(No Model.) 5 Sheets—Sheet 1.

B. W. TAYLOR.

WATER AND AIR HEATER.

No. 576,628. Patented Feb. 9, 1897.

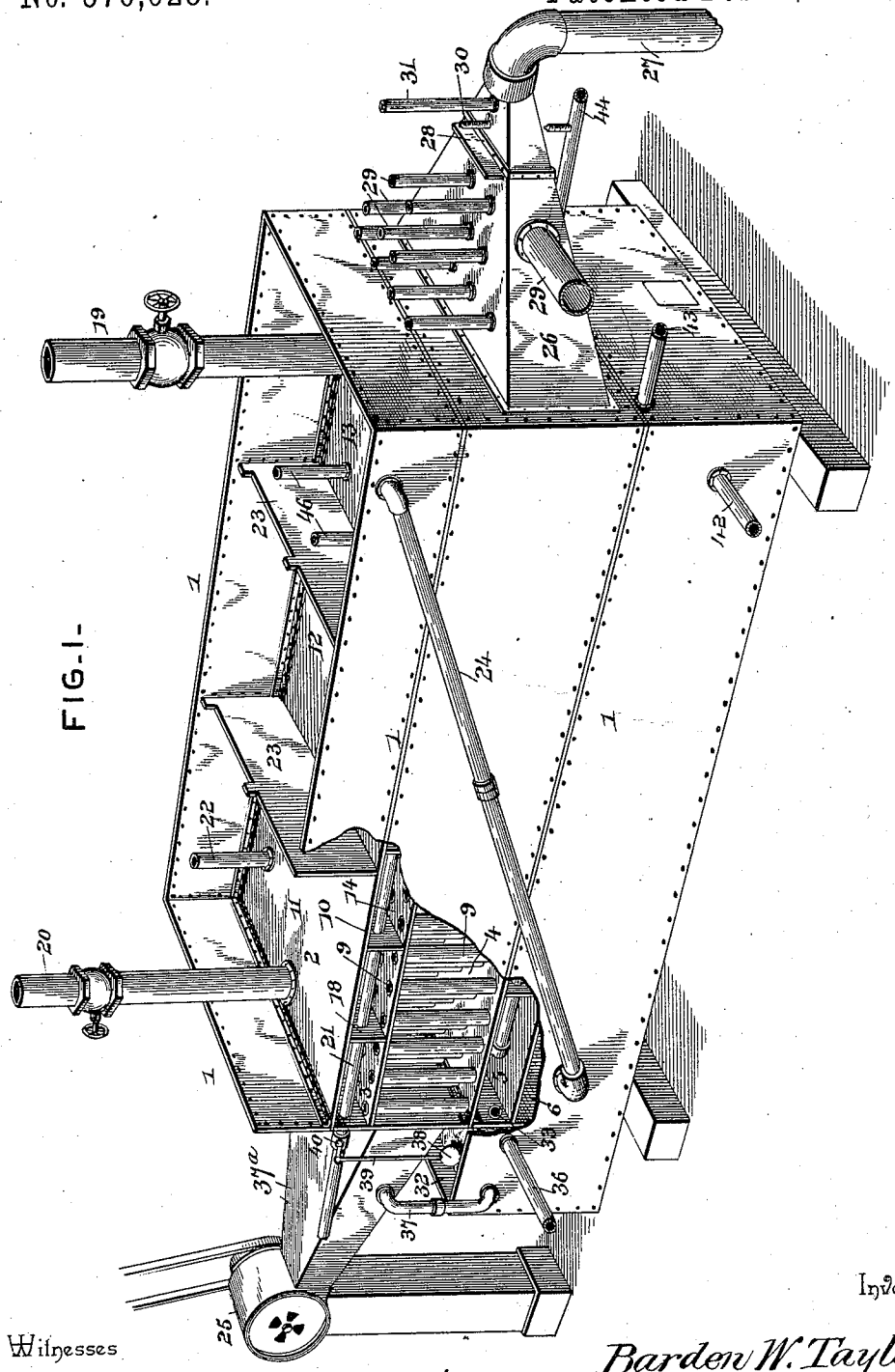

FIG. 1.

Witnesses

Jas. K. McCathran

V. B. Hillyard.

Inventor

Barden W. Taylor

By his Attorneys.

C. A. Snow & Co.

(No Model.) 5 Sheets—Sheet 2.

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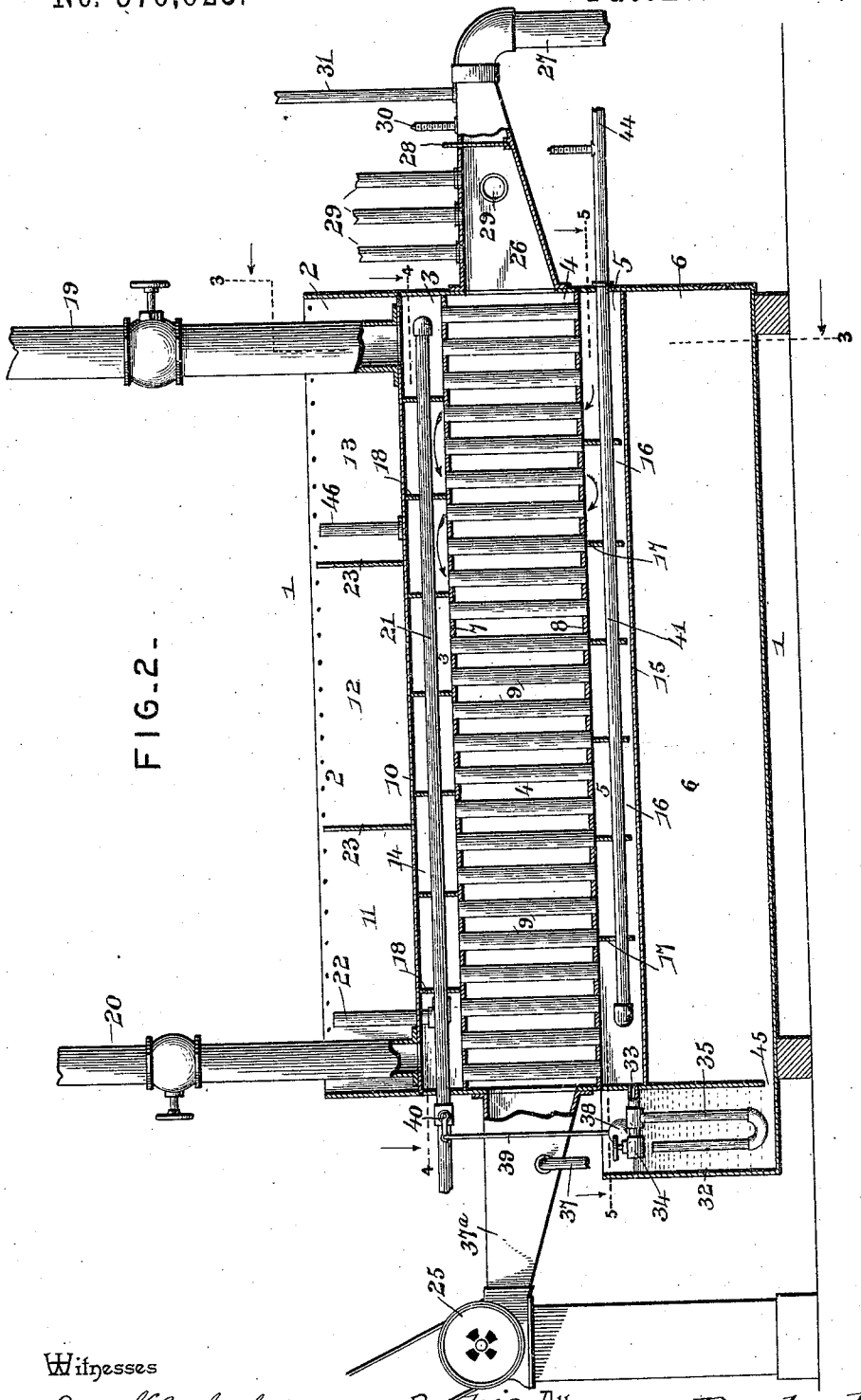

FIG. 2.

Witnesses
Jas. L. McCathran
V. B. Hillyard.

Inventor

By his Attorneys, Barden W. Taylor
C. A. Snow & Co.

(No Model.) 5 Sheets—Sheet 3.

B. W. TAYLOR.

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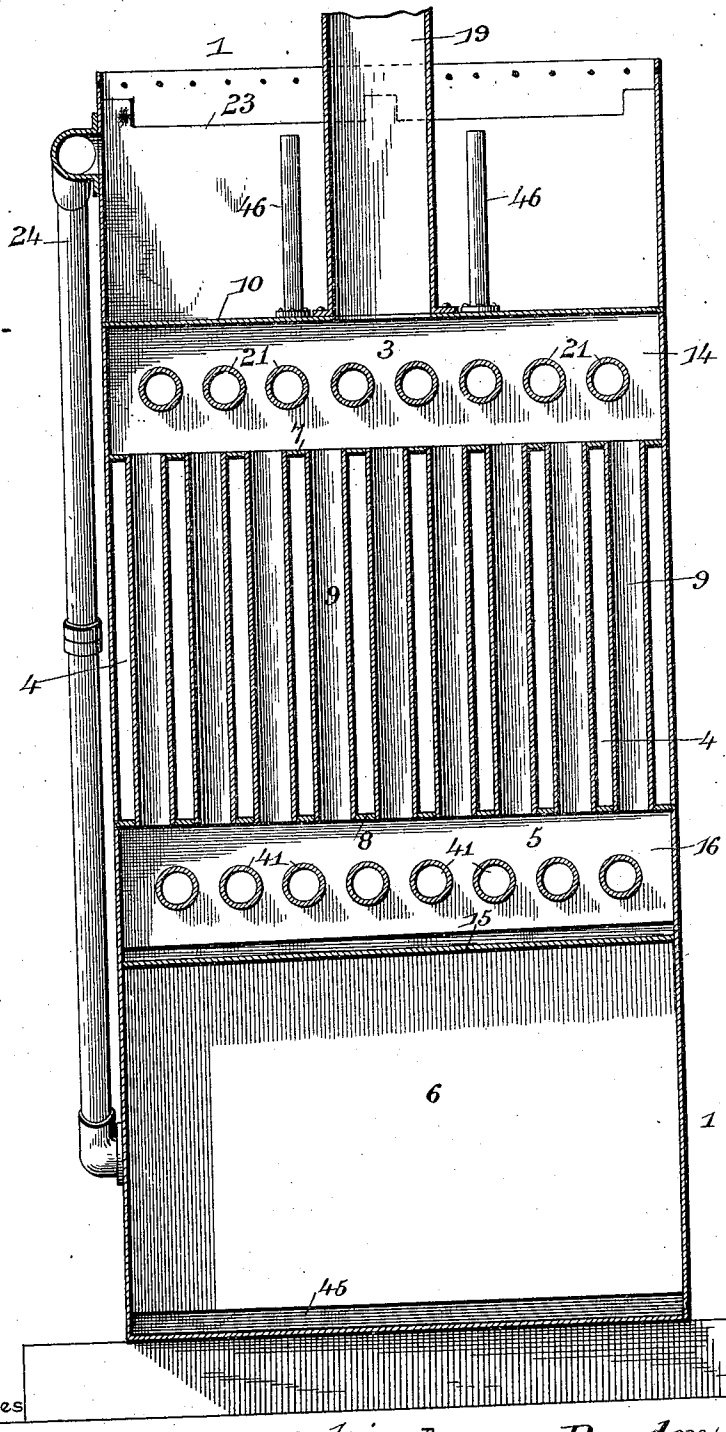
FIG. 3.



Witnesses
Jas. K. McCutchan
V. B. Hillyard.

Inventor
By his Attorneys, Barden W. Taylor
C. A. Snow & Co.

(No Model.) 5 Sheets—Sheet 4.

B. W. TAYLOR.

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FIG. 4.

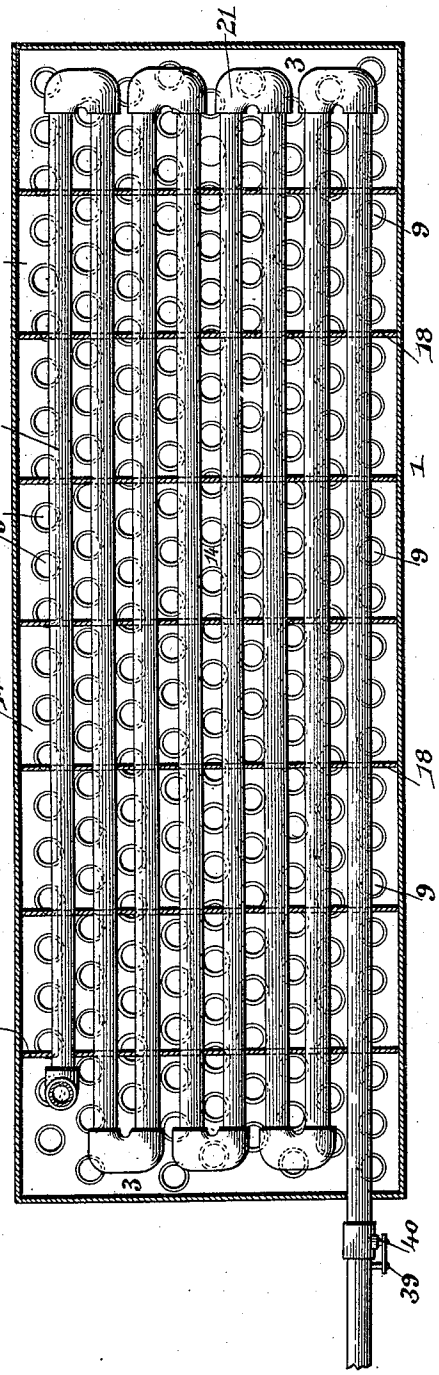
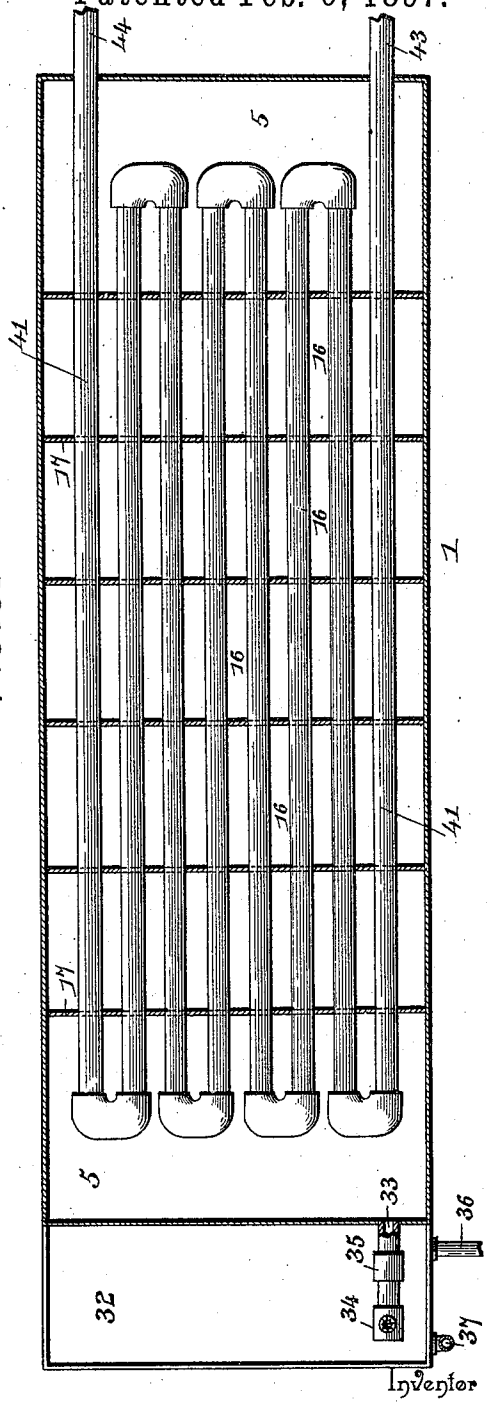


FIG. 5.



Inventor

Witnesses

Jas. K. McCathran

U. B. Hillyard.

Barden W. Taylor

By his Attorneys,

C. A. Snow & Co.

(No Model.)

5 Sheets—Sheet 5.

B. W. TAYLOR.

WATER AND AIR HEATER.

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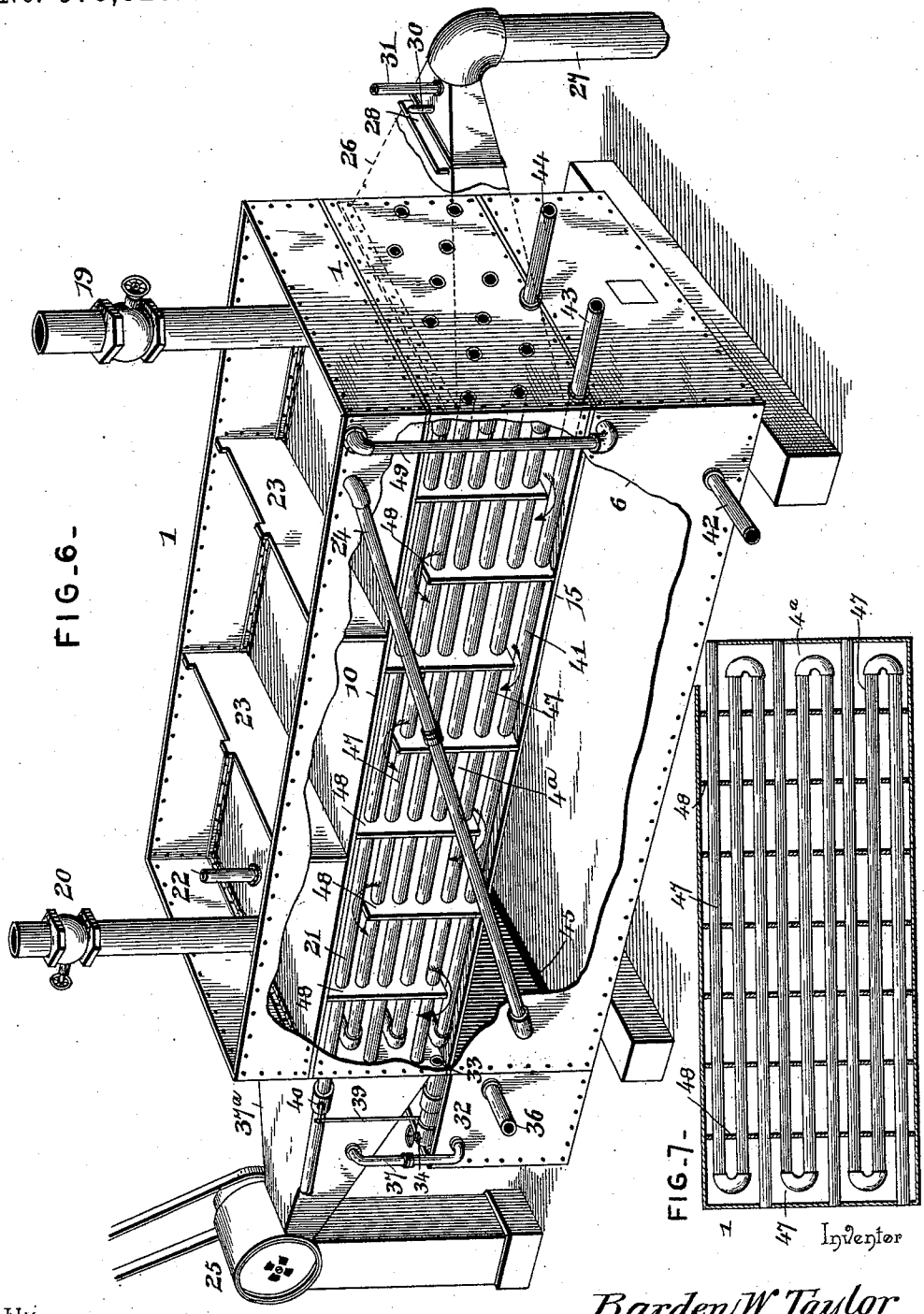

FIG. 6.

FIG. 7.

Witnesses
Jas. K. McCathran
V. B. Hillyard.

Inventor
Barden W. Taylor
By his Attorneys,
C. A. Snow & Co.

UNITED STATES PATENT OFFICE.

BARDEN WALTON TAYLOR, OF DENVER, COLORADO.

WATER AND AIR HEATER.

SPECIFICATION forming part of Letters Patent No. 576,628, dated February 9, 1897.

Application filed April 15, 1896. Serial No. 587,683. (No model.)

To all whom it may concern:

Be it known that I, BARDEN WALTON TAYLOR, a citizen of the United States, residing at Denver, in the county of Arapahoe and State of Colorado, have invented a new and useful Appliance for Utilizing Exhaust-Steam and Waste Products of Boiler-Furnaces, of which the following is a specification.

This invention has for its object the provision of an apparatus to arrest and hold in a continuous round of service, as a motor, heat and vapor of exhaust-steam and utilize other waste products of boiler furnaces; to purify the water of condensation by eliminating therefrom all oil and grease; to precipitate all mineral and other matter from the feed-water prior to admitting it into the boiler, whereby incrustation is obviated or reduced to a minimum; to supply the necessary air to the water of condensation, whereby explosion from a deficit of air is avoided and economy in the consumption of fuel is secured; to supply the water to the boiler at a temperature beyond the boiling-point, and, lastly, to reduce the consumption of the fuel to a minimum and to provide a contrivance for attaining all the ends aforesaid in an effective and practicable way.

For a full understanding of the merits and advantages of the invention reference should be had to the accompanying drawings and the following description.

The improvement is susceptible of various changes in form, proportions, and the minor details of construction without departing from the principle or sacrificing any of the advantages thereof, and to a full disclosure of the invention an adaptation thereof is shown in the accompanying drawings, in which—

Figure 1 is a perspective view of the invention, the top being removed and parts being broken away to show the relative arrangement of the parts. Fig. 2 is a vertical longitudinal section of the invention. Fig. 3 is a transverse section on the line 3 3 of Fig. 2, looking to the left. Fig. 4 is a section drawn on the line 4 4 of Fig. 2. Fig. 5 is a horizontal section on the line 5 5 of Fig. 2. Fig. 6 is a perspective view of an apparatus for effecting the objects of this invention of more simple construction and having the parts differently related. Fig. 7 is a plan view of a layer of the bank or series of horizontal pipes entering into the formation of the apparatus illustrated in Fig. 6, the casing and vertical baffle-plates being shown in section.

In addition to the advantages enumerated others are contemplated and will appear to those skilled in the art as the invention is comprehended; and to this end reference is to be had to the designating characters of the figures of the drawings and the following description, in which like numerals denote similar and corresponding parts.

The invention appears in the form of an oblong box 1, having a series of horizontal compartments, preferably five, 2, 3, 4, 5, and 6, with their several subdivisions, each working out an essential part of the final result of returning the heat of exhaust-steam back to the boiler and furnace and converting the same into effective energy for future service.

The central or middle section 4 is the air-chamber provided to arrest and return the heat of exhaust-steam. This section 4 is comprised between upper and lower flue-sheets 7 and 8, of steel, spaced about eighteen inches apart and connected by upright flues 9, alternately arranged or staggered. These flues 9 have their ends expanded into the flue-sheets, so as to provide a substantial and firm joint. Above the upper flue-sheet 7 is set the upper horizontal baffle-plate 10, which forms the bottom of the three settling-basins 11, 12, and 13, located in the compartment 2. These settling-basins are over a succession of steam-chambers 14, which are formed by means of upright baffle-plates 18, placed between the upper flue-sheet 7 and the upper horizontal baffle-plate 10. Immediately below the air-chamber is arranged the lower horizontal baffle-plate 15, forming with the flue-sheet 8 the compartment 5, which is cut into a succession of return steam-chambers 16 by upright baffle-plates 17. The upper and lower upright baffle-plates 18 and 17 are so set that the lower one to the right sets out from the right-hand end of the box and cuts the second chamber above in the center, so that the exhaust-steam coming in at the pipe 19 above is received in the first chamber of the series 14. This first chamber is three times the capacity of the exhaust-pipe 19 to allow for the expansion of steam and prevent back pres-

sure on the engine. The steam driven down through the first section of upright flues 9 on the right enters the first of the series of return steam-chambers 16 and is checked by the lower horizontal baffle-plate 15, and at the first upright baffle-plate 17 the steam is turned up through other upright flues into the second steam-chamber of the series 14 and is thus driven down and up to the left by these return steam-chambers 14 and 16 and upright flues 9 until it reaches the last chamber of the series 14 above, and if there is any steam not condensed it passes out at the escape-pipe 20. The steam on its winding way or zigzag course through these upright flues and chambers from right to left in this box performs four essential offices in the results sought. The cold and impure water to make up the deficiency of pure feed-water made by diverting steam from the boiler for heating purposes passes through an upper coil 21 back and forth and flows out at 22 into the settling-basin 11. In this settling-basin 11 the coarse sediment held in suspension by the water is precipitated and the water is raised to a temperature of about 190° and flows over a baffle-plate 23 into the settling-basin 12 and has its temperature raised to 200° and the finer flour of lime and gypsum is precipitated, and again the water flows over a baffle-plate 23 into the settling-basin 13 and from thence into a pipe 24 to the compartment 6, which is a pure-water tank.

By having the coil of pipe 21 enveloped in steam all along in section 3 and the repeated action of the steam playing up and striking the under side of the upper horizontal baffle-plate 10 the deficit of feed-water is purified and the impurities that form crust in boilers are precipitated in the settling-basins 11, 12, and 13, from which they can be removed with little trouble by the use of a shovel. The distance traveled through the upright flues and the upper and lower return steam-chambers will be extensive, aggregating about sixty feet in length, and the steam acting on the surface of all the flues and the surface of the upper and lower flue-sheets is exposed to about three hundred and forty square feet of iron surface, that absorbs the heat of the steam and transmits it into the space between the upright flues, and a fan 25, kept in action at about sixteen hundred revolutions per minute, moves the heat out into a collector 26 and on through a conveyer 27 into the furnace to promote combustion of fuel, since this air for supporting combustion is raised to about 250° of heat by exhaust-steam. The rule developed by heat conservators is that 100° of heat returned is ten per cent. of fuel saved.

The attachment or collector 26 works out several useful results, and is supplied with a gate 28, and when dry hot air is wanted for drying or heating purposes this gate is shut down and the hot air is forced by the fan out through openings 29 to where it is wanted. A thermometer 30, to determine the temperature of the hot air going to the furnace or dry-kiln, is located on the top of the collector.

31 is a pipe bringing in the exhaust-steam from the hot-water pump. By this steam from the pump the deficit of oxygen in air is made up and combustion is completed, provided always that the hot oxygenized air is let in through a hollow bridge-wall of the furnace with openings upward, so as to distribute the oxygenized air evenly across the furnace to catch all the receding incandescent particles of carbon before they cool down below a kindling temperature.

The lower horizontal baffle-plate 15 receives all the condensed water from the steam and with it the oil coming in the steam from the cylinder-head. This oil is dangerous and must be removed, and to do this the lower upright baffle-plates 17 are lifted one-half inch from the horizontal baffle-plate 15, and the device is tilted in setting one-half inch to the left to force the reduced water to flow into the oil-extractor 32.

33 is a pipe that lets the condensed water and oil through the valve 34, which is kept closed, and the water flows down and up through a U pipe or trap 35, and the oil finally rises and floats on the top of the water in the extractor or separator 32, where the oil accumulates and separates from the last traces of water and is drained out at 36. The pipe 37, connecting the fan-spout 37^a and the oil-extractor 32, serves two very important purposes—first, to separate the oil from the reduced water, and, second, to restore the reduced water to its normal condition for producing steam. The left leg of the water-trap 35 in the oil-extractor terminates about two inches below the surface of the water, and the reduced water coming up through it spreads out all over the surface, and the cold air driven in by the fan through the pipe 37 spreads all over this water and cools the oil sufficiently to liquefy it, when it separates and floats on the water and is driven out through 36, and at the same time this cold fresh air from the fan aerates the reduced water and restores it to its normal condition to produce steam.

There is a certain but unknown quantity of air in water, and every time it is raised to steam and condensed a portion of this air is expelled, and as the air is expelled more fuel is required to convert the water into steam. When all the air is expelled, the water will not be converted into steam at all, but when it is raised to about 300° it explodes with the force and fury of giant-powder. This device prevents a waste of coal and this danger of explosion and assists in separating the oil from the condensed water. As the air is driven out of feed-water it requires more and more coal to keep up steam, and after the air is eliminated and a temperature of 300° is reached the crash of an explosion comes and the destruction of life and property follows. The greater part of the oil is kept back by the

upright baffle-plates until the valve is opened and the water is lowered, and water and oil flow under the upright baffle-plates and out through the valve into the oil-extractor, where, while the engine is stopped, the oil gathers and passes out at 36. The condensed water that is constantly delivered through the trap 35 finds its way into the feed-water tank 6 through an opening 45 at the bottom.

A bulb or float 38 has its stem 39 attached to a faucet 40, which regulates the feed-water going into the coil 21. In compartment 5 is placed a coil 41 of two-inch pipes for the purpose of superheating the feed-water. The hot-water pump takes the feed-water out of tank 6 at 42 and forces it into this coil at 43 at a temperature of 210°, and the water being under pressure and subjected to the heat of the exhaust-steam playing on the coil has its temperature considerably raised. The steam playing upon the upper and the lower coils brings the feed-water for boilers out at 44 fully up to the temperature and elastic driving-power of the exhaust-steam. Water under pressure in pipes or boilers after it is raised above 212° temperature is compressed steam. This device feeds boilers with compressed steam far above 212° or boiling-temperature. At sea-level this device holds 400° of the heat of exhaust-steam as a perpetual motor on and after the steam-gage on the boiler registers sixty pounds pressure and a relative quantity above and below that pressure. A reliable rule for coal saving is that 100° of heat returned is ten per cent. of fuel saved. This 400° of heat returned is therefore forty per cent. of fuel saved.

The settling-basins of the compartment 2 are prevented from flooding by locating one or more relief-pipes 46 in the said compartment and connecting them with the baffle-plate 10, the upper end of this relief pipe or pipes terminating a short distance from the top or cover of the box.

In the form of apparatus shown in Fig. 6 the fan, the oil-extractor, the collector, and the settling-basins are identical with the corresponding elements herein fully described and illustrated, and the like parts are indicated by the same reference-characters. In this structure the flue-sheets 7 and 8 are omitted, together with the baffle-plates 17 and 18 and the upright flues 9, and are substituted by a bank of pipes 47, which are horizontally disposed and communicate at their opposite ends with the fan through the connection 37^a and the collector 26. The coils 21 and 41 are retained and are located adjacent to the respective baffle-plates 10 and 15, the bank of pipes 47 being located between them. The pipes 47 are arranged at different levels and those of each level are subdivided into sections or groups of three, which communicate at their opposite ends with the fan and the collector. Vertical baffle-plates 48 are alternately related, so as to compel the exhaust-steam entering through the pipe 19 to pass through the middle compartment 4^a in a zig-zag direction, as indicated by the arrows, thereby insuring a utilization of the waste product. These baffle-plates 48 are spaced a proper distance apart, and the top edges of the alternate ones touch the baffle-plate 10, and the lower edges of the intermediate ones touch the baffle-plate 15, thereby leaving spaces at the opposite ends of adjacent baffle-plates, as shown. The baffle-plates 48 have openings through which pass the individual pipes of the bank of pipes 21, 47, and 41, and they serve to support and maintain the various pipes at fixed distances apart.

In the apparatus shown in Fig. 6 the exhaust-steam passes around and among the pipes 21, 47, and 41, and the air to be heated is forced through the pipes 47, thereby differing in operation from the construction illustrated most clearly in Fig. 2, in which the exhaust-steam is compelled to pass through the upright flues 9 and the air to be heated around and among the said flues. A relief-pipe 49 connects the upper portion of the compartment 1 with the upper portion of the compartment 6, so as to obviate pressure upon the surface of the water in the compartment 6 and the consequent overflow over the edges of the oil-extractor by providing for the escape of any steam which may tend to collect in the upper portion of the compartment 6 into the compartment 1, as will be readily understood.

Having now fully illustrated and explained each general compartment and coöperative subdivision of the invention, and how all these five coördinate divisions and their dependent subdivisions work out the final result of arresting and holding in one continuous round of service the heat of exhaust-steam and utilizing other lost products of boiler-furnaces, and the plan of purifying feed-water without the use of chemicals, and the plan of supplying the deficit of oxygen from exhaust-steam to complete the combustion of fuel, including smoke, I will now state what I claim and what I desire to have protected by Letters Patent:

1. In combination, a compartment subdivided to provide a series of communicating settling-basins, a compartment immediately below the settling-basins and in communication with the last settling-basin of the series, means for circulating exhaust-steam or other waste-heat product through the lower compartment, and a coil of pipe located within the lower compartment and having communication with the first settling-basin of the series, substantially as and for the purpose set forth.

2. In combination, upper and lower compartments, baffle-plates subdividing the lower compartment into a series of chambers, means for passing exhaust-steam or other waste-heat product through each of the said chambers, and a coil of pipe located in the lower compartment and supported and held in place

by passing through openings in the said baffle-plates, and having one end in communication with a water-supply, and having its opposite end opening into the upper compartment, substantially as set forth.

3. In combination, an upper compartment subdivided into a series of settling-basins, a lower compartment in communication with the last settling-basin, an upper and a lower coil of pipe confined between the upper and lower compartments, the upper coil of pipe extending into the first of the series of settling-basins, and means for circulating or passing exhaust-steam or other waste-heat product through the inclosure formed between the upper and lower compartments, substantially as and for the purpose set forth.

4. In combination, a compartment, a bank of flues or pipes located in the compartment, baffle-plates subdividing the said compartment, independent means for passing air and exhaust-steam through the said compartment, and a separator in communication with the lowest point of the said compartment to receive the water of condensation and remove the oil therefrom, substantially as set forth.

5. In combination, a compartment having its bottom inclined toward a given point, baffle-plates subdividing the compartment into a series of chambers and having their lower edges arranged a short distance from the bottom of the compartment, a separator in the plane of the compartment, and a pipe communicating with the lowest point of the compartment and having a trap located in the separator, substantially as and for the purpose set forth.

6. In an apparatus for converting exhaust-steam into motive power and utilizing other waste-heat products of boiler-furnaces and engines, the combination of a compartment subdivided into a series of settling-basins, a second compartment disposed contiguous to the first-mentioned compartment, a coil of pipes located in the second compartment and opening into the first compartment, and means for circulating exhaust-steam through the second compartment and around the coil of pipes therein, substantially as set forth for the purpose described.

7. In combination, a water-compartment, a separator contiguous to and having communication at its lower end with the compartment, a second compartment placed above the first compartment and adapted to have the exhaust-steam passed therethrough, a trap located in the separator and communicating with the second compartment and receiving the water of condensation therefrom, and means for supplying a blast of air to the separator to facilitate the separation of the oil and aerate the condensed water, substantially as and for the purpose set forth.

8. In combination, a settling-compartment, a water-compartment located below the settling-compartment and in communication therewith, an intermediate compartment subdivided by baffle-plates, means for passing exhaust-steam through the intermediate compartment, a coil of pipe in the intermediate compartment and communicating with the settling-compartment, a separator in communication with the water-compartment, and a float operated by the change of water-level in the separator to open or close a controlling-valve in the aforesaid coil of pipe, substantially as and for the purpose set forth.

9. In combination, a settling-compartment, a steam-compartment to receive the exhaust-steam, a water-compartment, a separator in communication at its lower end with the water-compartment and having connection with the settling and the steam compartments, a trap located in the separator and adapted to have the water of condensation passed therethrough, a coil of pipe extending through the steam-compartment and opening into the settling-compartment, and having a faucet in its length, and a float operating in the separator and adapted to control the faucet to regulate the supply of water to the settling-compartment, substantially as set forth.

10. The herein-described apparatus for utilizing exhaust-steam and similar waste products, the same embodying in its organization a middle compartment supplied with a vertical set of flues, a fan communicating with one end of the said compartment, a collector having connection with the opposite end of the said compartment and provided with a cut-off and branch pipes, a second compartment placed above the first compartment and subdivided into a series of steam-chambers by vertically-arranged baffle-plates, a third compartment placed below the first compartment and subdivided by various baffle-plates into a series of steam-chambers, the baffle-plates of the third compartment alternating in position with the baffle-plates of the second compartment and having a space at their lower edges, a coil of pipe in the third compartment, a fourth compartment placed above the second compartment and subdivided into a series of communicating settling-chambers, a coil of pipe located in the second compartment and leading into the fourth compartment, and having a faucet in its length, a separator having communication with the third compartment and with the fan, a trap in the separator receiving the water of condensation from the third compartment, a float to control the faucet, and a fifth or water compartment in communication with the lower portion of the separator, the parts being arranged to operate substantially in the manner and for the purpose set forth.

11. In a heat-conservator, the combination of a settling-compartment, a steam-compartment, a water-compartment, and a superheating-coil located in the steam-compartment and receiving its supply from the water-compartment, substantially as described, whereby the water is delivered to the boiler fully up to the temperature and the elastic

driving power of the exhaust-steam, substantially as described.

12. In combination, a settling-compartment, a water-compartment in communication with the settling-compartment and arranged below it, an intermediate compartment, means for passing exhaust-steam through the intermediate compartment, a separator in communication with the water and intermediate compartments and receiving the water of condensation from the intermediate compartment, and means for forcing a blast of air through the intermediate compartment and into the separator for condensing the exhaust-steam, extracting the oil therefrom, and supplying the necessary air to the water of condensation, substantially in the manner set forth for the purpose described.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

BARDEN WALTON TAYLOR.

Witnesses:

EDMUND A. WILLOUGHBY,

ANDREW C. WRIGHT.