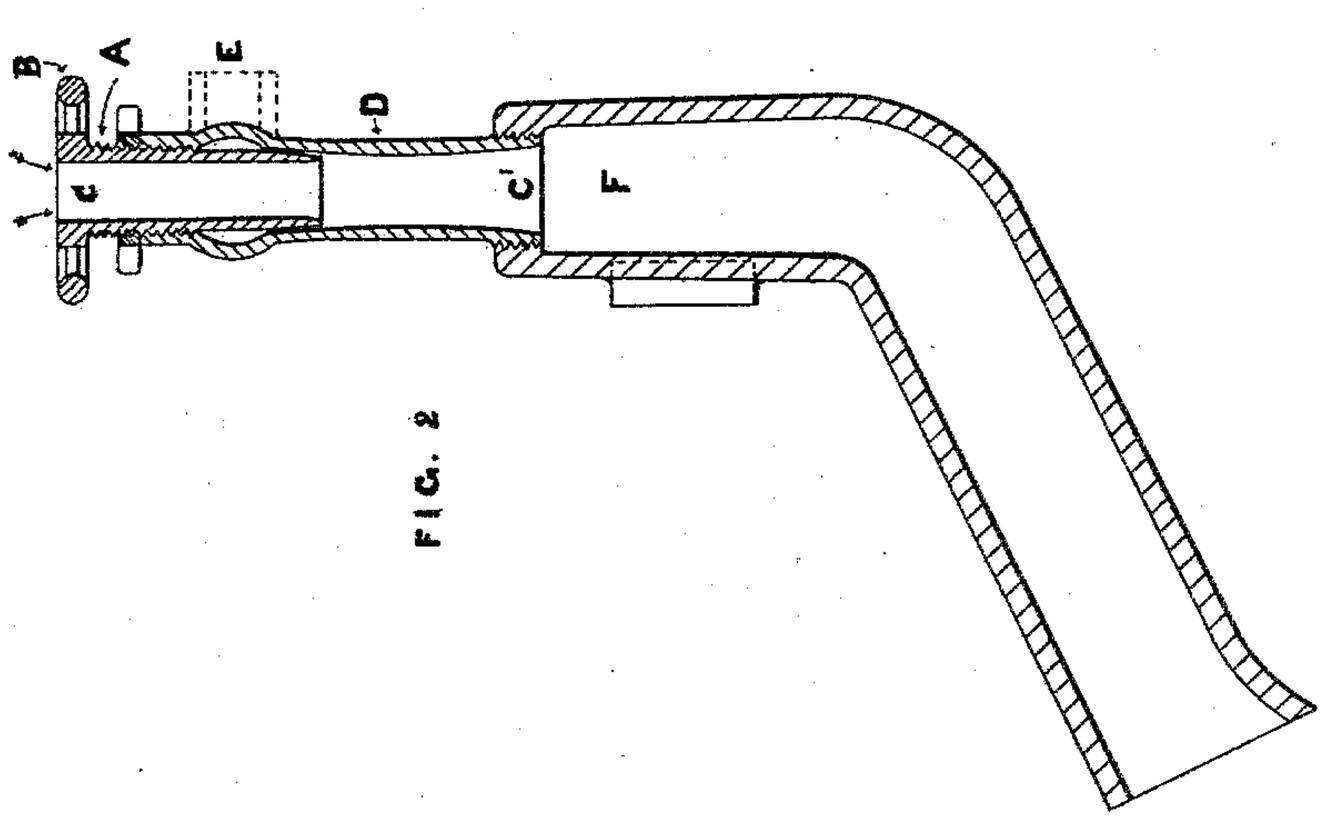

FIG. 2

Witnesses.
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UNITED STATES PATENT OFFICE.

ALFRED DON AND JOHN SANDS, OF SYDNEY, NEW SOUTH WALES.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 411,984, dated October 1, 1889.

Application filed January 5, 1889. Serial No. 295,499. (No model.)

To all whom it may concern:

Be it known that we, ALFRED DON, engineer, a subject of the Queen of Great Britain, residing at Donville Villa, Garner's Avenue, Marrickville, Sydney, in the Colony of New South Wales, and JOHN SANDS, engineer, a subject of the Queen of Great Britain, residing at Harris Street, Pyrmont, Sydney aforesaid, have invented a certain new and useful Improvement in Apparatus for the Prevention and Consumption of Smoke and the More Complete Combustion of Fuel in Steam-Boiler and other Furnaces, of which the following is a full, clear, and exact description.

Our invention consists of an improvement in apparatus (operating by means of a steam-jet and an induced current of air) for the prevention and consumption of smoke and the more complete combustion of fuel in steam-boiler and other furnaces, the same being an improvement upon apparatus shown and described in Letters Patent of the United States No. 376,948, issued to the undersigned, Alfred Don, on the 24th day of January, 1888.

The apparatus shown and described in the specification of the said former invention comprises in one form a vertical air-induction pipe, L-shaped, (or bent or curved at the lower end,) constructed, preferably, of cast-iron, oval or of other preferred contour in cross-section, and of particular dimensions of area, fixed in front of the furnace with its curved portion projecting into the furnace through an opening above or in the top of the door thereof, its exit being bell-shaped, having a slightly downward deflection over the fuel, the mouth of the said induction-pipe being also bell-shaped and provided with a lid or cover for the admission or exclusion of air, having fitted therein a vertical L-shaped steam-pipe constructed, preferably, of copper, carried within the air-pipe, so that its point of discharge is just beyond the bend or curve of the air-pipe, the said steam-pipe being connected at the other end with the steam-chest or other source of supply and controlled by a suitable valve.

Having reference to the said former invention, our present improvement has for its object, first, a corresponding result with the consumption of a smaller quantity of steam; second, the absence of a considerable noise which is found to accompany the working of the previous form of apparatus; third, an increased efficiency, consisting in a greater margin of power under control, whereby a very much increased volume of air may be driven into a furnace and at a greater velocity.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar letters of reference indicate corresponding parts in the several views.

Figure 1, Sheet 1, represents a vertical longitudinal section of an ordinary marine boiler and furnace, the dimensions of the latter being six (6) feet by two (2) feet nine (9) inches, with the complete apparatus as used by us affixed thereto. Fig. 2, Sheet 2, is a sectional side elevation of our improved apparatus. Fig. 3, Sheet 2, is a front elevation of the same parts.

In carrying out our invention we construct a pipe F, bent or curved at its lower end, (or of an L-shaped form,) similar to the air-induction pipe described in the specification of the former invention, but differing somewhat therefrom, as hereinafter mentioned, with a bell-shaped distributing-exit having a downward deflection constructed and projecting into the furnace or fire-box in the manner described in the specification of the former invention. The construction of the said pipe F (which in this specification we term a "distribution-pipe") and otherwise of the apparatus the subject of the present invention differs from the former apparatus in the following material respects: First, that the area and dimensions of the said pipe F are immaterial within approximate limits, so long as the lower portion thereof is of such convenient size as to admit of the construction of the distributing-exit in the requisite manner; second, in the apparatus the subject of the present invention we use an annular injector C′, (into which the steam-pipe is carried,) which is fixed in the mouth of the before-mentioned pipe F, a current of air being induced through the center of the annular injector by means of the steam.

In Fig. 1 of the said drawings, G represents the boiler; H, the furnace; I, the furnace-door, and F the distribution-pipe with the annular injector C′ fitted therein, the same

being secured to the furnace and entering the fire-box, as shown in the drawings.

K represents a steam-pipe fixed into a side socket E of the annular injector, extending upward to a stop-cock L, inserted in the steam-chest M. L′ represents another steam-cock placed in proximity to the annular injector.

In Figs. 2 and 3, F represents the distribution-pipe, and C′ the annular injector. The said distribution-pipe F may be of any suitable contour; but we construct the same tapering from the top to the exit, the upper portion thereof circular in form and running into an oval at the exit. The upper portion as far as the bend or curve may be of any convenient length, and we construct the same for a furnace of the said dimensions with a diameter of about two (2) inches; but the same is not material within approximate limits. We construct the lower portion of the said distribution-pipe F from the bend or curve therein of such length as may be requisite for entering the furnace, with an area for a furnace of the before-mentioned dimensions of about twelve inches at the exit. The said area may be slightly exceeded or diminished so long as it is of sufficent size to admit of the proper construction of the bell-shaped exit. We construct the said exit for a furnace of the said dimensions of an oval form five (5) inches in length by two and three-quarters ($2\frac{3}{4}$) inches in width, with such downward deflection thereof that the currents passing through it will reach all the sides or angles of the fire-box opposite thereto approximately above the level of the fuel. The size of the exit and shape as regards length and breadth and the deflection thereof will necessarily vary with the size and shape of the furnace. The said exit enters a furnace of the before-mentioned dimensions so as to extend slightly beyond the inner baffle-plate of the furnace-door; but such extent may be increased or diminished to adapt the said exit to the furnace, so that the same may be fitted therein at the requisite angle of deflection.

As stated in the specification of the former invention, the steam-pipe K is extended upward along and over the end of the furnace as far as possible, so as to insure the dryness of the steam it is intended to convey to a connection with the steam-chest, as appearing in Fig. 1.

As stated in the specification of the said former invention, immediately above the furnace-door or centrally of its upper edge an opening is cut suited to admit the passage of the distribution-pipe F in an approximately tight joint through the casing of the furnace above the door, or in the door when the same is closed. The said apparatus is placed against the end of the furnace so that its exit projects within the fire-box through the said opening.

The annular injector, as shown in Figs. 2 and 3, consists of two parts, the first part of an annular tube A. We have found the same constructed for a furnace of the said dimensions with an internal diameter of one and one-eighth ($1\frac{1}{8}$) inches to give an efficient result. The said tube A has a hand-wheel B fitted at the end thereof for the adjustment of the instrument. This tube is screw-threaded at its upper end for insertion into the second part of the instrument, being the external tube D. The lower end of the tube A is tapered for insertion into the seating in the tube D below the enlargement formed for the admission of steam from the side pocket E. We have found the instrument most effective when the tube A is carried down to and the said seating is fixed at the point in the tube D in proportion to the length thereof, which is shown in the drawings, the same being where the curve in the tube D commences. The tube A is so constructed and the screw-threads are so cut thereon that when the tube A is fixed into the tube D turns or revolutions of the hand-wheel B will withdraw the tube in the seating and regulate the annular space between the tubes occasioned thereby for the admission of steam in the required quantity. We have found that with the screw-threads on the tube A cut sixteen (16) to the inch three (3) revolutions of the hand-wheel give a good result in general use. The tube D is constructed with a diameter increased at the upper part for connection with the steam-pipe and to give the necessary space for the admission of steam.

For larger furnaces than a furnace of the above-mentioned dimensions the said annular injector should be so constructed that the internal diameter of the tube A will be increased. For furnaces up to an approximate area of sixteen (16) square feet an annular injector of the above dimensions will suffice. For furnaces of larger size the internal area of the tube A must be increased approximately in like proportion to the size of the furnace. In furnaces of extra large dimensions it might be desirable to use two instruments—such as is shown in detail in Figs. 2 and 3—fixed in front of the furnace in connection with the steam-pipe K.

The apparatus is operated by setting the hand-wheel B so as to allow of the admission of steam through the annular space thereby occasioned between the tubes A and B and then turning on the steam. It will easily be ascertained in practice how many revolutions of the hand-wheel will be required to suit the quality of the fuel supplied to the furnace. The current of air induced by the admission of steam into the tube A at its mouth or inlet, (lettered C,) passing through the distribution-pipe in manner described, will have the effect, with careful stoking, of almost immediately dispersing any smoke and of preventing smoke being generated by the fresh fuel, and also, within a few minutes, of rendering the fuel incandescent, when the

steam can be turned off. The said apparatus is of course available for such furnaces other than steam-boiler furnaces as are of a construction to admit of the same being adapted thereto.

The principle underlying the former invention, and which finds a more efficient operation in our improved form of apparatus, is that a large volume of air is driven into the furnace at a great velocity of pressure, being, it is believed, a very much larger volume of air and driven at a greater velocity or pressure than has been attempted in or effected by other smoke-preventing apparatus, and that, the same being distributed by the means adopted all over the surface of the fuel, the whole of the carbon and gases generated are forced by pressure into immediate chemical union with the requisite amount of oxygen for their complete combustion.

We may state that the use of the steam-jet in connection with our invention is for the purpose only of inducing the air-current and not for the introduction of the combined air and steam, as in the case of some other smoke-preventing apparatus.

In the use of the former apparatus a current of air is induced which attains a velocity or pressure through the inlet equal to supporting from one-eighth ($\frac{1}{8}$) of an inch to one-fourth ($\frac{1}{4}$) of an inch of a column of mercury, but not approximately exceeding the latter velocity. By the use of the annular injector we introduce a current of air into the furnace at a greatly-increased velocity, but approximately the like quantity of air to produce the desired result. By means of the said annular injector a current of air could be projected into a furnace at a velocity equal to supporting from one-fourth ($\frac{1}{4}$) of an inch to seven (7) inches of a column of mercury, and we have found in practice that the use thereof so as to give approximately a velocity equal to supporting one and a half ($1\frac{1}{2}$) inch of a column of mercury produces the desired result.

In the apparatus the subject of the said former invention the air-induction pipe thereof is constructed for the size of furnace therein mentioned with a diameter of four (4) inches by two and a half ($2\frac{1}{2}$) inches, and in using the said apparatus for attaining the full result the lid or valve at the mouth of the pipe is fully opened and allows the admission into the furnace within a given time of the quantity of air which a pipe of such dimensions can contain at one and the same time, passing into the furnace at a velocity of pressure, as before stated, equal approximately to supporting a quarter ($\frac{1}{4}$) of an inch of a column of mercury. The annular injector being constructed for a furnace of approximately the same size, with an aperture for the admission of air of a diameter of one and one-eighth ($1\frac{1}{8}$) inch only, is approximately an area one-seventh ($\frac{1}{7}$) of the former apparatus, while, as before stated, the velocity or pressure of the air-current is increased from the capacity of supporting one-fourth ($\frac{1}{4}$) of an inch to being equal to supporting one and a half ($1\frac{1}{2}$) inch of a column of mercury.

The said invention differs in operation from the former invention in the following particular, that in the use of the annular injector the velocity of the current of air is so much greater that the distribution thereof is aided by the same being in the first instance projected against some portion of the pipe entering the furnace. In the specification of the former invention the said pipe is termed an "air-induction pipe." In our improved apparatus the said annular injector is the air-induction pipe, and the pipe entering the furnace with its distributing-exit serves mainly the purpose of a distributing medium. When the annular injector is used in combination with an L-shaped distribution-pipe, or a pipe bent or curved at its lower end, which we regard as the preferable and most convenient form of apparatus, the current of air is projected against the bent portion of the pipe. If the annular injector were used in combination with a straight pipe, the same result could be brought about by inserting the annular injector obliquely therein. Having regard to this feature of the invention, we do not restrict the same merely to the combination of an annular injector with a distribution-pipe entering the furnace, as other means or combinations can be arranged whereby a current of air may be projected into a furnace by means of an annular injector, with the use of some other means of distributing the air-current at the time of entering the furnace.

One important result from the use of the said annular injector is the consumption of a very much smaller quantity of steam for the use of the apparatus. Another important result is the absence of a considerable noise which is found to accompany the working of the former apparatus, the working of our improved apparatus being practically noiseless. A further result is the margin of power under control to permit of air being introduced into the furnace at a greater velocity and in greater volume than is practicable by means of the former apparatus, the velocity of the air-current and the volume of air having sometimes to be increased, having regard to the quality or an extra quantity of the fuel.

The introduction into furnaces of a current of air by the aid of a steam-jet has been well known to aid in preventing or diminishing smoke and increasing the combustion of fuel; but the apparatus heretofore employed for such purposes and the methods of applying the same have not insured the complete success, with the facilities for the operation thereof, which are incident to our invention.

Our improved apparatus is simple in construction and can be applied with the greatest

facility and at a nominal cost to any steam-boiler furnace or other furnace to which the same may be adapted without alteration in the structure thereof. It can also be regulated in the simplest way to insure efficiency in operation as may be requisite, having regard to the quantity or quality of the fuel used or to other conditions, and it works a greater economy in the consumption of fuel, both directly and indirectly, in the quantity of steam required for the use of the apparatus, than any similar apparatus heretofore used.

Having thus described our invention and how the same is to be carried into effect, what we claim, and desire to secure by Letters Patent, is—

An attachment for furnaces, consisting in the angular distributing-tube, the two arms of which form an obtuse angle, and the bore of the tube gradually increasing in diameter from its inlet to its discharge end, and the annular injector having an adjustable air-pipe and connected at its outlet end to the upper or inlet end of the distributing-tube, substantially as set forth.

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