(No Model.)

L. HUSSEY.

AIR HEATER.

No. 411,382. Patented Sept. 17, 1889.

FIG. 2.

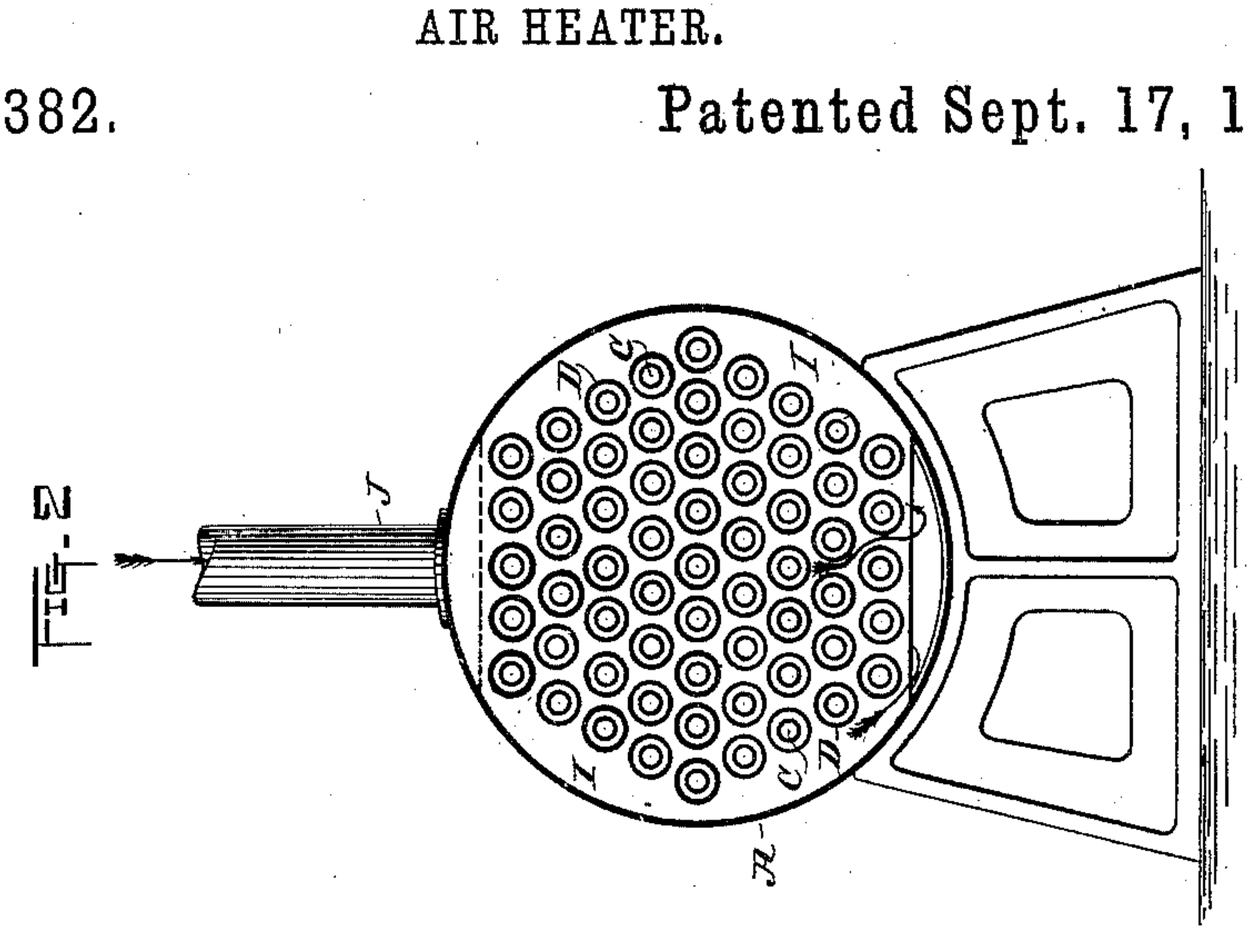
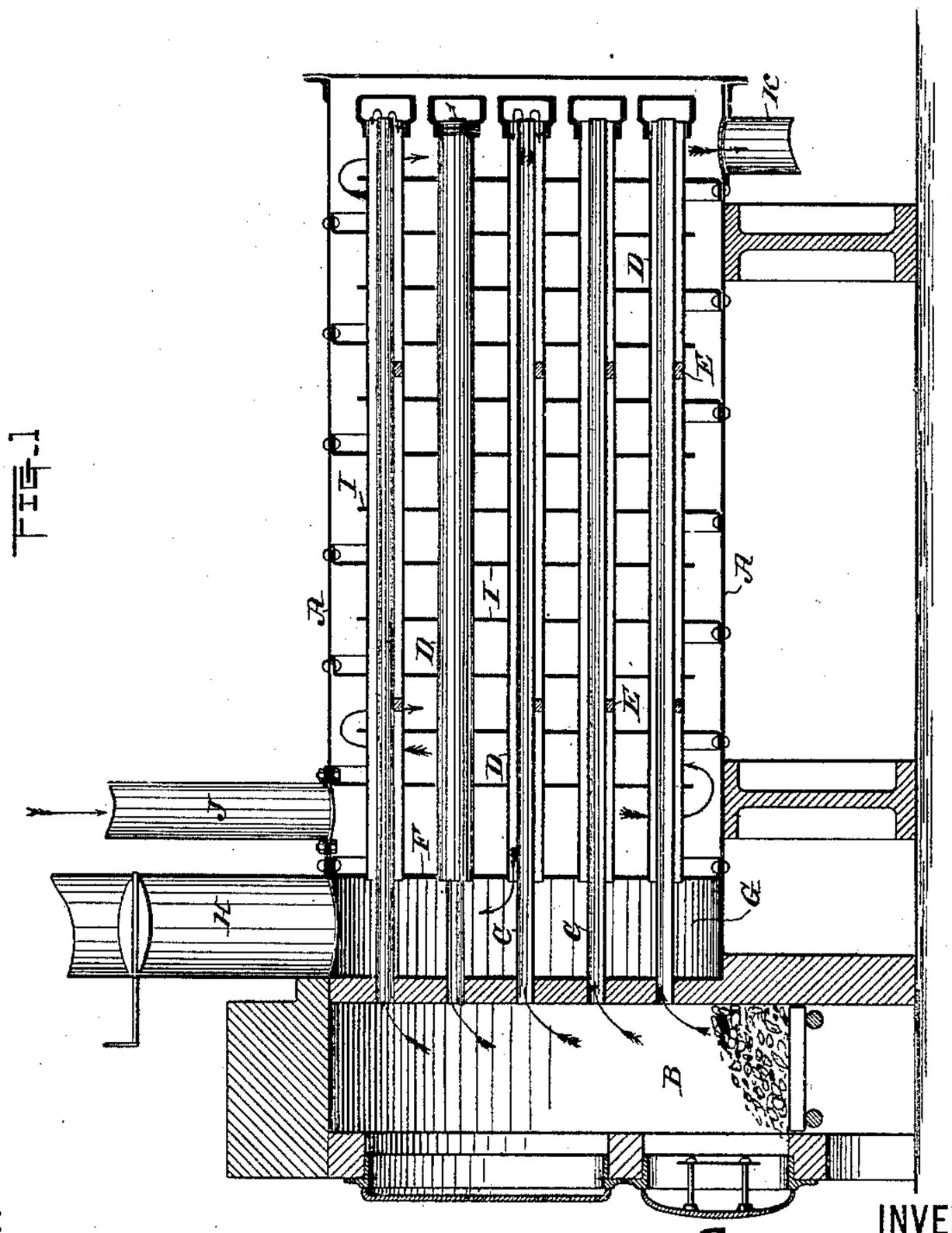


FIG. 1.



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LEVI HUSSEY, OF NEW YORK, N. Y.

AIR-HEATER.

SPECIFICATION forming part of Letters Patent No. 411,382, dated September 17, 1889.

Application filed August 10, 1888. Serial No. 282,441. (No model.)

To all whom it may concern:

Be it known that I, LEVI HUSSEY, of the city, county, and State of New York, have invented certain new and useful Improvements in Air-Heaters, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

This invention relates to apparatus for heating compressed air. It has special reference to apparatus in which the air is to be greatly compressed and heated to a high temperature. Thus, for example, the heater here illustrated is designed to compress or pack the air to an extent at which it will exert a pressure of about two hundred pounds to the square inch and have a temperature of five hundred degrees. For thus heating compressed air, a heater must be provided that will be capable of withstanding the very great strain due to the high heat and enormous pressure—a strain that none of the common forms of heaters can resist—and the heater must be constructed to have a heating capacity equal to the requirement of raising the air to so high a temperature.

My invention consists in a heater designed to satisfy these requirements, the features of improvement of which will be pointed out in the following description, and be specifically made the subject of the claims to follow the description.

In the drawings, Figure 1 is a longitudinal section of a heater embodying my improvements, and Fig. 2 is a cross-section of the same.

In the views, A represents the body or shell of the heater, such body part being a cylindrical structure composed of plates of sheet metal of suitable thickness properly shaped and riveted or otherwise secured together, so that the cylinder, as a whole, is capable of withstanding the pressure of the heated air.

B is a furnace, which may be of any suitable form so long as its heating capacity is sufficient for the purposes required. The back or head plate of this furnace is perforated for the flues C, which flues at this end are removably secured in such plate and extend into and nearly to the inner ends of the exterior flues D in the heater A, being supported at intervals by blocks E. The flues D are firmly secured in the inner head F of the cylinder, being closed at their inner ends, which are preferably slightly enlarged, as shown. The outer ends of these outer flues open into the smoke-chamber G, which communicates with the chimney H.

I represents diaphragms, which are secured to the interior of the cylinder in such manner as to divide the interior space of the cylinder into various compartments, which communicate with each other alternately at the top and bottom of the cylinder, so that the air in passing through the cylinder passes back and forth from the top to the bottom of the same. These diaphragms are pierced for the flues D, which they also support and hold in position.

J is the air-inlet pipe, which communicates with an air-pump or other machine adapted to suitably compress the air.

K is the outlet-pipe, which leads to the digester or apparatus where the heated and compressed air is to be utilized. This outlet-pipe may be provided with a valve constructed to regulate or control the air forced through it.

The heated gases of combustion pass from the furnace through the inner flues, and then returning through the outer flues into the smoke-chamber pass into the chimney, thereby heating the outer flues and the air that is circulating around their exterior surfaces. The number of the heating-flues and their size will of course be in accordance with the amount of heating-surface required and in proportion to the furnace, and the number of diaphragms will likewise be according to the temperature to which it is desired to raise the air—that is, they will be in sufficient number to constitute a passage of sufficient length and a heating-surface sufficiently long to insure the air being properly heated in passing through it.

By this construction the following advantages are secured: A large surface in a small apparatus is presented to the heated gases of combustion and to the current of air to be heated, so that practically all the available heat of the furnace is applied to the air without material waste by radiation and conduction, which is a matter of importance in apparatus

in which high temperature and pressure are to be attained. The particular arrangement of flues is also important, because thereby the cylinder, which must withstand a high internal pressure, is not subjected, as in common forms of air-heating apparatus, to the disruptive strains due to the variation of the heat of the furnace or to the difference of the temperature of the heating gases and the cold air entering the holder—that is, in order to prevent such expansion and contraction and the rupturing effects thereof upon the cylinder, it is essential that the heated gases as they come from the furnace be first applied to that part of the cylinder where the air is hottest, as also that the cold air shall enter where the gases of combustion have lost most of their heat and just before they pass away from the cylinder. Accordingly it should be noted that the air enters at one end of the cylinder and passes through the same to the other end, where its place of exit is, being gradually heated during the passage; also that the gases from the furnace pass through the smaller inner flues, which have small heating-surface, to the end of the cylinder where the air is hottest, and then escape into the inner ends of the larger outer flues, losing more and more of their heat as they pass to the end of the cylinder where the air enters. In this way the gases of lowest temperature are applied to heat the air of lowest temperature, and as the air moves through the cylinder it is gradually made hotter and hotter by passing over surfaces subjected to the hotter gases. Furthermore, where the greatest heat is applied to the air there is no fixed connection between the flues and the cylinder, and the effects of variation of temperature, which with fixed connections would at this place be most pronounced, are avoided. The furnace-flues are also readily removed from the cylinder for the purpose of clearing out or repairing the same, and the cylinder-flues are readily reached and removed after removing the head of the cylinder next the air-outlet.

With this construction of heater it is possible to practically and economically heat air to a higher temperature, and when confined at a higher pressure, than is possible with the common forms of heaters, and the reasons for this are, in the main, because of constructing the heater so that the strains due to very high temperatures and pressures are reduced to the minimum.

This construction may in various ways be modified without departing from the principle of the invention, the essential features of which consist of the furnace-flues removably arranged within the larger flues of the heater, the flues of the heater fastened to the heater only at the end where the air-inlet is, and the air inlet and outlet being respectively at the end of the heater next the furnace and the end farthest therefrom, as, also, when required, of the diaphragms within the heater for causing the current of air to pass many times laterally across the heater as it moves toward the outlet therefor.

What is claimed as new is—

1. The combination, in an air-heater, substantially as herein described, of the cylinder A, having the air-inlet J and air-outlet K, the flues D, fixed to the head of the cylinder at the air-inlet end thereof, the furnace B, and the furnace-flues C, movably arranged within the cylinder-flues.

2. The combination of the cylinder A, the flues D, fixed to the head F, the diaphragms I, arranged to conduct the air back and forth laterally across the cylinder, the furnace B, and the furnace-flues C, removably arranged within the flues D.

3. The combination of the cylinder A, having air inlet and outlet J and K, the flues D, secured to the cylinder at its air-inlet end only, the diaphragms I, for directing the air back and forth across the cylinder, the furnace B, and the furnace-flues C, arranged within the flues D.

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