(No Model.) 2 Sheets—Sheet 1.

W. A. KONEMAN.

APPARATUS FOR UTILIZING WASTE HEAT.

No. 469,860. Patented Mar. 1, 1892.

Fig. 1.

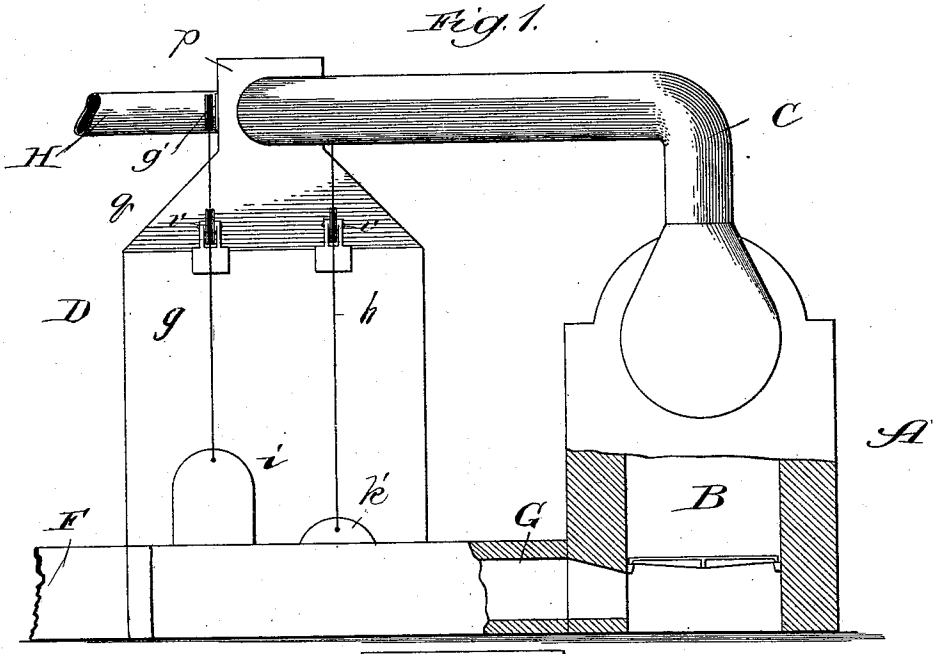
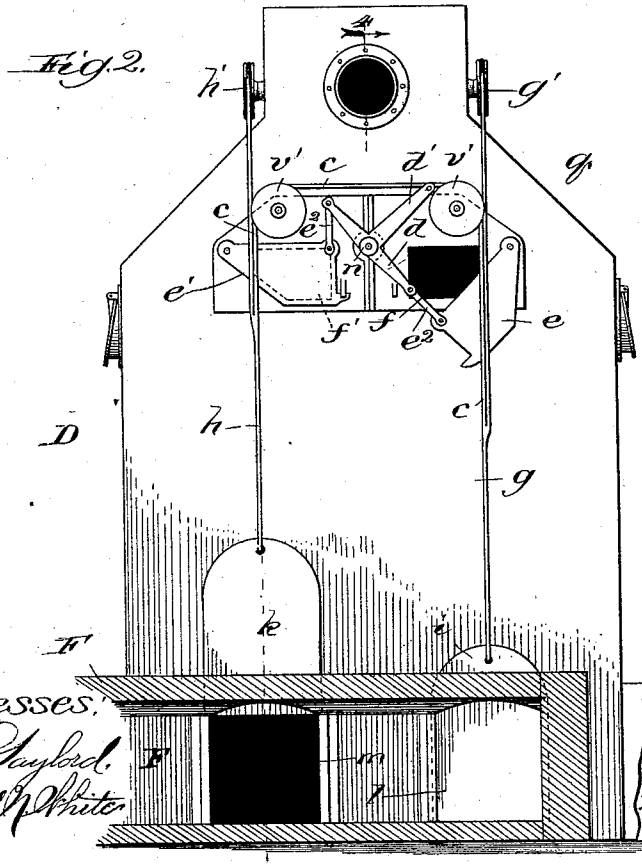


Fig. 2.



Witnesses:
Chas. E. Gaylord.
Clifford P. White.

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(No Model.) 2 Sheets—Sheet 2.

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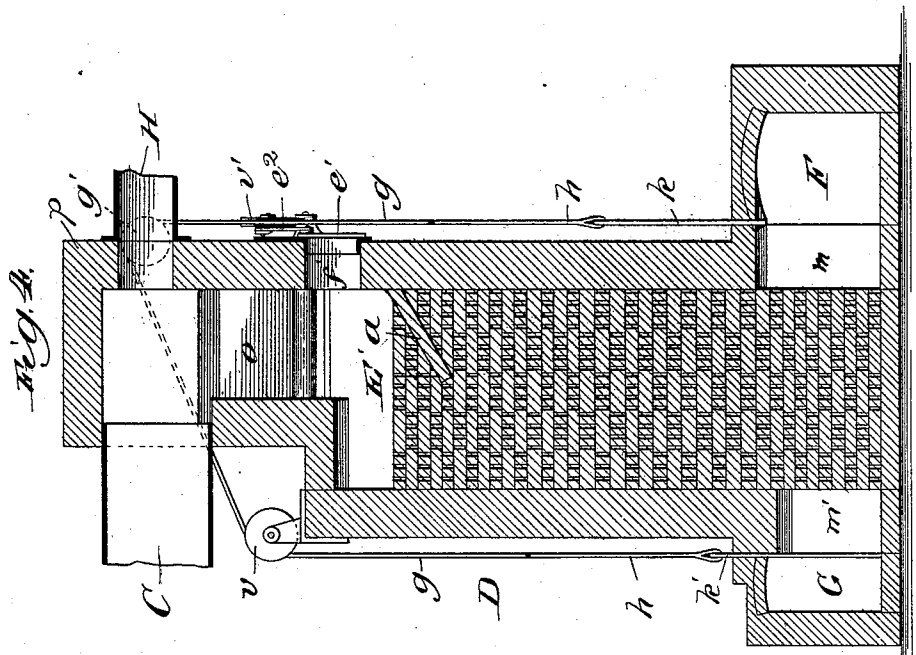

Fig. 4.

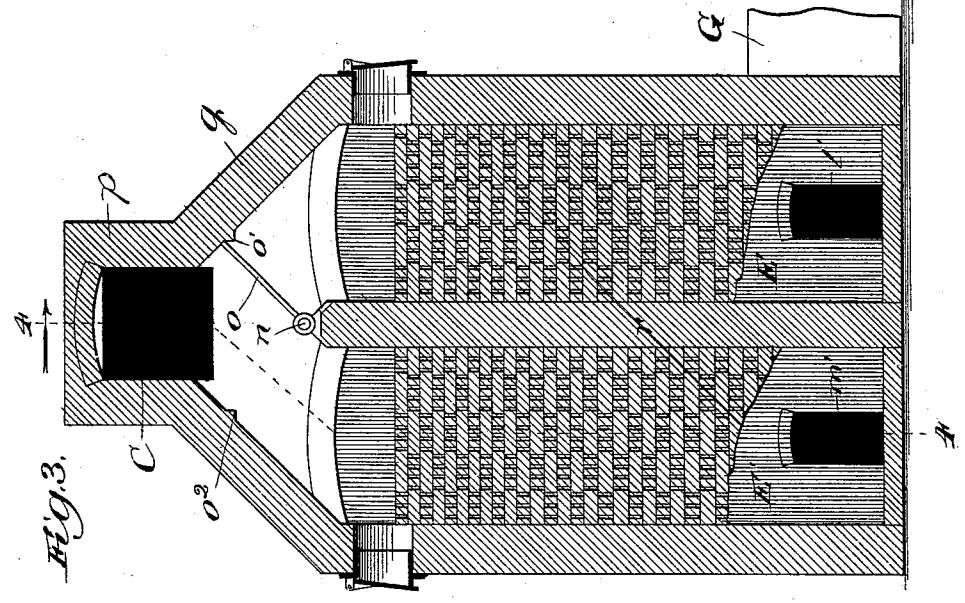

Fig. 3.

Witnesses:
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UNITED STATES PATENT OFFICE.

WILLIAM A. KONEMAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE CHICAGO HEAT STORAGE COMPANY, OF SAME PLACE.

APPARATUS FOR UTILIZING WASTE HEAT.

SPECIFICATION forming part of Letters Patent No. 469,860, dated March 1, 1892.

Application filed May 8, 1891. Serial No. 392,099. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM A. KONEMAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Waste-Heat-Utilizing Apparatus, of which the following is a specification.

The object of my invention is to provide an especially effective apparatus for utilizing the waste hot products of combustion on their way from a furnace or other heater to the stack for heating previous to its admission to such furnace air for promoting combustion of the fuel employed, thereby to attain the obviously resultant economy in fuel and incidentally to maintain the stack at a comparatively low temperature.

My invention consists in the general construction of my improved apparatus, and it also consists in details of construction and combinations of parts.

In the accompanying drawings, Figure 1 is a view, mainly in elevation, but partly broken and sectional, of my improved apparatus. Fig. 2 is a similar but somewhat enlarged view of the waste-heat utilizer, presenting the side opposite that shown in Fig. 1. Fig. 3 is a vertical section of the device illustrated in Fig. 2. Fig. 4 is a section taken on the line 4 4 of either Fig. 2 or Fig. 3 and viewed in the direction of the arrows.

The generally-stated plan of my improved apparatus is to have controllably communicating with the outlet or outlets for the products of combustion of a furnace or any number of furnaces, but extraneous therefrom, the waste-heat-utilizing device interposed in the course of the products of combustion to the stack and controllably communicating with the air-supply to it and through it to the furnace. The waste-heat-utilizer is divided into separate controllably-intercommunicating chambers, each of which contains an interstitial pile of non-combustible material, as checker-work of fire-brick. The waste products of combustion from the furnace or furnaces are caused to pass through, one at a time of these checker-chambers, to the stack, thereby giving off their heat to the checker-work, which is thereby reduced to a very hot state, so that when the products of combustion reach the stack they are greatly reduced in temperature, thereby avoiding excessive heating of the stack. When the checker-work in one of said chambers has attained the temperature of the hot products of combustion passed through it, so that it will take from them no more heat, the outlet from the furnace or furnaces is caused to communicate with the stack through the other checker-chamber to heat it in the same manner. At the same time the chamber already heated, as described, is caused to communicate from one end with the air-supply and from the other end with the combustion-chamber of each furnace to cause the air to be heated by the checker-work on its course to such combustion-chamber. Thus each of the checker-chambers is alternately heated by and utilized to give up its heat abstracted from the waste products of combustion to be reconveyed with the air to the combustion-chamber of each furnace in the system. But one waste-heat utilizer is required for any desired number of furnaces, though the capacity of each chamber or of the utilizer should be in proportion to the entire waste-heat-flue area and the aggregate of interstices in the checker-chamber should be about one-fifth greater than the waste-heat-flue area to allow for friction through the interstices of the checker-work.

Following is a detailed description of my improved apparatus employed with only one furnace, as shown, though with the foregoing explanation its employment with a number of furnaces will be readily understood.

A is the furnace, of which B is the combustion-chamber, and C is the outlet-pipe for the products of combustion.

D is the waste-heat utilizer. It comprises a structure, preferably rectangular in cross-section, located between the stack (not shown) and the furnace, and divided vertically by a partition *r*, extending to the head *q* into two chambers filled with spaced fire-brick, as shown, and forming checker-chambers E and E′ for storing waste heat, as hereinafter described. The head *q* terminates in a crown *p*, into which the pipe C leads. In the head *q* at the upper end of the partition *r* is a valve *o* on a rock-shaft *n*, journaled at opposite sides of the structure and protruding be-

yond one side of the same, as shown in Fig. 2, for a purpose hereinafter described. At the one side of the base of the utilizer D is a horizontal flue F, passing ports *m* and *l* in the adjacent side of the said base and leading to the stack. (Not shown.) Valves *k* and *i* are supported to be raised and lowered in suitable guides with relation to the ports *m* and *l* to open and close them to the flue F.

G is a horizontal flue extending across the base of the opposite side of the utilizer D and leading to the combustion-chamber B of the furnace A. In this side of the said base are ports *m'* and *l'*, corresponding with the ports *m* and *l* and opening into the flue G, which passes them, and, like the ports *l* and *m*, having their communication with the adjacent flue controlled by valves *k'* and *i'*. The valves *k* and *k'* are connected together by a cable *h*, passing over a guide-pulley *h'*, supported to extend from a side of the crown *p*, and the valves *i* and *i'* are similarly connected by a cable *g*, passing over a pulley *g'*, supported to extend from the opposite side of the crown, other pulleys *v* being provided to guide the cables over the head.

In one side of the utilizer D, (see Fig. 2,) near its upper end, or in the head portion *q* thereof, are ports *f* and *f'*, leading, respectively, from the air-supply (or outer air) into the chambers E and E', and having pivoted adjacent to them the covers or valves *e* and *e'*, connected from corresponding points, where links e^2 extend from them, with opposite ends of a lever *d*, secured at its center to the protruding end of the rock-shaft *n*. The lever *d* has extending from it transversely an arm *d'*, which renders it a double bell-crank. Above the ports *f* and *f'* are guide-pulleys *v'*, over which extends a branch cable *c*, connecting the two cables *h* and *g*, and with the cable *c* is connected the arm *d'* of the bell-crank.

From the foregoing description of the apparatus the operation will be understood to be as follows: The valve *o* is adapted to be turned by the shaft *n* from the position shown of bearing at its free end against a stop *o'*, Fig. 3, wherein it shuts off the chamber E from the pipe C and opens communication of the latter with the chamber E' to the position of so bearing against the stop o^2, wherein it opens communication to the chamber E from the pipe and closes that from the pipe to the chamber E'. Turning of the shaft *n* to throw the valve *o* is produced by properly pulling the cables *h g*. Thus to have thrown the said valve to the position illustrated the pull may have been exerted on the cable *g*, and the effect thereof was not only to throw the valve *o* through connection of the bell-crank with the branch cable *c*, but also to lower the valve *i* and raise the valve *i'*, thereby closing the port *l* to the stack-flue F and opening the port *l'* to the air-flue G and to raise the valve *k* and lower the valve *k'*, thereby opening the port *m* to the stack-flue and closing the port *m'* to the air-flue. A further result of the operation described was, by the resultant action of the lever *d*, to open the air-inlet port *e* and close the port *e'*, so that the ultimate result produced was to enable the hot products of combustion from the pipe C to pass through the checker-chamber E' and out to the stack by way of the flue F, thereby heating the checker-work, and to admit air into the chamber E and direct it through the latter to the combustion-chamber of the furnace by way of the flue G. If, as is to be supposed, the chamber E has been previously heated in the manner the chamber E' is being heated, the air passed through it will be heated on its way to the furnace.

It should be stated that I provide in the upper end of each checker-chamber a deflector *a*, Fig. 4, extending from one side thereof to prevent the draft from drawing the products of combustion through only a portion of the brick-work, which would prevent uniform heating thereof and entail loss of the heat. The mechanism is thus adapted to be operated to induce the passage of products of combustion and that of air through each checker-chamber, the former to the stack and the latter to the combustion-chamber through each of the checker-chambers, the periods at which the changes are made being dependent on the condition as to temperature of the air-heating chamber—that is to say, the latter is continued as such until its heat is to such an extent abstracted by the air passing through it that it requires reheating, when the other chamber, meantime heated, is made the air-heater. With the apparatus employed by me I make the change about every hour.

The pipe H (shown as entering the crown *p* at the side thereof opposite the entrance of the pipe C) is for an auxiliary purpose—namely, that of conveying from a producer (not shown) waste fuel-gas, in case that be the fuel employed for the furnace A and the latter be of a kind adapted to be heated with the gas. The opportunity for using such "waste" gas for heating the chambers would arise whenever the fuel-supply to the furnace and as a consequence the operation of the producer are discontinued temporarily, when, of course, the distillation of gas in the producer is not stopped immediately, but continued until the material (coal) has been used up. The product thus arising I refer to by the term "waste" gas, which, instead of being wasted, serves for heating the checker-chambers. It also serves to burn out any soot that may be deposited in the interstices of the checker-work.

The flues F and G, instead of being provided at opposite sides of the structure D, may be on the same side thereof and, if desired, imposed one on the other. Changes such as these are too obvious to require illustration.

What I claim as new, and desire to secure by Letters Patent, is—

1. In combination with a heater, a waste-

heat-utilizing apparatus D, separate and extraneous from the heater and interposed between it and the stack and comprising checker-chambers E and E′, separated by a wall *r* and provided with an air-supply port at the inlet end and with ports *m* and *l* and *m′* and *l′* at the outlet end, a flue C, leading from the discharge end of the heater to the inlet end of the checker-chambers, a stack-flue F, leading from the said checker-chambers past the ports *m* and *l* to the stack, valves *k* and *i* for controlling communication between the flue F and chambers E and E′ through the ports *m* and *l*, a hot-air flue G, leading from the said chambers past the ports *m′* and *l′* to the heater and provided with valves *k′* and *i′* for controlling communication between it and the chambers through the ports *m′* and *l′*, and a valve *o*, interposed between the checker-chambers at their inlet end and connected with the said valves of the other ports of the apparatus and operating through said connection by turning it to produce simultaneously communication of the flue C with the stack-flue F through one chamber and of the hot-air flue G through the other chamber with its air-inlet port, substantially as described.

2. In combination with a heater A, a waste-heat utilizer D, divided by a wall *r* into chambers E and E′, containing interstitial piles of incombustible material and having a common inlet in the upper part of the structure, into which the pipe C from the heater leads, air-inlet ports *f* and *f′*, leading into the chambers and provided with valves *e* and *e′*, a valve *o*, supported above the wall *r* on a rock-shaft *n*, carrying a lever *d*, with which the valves of the air-inlet ports are connected, a flue F, leading to the stack from one side of the base of the device D and communicating with the chambers through ports *m* and *l*, having valves *k* and *i*, and an air-flue G, leading to the heater from the opposite side of the device D and communicating with the chambers through ports *m′* and *l′*, having valves *k′* and *i′*, connected, respectively, with the valves *k* and *i* and with the lever *d*, the whole being constructed and arranged to operate substantially as described.

WILLIAM A. KONEMAN.

In presence of—
J. W. DYRENFORTH,
M. J. FROST.