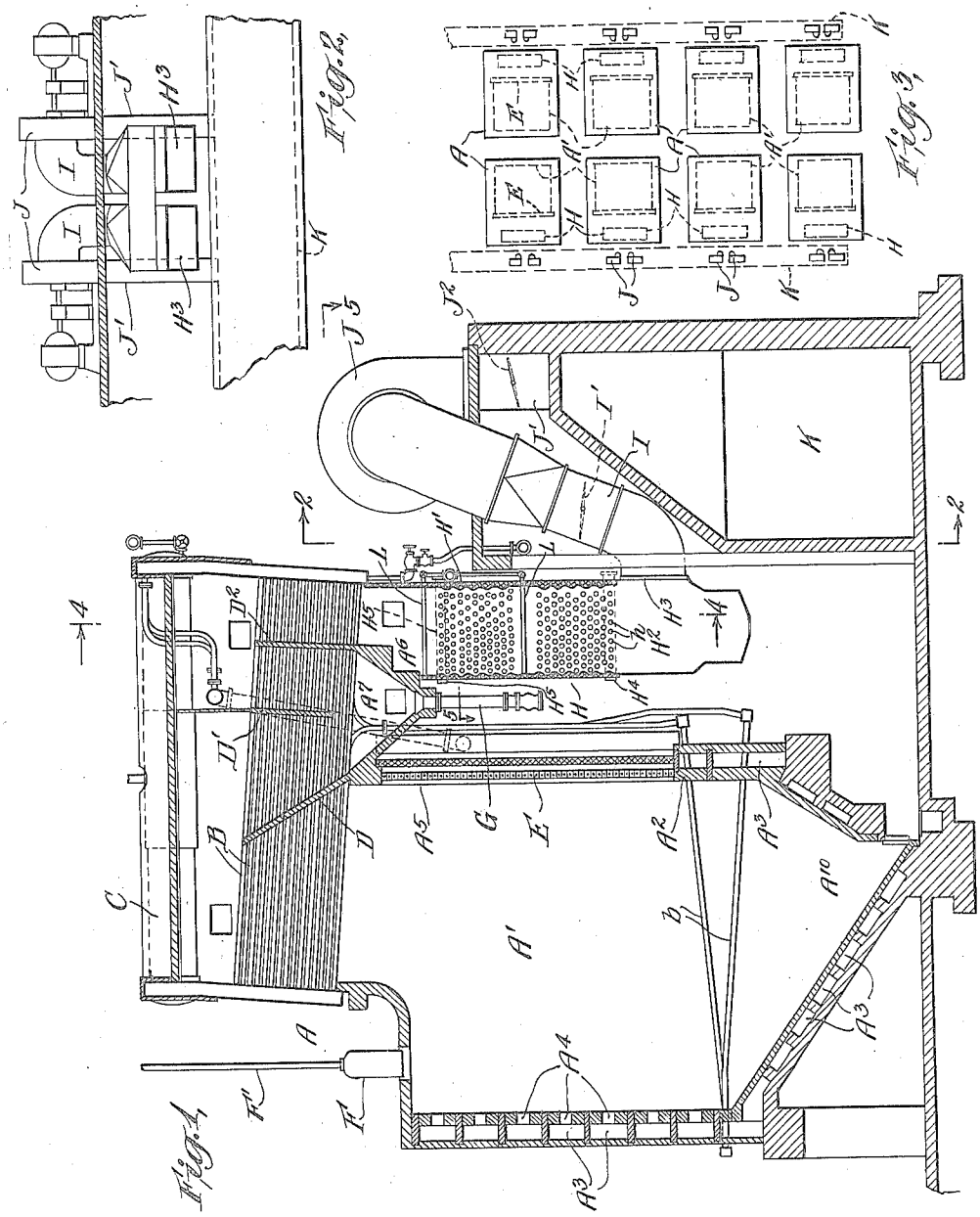
Oct. 2, 1928. 1,685,898

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ECONOMIZER BOILER

Filed March 7, 1923 2 Sheets-Sheet 1



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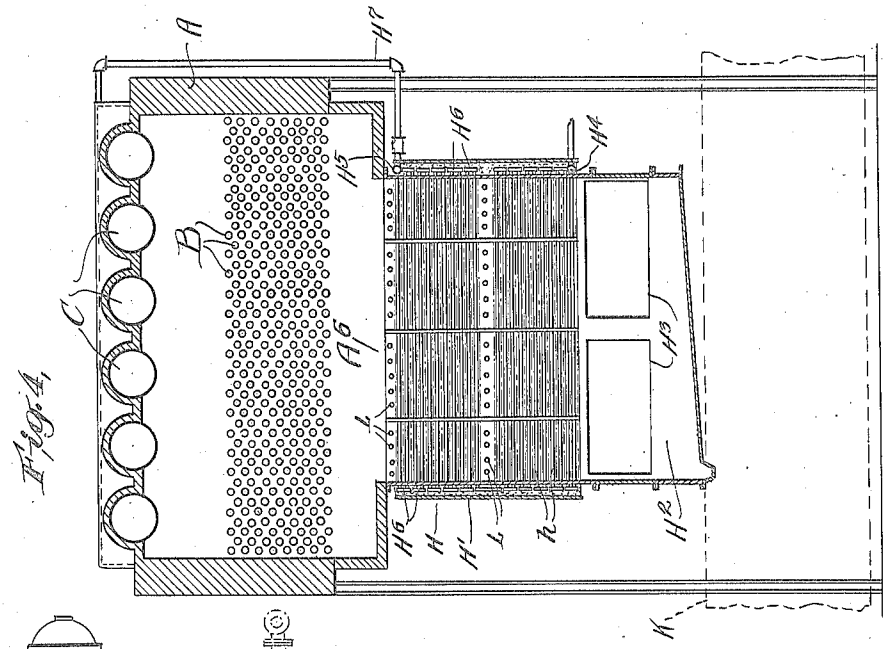


Fig. 4.

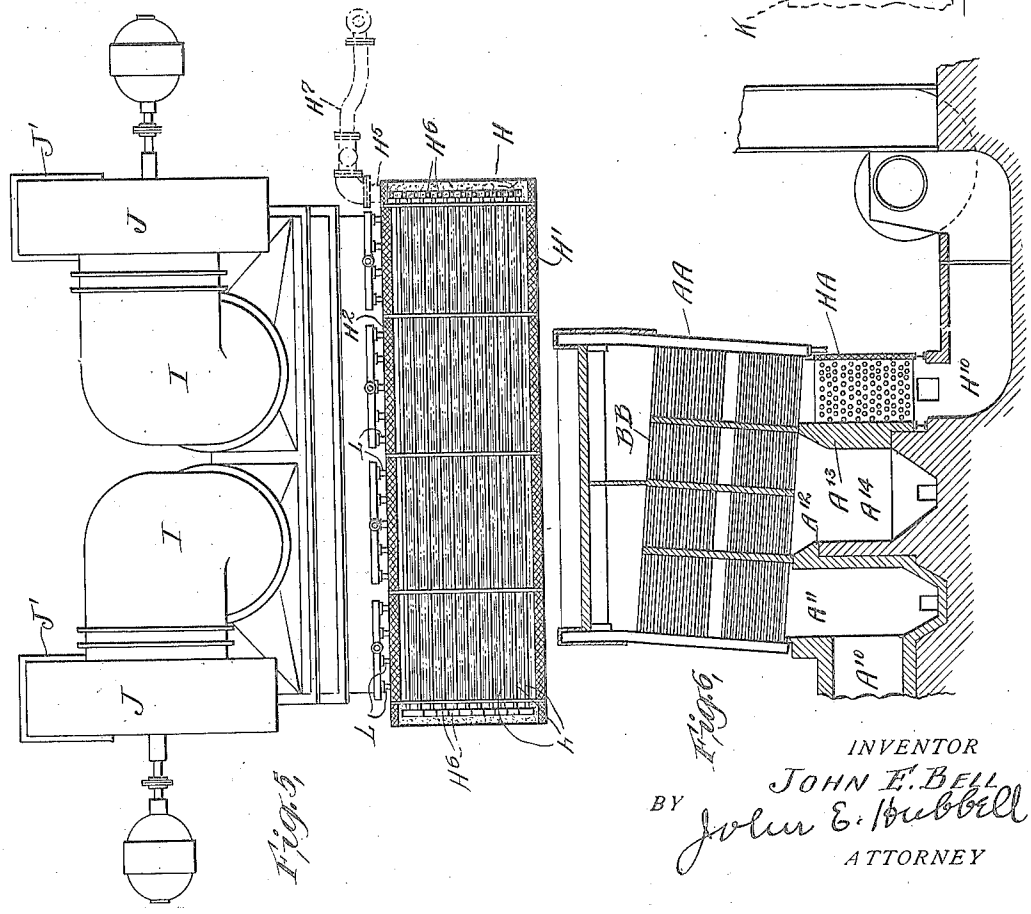


Fig. 3.

Fig. 1.

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UNITED STATES PATENT OFFICE.

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ECONOMIZER BOILER.

Application filed March 7, 1923. Serial No. 623,385.

The general object of my present invention is to combine a water tube boiler with an economizer in such fashion as to provide an economizer boiler unit which can readily be constructed in a manner satisfying the requirements of approved modern steam plant engineering practice in respect to the capacity of the unit, its mechanical construction, its operating efficiency, and the ratio of economizer heating surface to boiler heating surface, and which will not require any more head room, and but little, if any, more floor space than would be required by the boiler if no economizer were combined with it.

In carrying out my invention I arrange my economizer immediately beneath the last pass of a horizontal water tube boiler in which, as in the ordinary four pass boiler, the flow of the heating gases through the last boiler pass is downward, and in which the last pass is at one end of the boiler and includes a small fraction, usually less than one quarter, of the length of the water tubes, at least in the lower rows of such tubes. By proceeding in this manner I am enabled to locate an economizer of suitable design and of amply large heat absorbing capacity in what would otherwise be wholly, or largely waste space, and still have ample room between the economizer and the chamber beneath the other end of the boiler through which the heating gases pass upward into the first boiler pass, for provisions for removing dust from the lower ends of the intermediate passes of the boiler.

The invention is especially useful in boilers, such as those heated by the combustion of powdered coal in which the vertical depth of the combustion chamber beneath the first pass of the boiler is relatively great, but is not limited to use in connection with a boiler furnace designed for burning any particular kind of fuel, and indeed, may advantageously be used in connection with ordinary four pass waste heat boilers.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of my invention, however, and its advantages, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of my invention.

Of the drawings:

Fig. 1 is an elevation in section of a boiler furnace and economizer;

Fig. 2 is a partial section on the line 2—2 of Fig. 1;

Fig. 3 is a diagrammatic plan of a boiler house containing a battery of boilers of the construction shown in Fig. 1;

Fig. 4 is a section on the line 4—4 of Fig. 1;

Fig. 5 is a plan partly in section on the line 5—5 of Fig. 1; and

Fig. 6 is a diagrammatic elevation of another type of boiler and economizer arrangement.

In the drawings, and referring first to the construction illustrated in Figs. 1, 2, 4 and 5, A represents a boiler furnace having a combustion chamber A′ beneath one end of the boiler proper, which comprises a bank of horizontally disposed water tubes B connected at their ends by the usual headers to steam and water drums C. Transverse baffles D, D′ and D^2 cause the heating gases leaving the top of the combustion chamber A′ to make four transverse passes across the water tubes before passing from the boiler proper through the outlet A^6. As shown, the boiler furnace is intended to be heated by the combustion of powdered coal which is introduced through the usual primary air and coal supply nozzles F, into the top of the portion of the combustion chamber extending outwardly in front of the boiler proper. The coal and carrying air are passed to the nozzles F from the usual powdered coal feeding devices (not shown), through pipes F′.

As shown, the front, side, and bottom walls of the combustion chamber are formed with air channels A^3, some of which are connected by ports A^4 with the chamber A′, and through which secondary air of combustion is passed into the chamber A′, whereby this air is preheated and the combustion chamber walls are cooled to protect them against the high temperatures prevailing in the combustion chamber, and to avoid erosive effects from the non-gaseous residue of the powdered coal burned. The rear wall A^5 of the combustion chamber is similarly protected by incorporating in it a radiant

heat superheater E. Tubes *b* forming a part of the water containing boiler heating surface, provide a cooling screen for the bottom wall of the furnace chamber through which ashes and slag pass down into the ash pit or pits A^{10}. The rear wall A^5 of the combustion chamber forms what may be regarded as a bridge wall from the top of which rises the first baffle D. This baffle is advantageously, though not necessarily, inclined, as shown. A dust pocket A^6 is formed beneath the lower ends at the second and third passes across the water tubes, G representing piping through which the dust accumulating in this pocket may be removed.

The economizer H is located directly beneath the fourth boiler pass, and comprises horizontally disposed tubes *h* extending transversely to the water tubes B, and arranged in a housing H', open at its upper end to the boiler waste heat gas outlet A^6. The housing H' is formed with an outlet chamber H^2 beneath the economizer tubes. In the rear side of the chamber H^2 horizontally elongated outlet ports H^3 are formed. Each port H^3 is connected by a conduit I to the inlet port of a corresponding draft exhaust fan J, the outlet J' of which opens into a horizontal off-take flue K running to a stack, not shown. The economizer H is advantageously and preferably constructed, as shown, in accordance with the disclosure of my prior Patent No. 1,565,304, granted Dec. 15, 1925, of closely spaced steel tubes encased in corrugated tubular cast iron sections and mounted in a housing formed of inner cast iron sections, and an outer metallic sheathing with a space between the sheathing and the inner metallic wall filled with a suitable heat insulating and joint packing material such as Silocel. As shown, the economizer tubes are arranged in two banks, with transverse pipes L above each bank for spraying water on to the exterior surfaces of the tubes *h* from time to time, in order to wash off dust accumulations. The lower end of the economizer housing is inclined to drain off the cleaning water to a suitable discharge conduit (not shown), for the removal of the water and dirt carried with it. The boiler feed water is supplied to the header H^4 connected to the lower row of economizer tubes, and thence passes back and forth through tubes at successively higher levels to the economizer outlet header H^5, the tubes in the different rows being connected to permit this flow by suitable headers or return connections H^6. From the outlet header H^5 the water passes to the boiler proper through piping H^7.

With the described arrangement the economizer proper is wholly located beneath the boiler proper, in space which otherwise would be wholly or practically waste space, and ample room is left between the economizer and the rear wall of the combustion chamber A' for the connections to the water screen pipes *b*, and for the dust pocket cleaning provisions G. With the relatively high combustion chamber A' required for the powdered coal burning furnace illustrated in Fig. 1, the economizer as shown may well have the bottom of the housing appreciably above the bottom level of the furnace housing. This permits the economizer to be suspended, as shown, which minimizes expansion troubles, and reduces the liability to leaky joints in the connections between the economizer and boiler housings.

The invention is well adapted for use in units of relatively large capacity. For instance, the particular construction illustrated in Figs. 1, 2, 4 and 5, is one designed for use with an economizer heating surface area approximately 80% of the boiler heating surface proper area of a boiler of 1765 h. p. nominal rating, and intended to heat the boiler feed water from an inlet temperature of 140° F. to an outlet temperature of from 215° to 260° F. depending on the rate operation when the boiler is operated at a pressure of 300 lbs.

In embodiments of my invention such as are illustrated herein, the horizontal dimensions of the last pass for the heating gases through the intertube space of the boiler and of the interior of the economizer housing will be substantially greater in the direction of the width of the boiler than in the direction transverse thereto. To insure the proper distribution of flow of the heating gases through the closely spaced economizer tubes, the outlet or outlets from the economizer housing for the spent heating gases should be distributed longitudinally of the width of the boiler. This result is obtained in an advantageous manner with the construction illustrated in Figs. 1, 2, 4 and 5 by the provision of the two outlet ports H^3 which are placed end to end, and are each but little less than half as long as the economizer housing. The provision of an individual draft inducing fan J for each economizer outlet port with dampers as shown in the fan inlet and outlet connections, forms a simple and effective arrangement for regulating the draft conditions through the boiler and economizer, but obviously other arrangements may well be employed for obtaining the desired draft suction through an economizer outlet port area distributed longitudinally of the economizer. Where, as is usually the case, a battery of boiler furnaces are arranged with but little space between the sides of each adjacent boiler furnace, the placing of a draft inducing fan, or fans for each boiler directly in the rear of the boiler economizes space and shortens flue connections, in addition to facilitating the maintenance of the

proper draft suction at points distributed along the length of the underside of each economizer housing.

The addition of an economizer to a boiler of the type illustrated in Fig. 1, adds nothing to the height of the boiler house required to house the boiler without the economizer, and adds nothing, or very little, to the floor space required for a boiler house enclosing a battery of such boilers arranged in accordance with modern boiler house practice. This will be apparent from Fig. 3, which is a diagrammatic plan of a boiler house enclosing eight boiler furnaces A arranged in two parallel rows of four each, with the front ends of the boilers in both rows adjacent the center line of the boiler house, and with an off-take or stack flue K for each row of boilers located adjacent the corresponding outer side of the boiler house. With the boiler arrangement illustrated in Fig. 3, the use of the economizer adds nothing to the length of the boiler house, and adds little, if at all, to the width of the boiler house. If the exhaust draft fans I, which are necessary with the compact economizer construction employed, were omitted as they might be in some, though not in all cases, when no economizers are employed, it might be possible to crowd the two off-take flues K a little closer together, and thus effect a trifling saving in the width of the boiler house. The saving in boiler house width, if any, obtained in this manner, is relatively unimportant.

The relatively great depth of the combustion chamber employed in a powdered coal boiler furnace, and the fact that the rear wall of the combustion chamber in such a furnace is, in any event, advantageously a substantial distance in front of the rear ends of the boiler proper, makes the invention especially useful and easy to apply in the case of such a boiler furnace. The invention can be employed with advantage, however, with practically any form of water tube boiler furnace of the four pass or analogous type, burning any kind of fuel, and indeed may well be used with waste heat boilers, and in Fig. 6 I have illustrated, in a somewhat diagrammatic way, a four pass waste heat boiler AA, which is provided with an economizer in accordance with the present invention. In the boiler AA the heating gases enter the boiler housing proper through an inlet A^{10} which opens into a heating gas inlet chamber A^{11} located beneath the front end of the bank of water tubes BB. Beneath the bank of water tubes are bridge walls A^{12} and A^{13} between which is located a chamber A^{14} through which the gases pass from the second pass into the third pass of the boiler, and which forms a pocket receiving dust dropping out of the gases in passing through the second and third passes. The front bridge wall A^{12} separates the inlet chamber A^{11} from the chamber A^{14}. The economizer HA is located immediately to the rear of the bridge wall A^{13} beneath the fourth boiler pass. The cooled heating gases which pass downward from the fourth pass of the boiler through the economizer, leave the latter at its lower end through lateral oulets H^{10} which may be arranged as are the outlets H in the construction first described.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The combination with a horizontal water tube boiler having a housing therefor and baffled to provide four transverse passes for the heating gases, of a chamber beneath the first pass through which heating gases pass upward into said first pass, an economizer located within said boiler housing beneath the fourth pass and comprising a closely spaced bank of heating tubes, and means providing a flow path for the discharge of heating gases from the bottom of the economizer including separate portions at opposite sides of a plane transverse to said tubes and intermediate the ends of the latter.

2. The combination with a horizontal water tube boiler having a housing therefor and baffled to provide four transverse passes for the heating gases, of a chamber beneath the first pass through which the heating gases pass upward into said first pass, an economizer located within said boiler housing beneath the fourth pass and separated from said chamber by a space and comprising a closely spaced bank of horizontal tubes, means providing a flow path for the discharge of heating gases from the bottom of the economizer including separate portions at opposite sides of a plane transverse to said tubes and intermediate the ends of the latter, and provisions located in said space for removing dust out of the heating gases in their travel through the second and third passes.

3. The combination with a boiler comprising horizontally disposed water tubes and baffling providing a path of flow for the heating gases through the intertube space of the boiler which begins at the underside of said space at the front end of the boiler and terminates in an outlet from the bottom of said space at the rear end of the boiler, of an economizer arranged below said outlet and comprising closely spaced horizontally disposed tubes and an enclosing housing open at its top to said outlet, said boiler, housing and baffling being proportioned and disposed to make the horizontal dimensions of said outlet and of the interior of said housing substantially greater in the direction of the width of the boiler

than in the direction at right angles thereto, and means providing a flow path for the discharge of heating gases from the bottom of the economizer including separate portions at opposite sides of a plane transverse to said tubes and intermediate the ends of the latter.

4. The combination with a boiler comprising horizontally disposed water tubes and baffling providing a path of flow for the heating gases through the intertube space of the boiler which begins at the underside of said space at the front end of the boiler and terminates in an outlet from the bottom of said space at the rear end of the boiler, of an economizer arranged below said outlet and comprising closely spaced horizontally disposed tubes and an enclosing housing open at its top to said outlet, said boiler, housing and baffling being proportioned and disposed to make the horizontal dimensions of said outlet and of the interior of said housing substantially greater in the direction of the width of the boiler than in the direction at right angles thereto, and provisions for withdrawing the heating gases from said housing at points distributed below the economizer tubes and along the width of the boiler whereby flow of the heating gases in the economizer in a direction parallel to the width of the boiler is minimized.

5. A boiler furnace heated by the combustion of powdered coal, comprising horizontally disposed water tubes, and a combustion chamber at the front end of the boiler furnace extending beneath the front ends of said tubes, an economizer beneath the rear ends of said tubes, baffling causing the heating gases to make four passes across the water tubes in passing upward from the combustion chamber into the intertube space of the boiler and downward from said space into the economizer, and draft inducing means at the rear end of the furnaces connected to the economizer at points distributed along the width of the boiler.

6. A battery of boiler furnaces heated by the combustion of powdered coal, and arranged in two parallel rows, with the front ends of the boiler furnaces in one row adjacent the front ends of the boiler furnaces in the other row, and with an off-take flue for each row of boiler furnaces at the rear ends of the corresponding furnaces, each boiler furnace comprising horizontally disposed water tubes, and a combustion chamber at the front end of the boiler furnace extending beneath the front ends of the water tubes, an economizer beneath the rear ends of the water tubes of each boiler furnace, baffling for each boiler causing the heating gases to make four passes across the water tubes in passing upward from the combustion chamber into the intertube space of the boiler and downward from said space into the corresponding economizer and induced draft fans at the rear ends of the boiler furnaces for passing the heating gases from the economizers into the corresponding off-take flues.

7. The combination with a horizontal water tube boiler having baffles therein to provide four transverse passes for the heating gases, of a chamber beneath the first pass through which the heating gases pass upward into said first pass, a bank of economizer tubes located beneath the boiler tubes in the fourth pass, a housing for the economizer, horizontally spaced outlet passages connected to the bottom of the economizer housing and extending laterally therefrom and an exhaust fan located in each of said conduits.

Signed at city of New York in the county of New York and State of New York this fifth day of March A. D. 1923.

JOHN E. BELL.