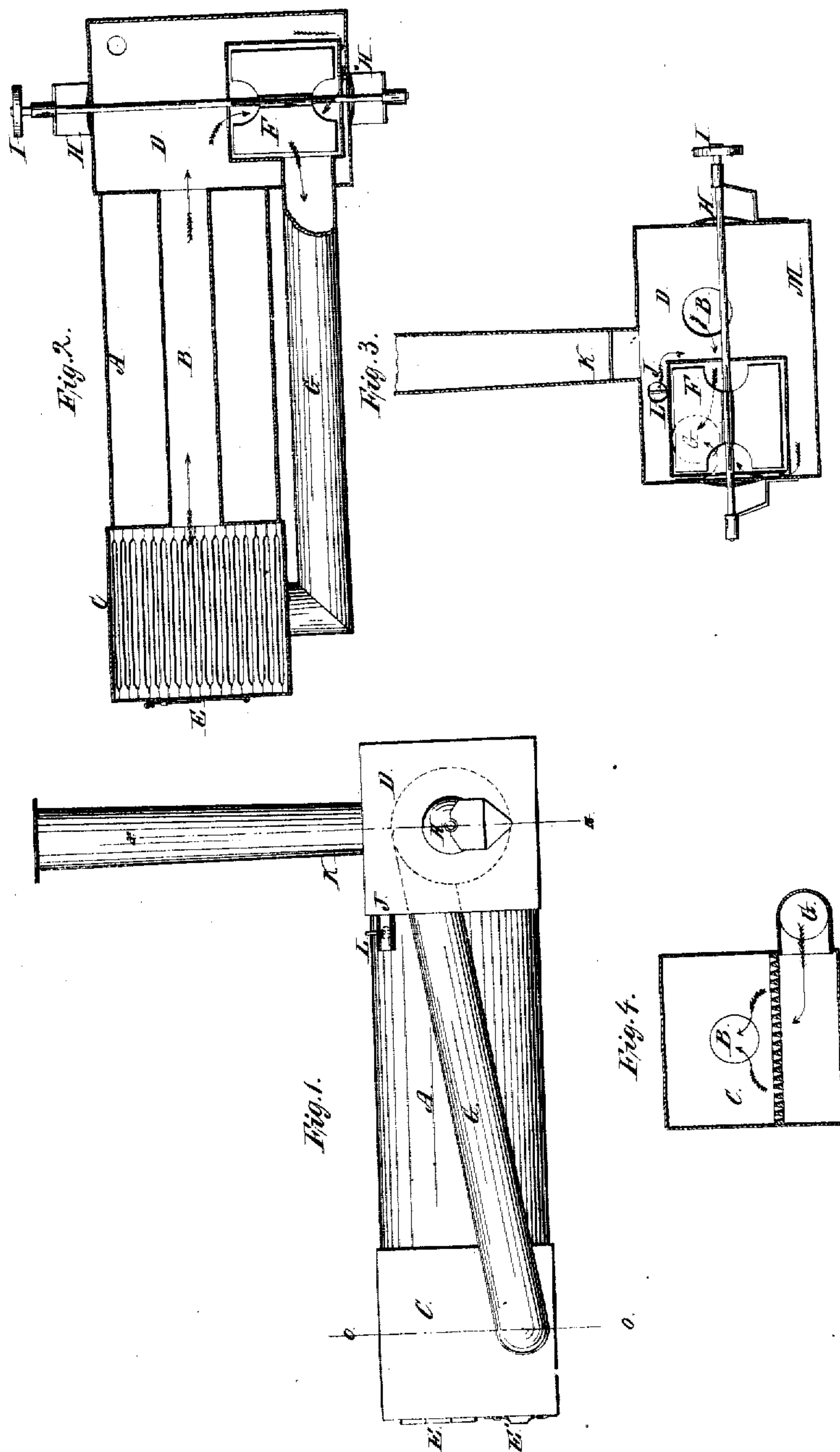


Case & Soule

Spark Arrester and Consumer,

Patented Oct. 20, 1857

No 18,432.



# UNITED STATES PATENT OFFICE.

JOHN CASE AND ISAAC SOULES, OF AMSTERDAM, NEW YORK.

## IMPROVEMENT IN FURNACES.

Specification forming part of Letters Patent No. 18,432, dated October 20, 1857.

*To all whom it may concern:*

Be it known that we, JOHN CASE and ISAAC SOULES, both of Amsterdam, in the county of Montgomery and State of New York, have invented a new and useful Improvement in Furnaces, specially adapted to the generation of steam for motive power, but applicable to furnaces for other purposes, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, in which—

Figure 1 represents a side elevation of a single-flue steam-boiler embracing our improvement. Fig. 2 represents a horizontal longitudinal section through the same. Fig. 3 represents a transverse section through the smoke-box at the line *x x* of Fig. 1, and Fig. 4 represents a transverse section through the furnace at the line *o o* of Fig. 1.

The principal objects of our invention are to economize fuel in the generation of steam for motive power by burning most of the combustible matter that usually escapes unconsumed by the chimney, to diminish the quantity of smoke, and thereby lessen its capacity for carrying off heat when it escapes, and incidentally to extinguish the sparks and prevent their escape. These objects are accomplished by burning the fuel in a close furnace through which a regular current of fresh air mingled with the gaseous products of combustion is constantly flowing. This current is established by connecting the furnace and smoke-box by two flues or series of flues, through one of which the gases can pass from the furnace to the smoke-box and through the other return from the smoke-box to the furnace, a fan or other suitable pump being arranged in the circuit to maintain the current at a proper velocity. As the gases enter the smoke-box they are mingled with cool air, thence passing into the fan-case are forced by the fan through the return-flue back into the furnace, where they are again inflamed, and pass through the flues of the boiler into the smoke-box to be again mingled with air. By this operation the gaseous products are alternately mixed with fresh air, reheated, and inflamed until they are thoroughly oxidated, most of the heat which they evolve during the process of oxidation being transferred to the water in the boiler,

after which they are so reduced in bulk and increased in weight as to settle by their own gravity to the bottom of the smoke-box, through which they escape by a small opening provided for the purpose. The sparks also settle to the bottom of this receptacle and are extinguished by the burned and un-inflammable gas in which they are immersed.

In the accompanying drawings a boiler to which our improvement is applied is shown. The boiler consists of a cylindrical shell A and flue B, connected at one end with a fire-chamber C and at the other with a smoke-box D. The fire-chamber C is provided with suitable tight doors E E' both above and below the grate-bars. The upper one E is used to supply the furnace with fuel from time to time, as required, and the lower one E' to give access to the ash-pit. A valvular feeding-hopper may be used instead of the upper door to supply the furnace with fuel. The flue B forms a communication between the fire-chamber and smoke-box, through which the gaseous products of combustion pass with the sparks from the furnace to the smoke-box. An orifice J, fitted with a valve by which it can be opened and closed at pleasure, enters the upper part of the smoke-box to supply the fresh air necessary for the combustion of the fuel.

A fan F, constructed like the ordinary fan-blower, is placed on one side of the smoke-box with sufficient space around the fan-case for the gases to enter it freely. A pipe G on the outside of the boiler (one end of which enters the furnace beneath the grate-bars and the other passes through the smoke-box and terminates in the fan-case) forms a communication between the smoke-box and the furnace through the fan-case. This pipe after leaving the fan-case may be forked, one branch entering the fire-box below the grate-bars and the other entering the fire-box just above the fuel on the grate, by which means the unconsumed gases mixed with air would enter the fire-box both above and below the grate-bars.

Under the arrangement of the fan here adopted its axle extends through the sides of the smoke-box and is supported in suitable bearings H, formed in the sides of the box. On one of the projecting ends of the axle is a



pulley I, by which motion is given to the fan in the usual manner. On the top of the smoke-box there is a chimney, which is fitted with a valve K, to be opened to create a draft while the fire is being kindled and also during the time fuel is being fed into the furnace, that the gases may not be blown out at the furnace-door. In order to avoid opening the valve in the chimney during the feeding of the furnace, a valve may be placed in the return-pipe leading from the fan, which the opening of the furnace-door will close; or if a valvular feeding-hopper is used the opening of this valve K while feeding will be unnecessary. As soon as the fire has been well kindled the furnace-doors and chimney-valve are closed, the valve L of the air-orifice J is opened, and the fan put in motion. Air for the support of combustion is drawn through the orifice J into the smoke-box and mingled with the gases in the upper part of the box, and thus mingled the two are forced by the fan into the furnace beneath the grate-bars, and as they pass through the fuel lying on the grate-bars a portion of the oxygen of the air mixed with the return gases is taken up by the fuel, and thus its combustion is maintained, while the remainder of the oxygen of the air combines with the gases as they are heated in passing through the furnace, to complete their combustion. On the passage of these gases through the flues a portion of their heat is taken up and imparted to the water by which they are surrounded. Those portions of the gases which have been saturated with oxygen and cooled by passing through the flues become heavier than the less oxidated and inflammable portions, and as these heavy saturated gases come in contact with the cool fresh air of the smoke-box as they issue from the direct flue their temperature is still further reduced and their density increased, and they settle to the bottom of the smoke-box and pass out through the waste-pipe M. The lighter and partially-oxidated gases mingled with the current of fresh air are drawn into the fan-case and forced back through the furnace, as already described, and the process of alternate mixing with fresh air and burning is repeated until the combustion of the gases is completed. The motion of the fan while producing this circulation creates a partial vacuum in the smoke-box, which draws the gases from the fire-box and causes the fresh air to enter through the orifice J. Owing to the entrance of the air at the upper part of the smoke-box it flows among and becomes intimately mixed with the gases before they enter the fan, and the agitation produced by

the rotation of the fan blends them still more intimately. When these gases mingled with fresh air pass through the interstices between the pieces of solid fuel on the grate-bars, a portion of the oxygen derived from the fresh air goes to the support of the combustion of the solid fuel, causing it to burn freely, while the remainder is gradually combined with the gases, as already mentioned. This intimate mixture of the fresh air with the gases before they enter the ash-pit is essential to the uniform combustion both of the solid fuel lying on the grate and of the gases, for if the gases were introduced beneath the grate-bars through one opening while a current of fresh air entered through another the air would pass through the grates almost unmingled with gases and produce an intense heat and rapid combustion of the fuel lying on the grate in the immediate path of the air toward the flue, while the fuel on the other portions of the grate would be deadened if its combustion were not quenched by the gases which would pass back again to the smoke-box, little, if any, more oxidated than when they left it, by which means neither the solid nor the gaseous fuel would be properly burned for want of a thorough mingling of the air and gases before entering the ash-pit. Much of those portions of the gases which are so saturated with oxygen as to be incombustible and yet not sufficiently cool to settle freely as they issue from the direct flue are cooled by coming in contact with the fresh air and then settle to the bottom of the smoke-chamber and escape.

In applying our improvement to existing furnaces it will be necessary frequently to vary the position of the smoke-box, fan, and return-flues to adapt them to particular circumstances. The fan must, however, in all cases be located at some point between the end of the direct flues and the fire-box.

What we claim as our invention, and desire to secure by Letters Patent, is—

The combination and arrangement of the fire and smoke boxes, direct and return flues, the valved atmospheric-air orifice and aperture for the escape of the spent gases, and the fan for maintaining the circulation of the air and gases, arranged substantially as before declared.

In testimony whereof we have hereunto subscribed our names.

JOHN CASE.  
ISAAC SOULES.

In presence of—

JOSEPH FRENCH,  
JAMES FRENCH.