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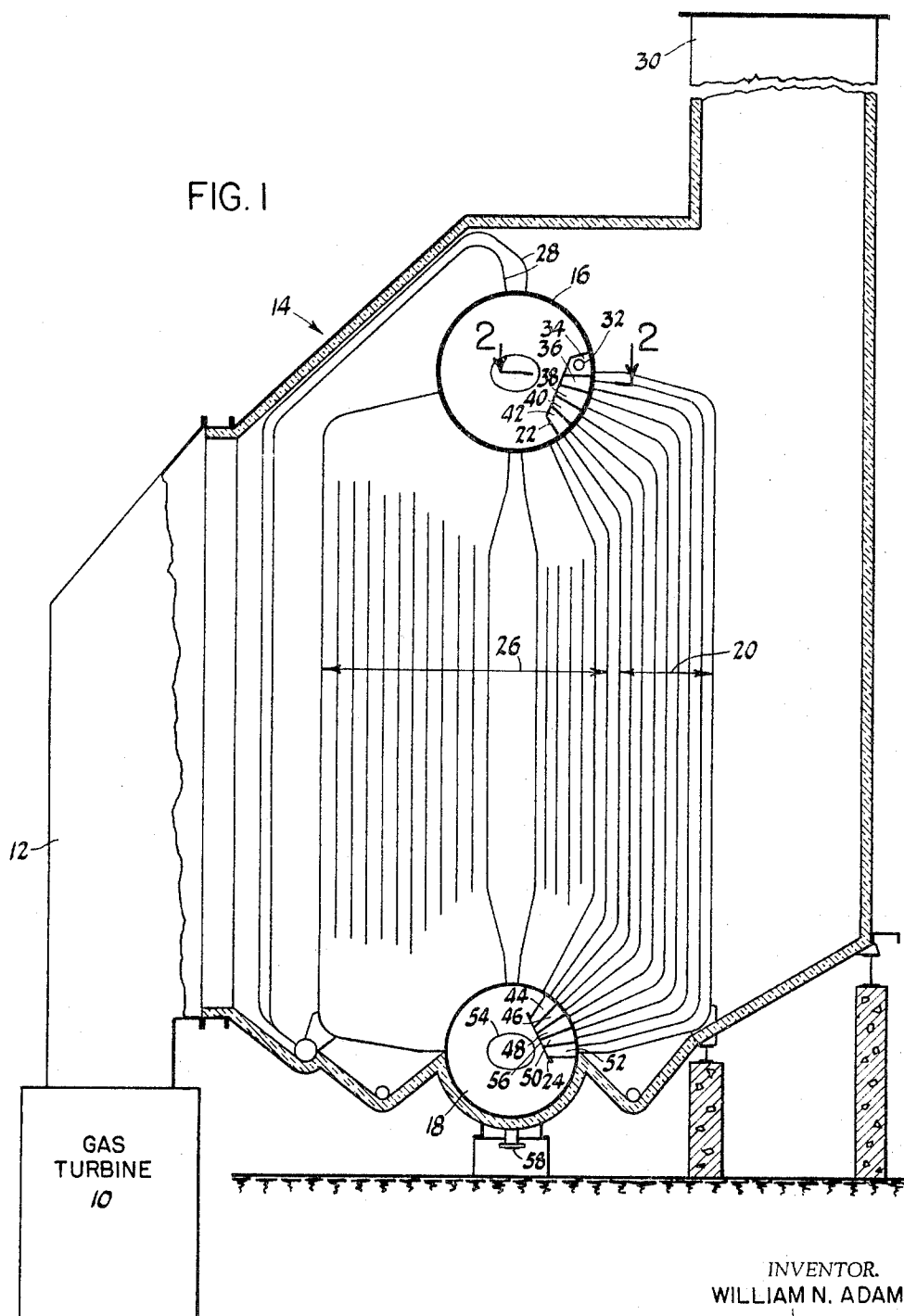
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INTEGRATED DRAINABLE ECONOMIZER WITH BOILER BANK

Filed May 24, 1965

3 Sheets-Sheet 1



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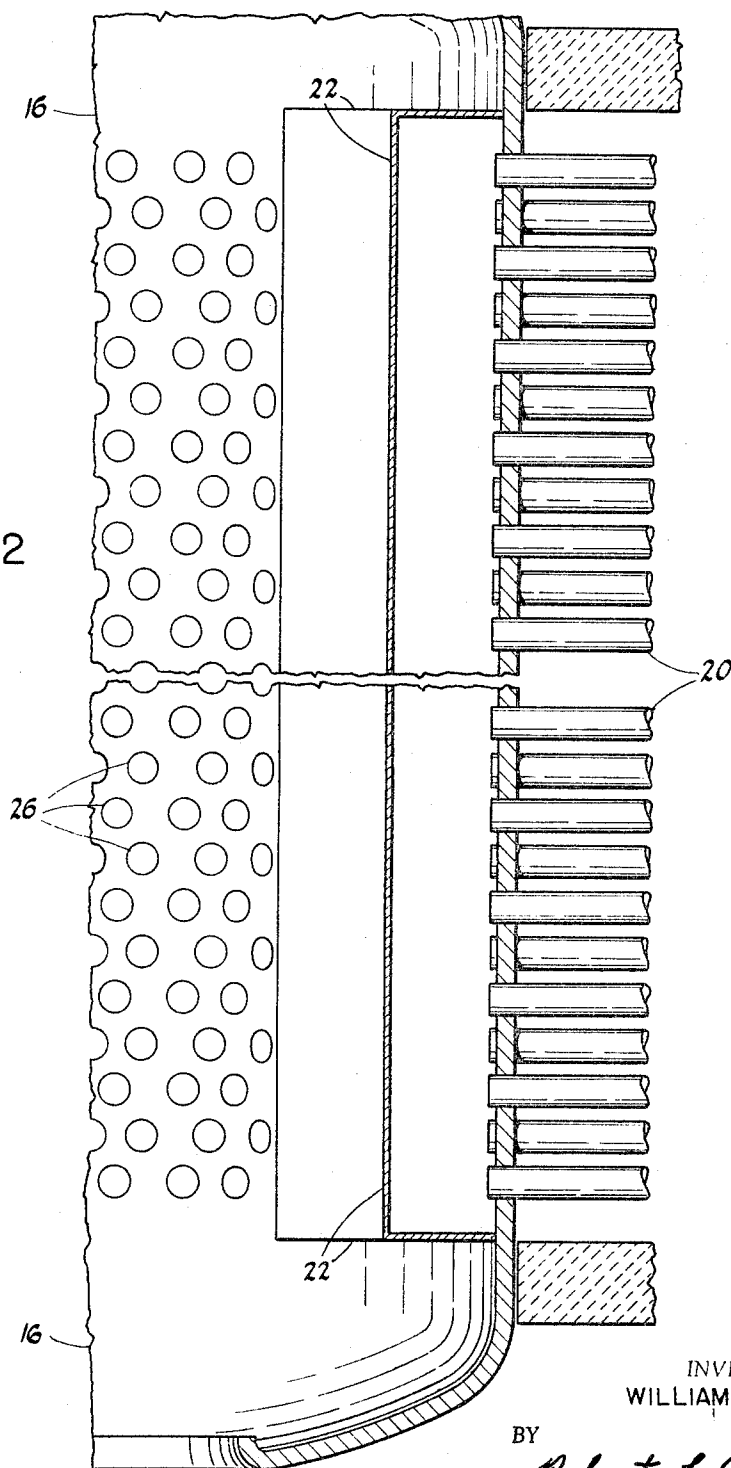
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3 Sheets-Sheet 2

FIG. 2



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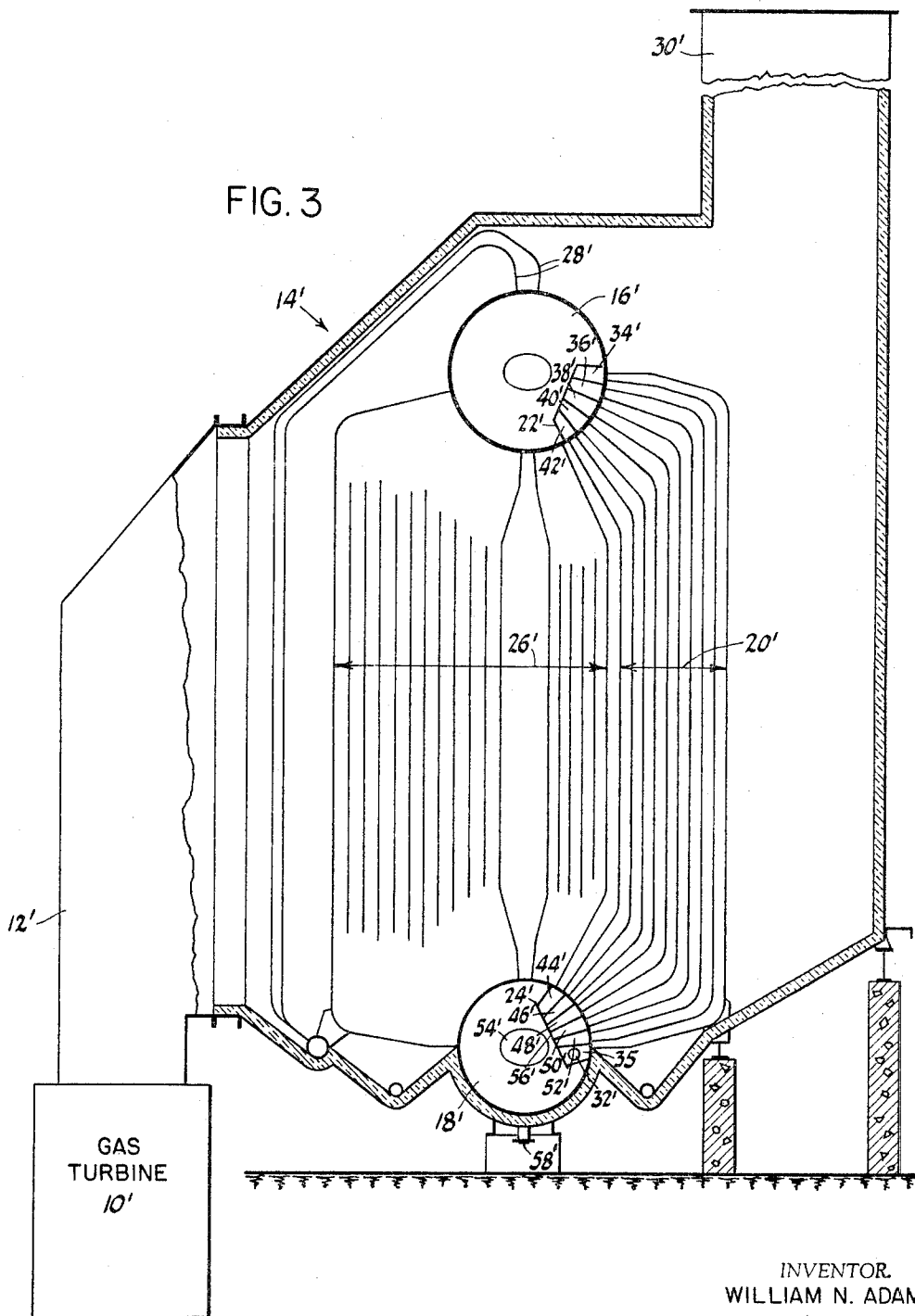
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1

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**INTEGRATED DRAINABLE ECONOMIZER WITH
BOILER BANK**

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4 Claims. (Cl. 122-7)

This invention is directed to a boiler bank, and in particular to a boiler bank incorporating an integral, drainable, economizer section therein.

It is an object of this invention to provide a compact waste heat boiler including a drainable economizer section therein requiring no separate economizer headers, and having maximum heat recovery with very little gas draft loss.

The invention is illustrated in the accompanying drawings wherein:

FIGURE 1 is a vertical cross section of a gas turbine and waste heat boiler combination including a drainable economizer;

FIGURE 2 is a top view of the boiler taken on lines 2-2 of FIGURE 1;

FIGURE 3 is a vertical cross section of an alternative design of a gas turbine and waste heat boiler combination including a drainable economizer.

Looking now to FIGURE 1, 10 denotes a gas turbine having an exhaust duct 12 through which the turbine exhaust gases are directed to a boiler 14.

Boiler 14 comprises an upper drum 16, and a lower drum 18 between which a plurality of rows of heat exchange tubes extend.

These rows of tubes include an economizer section 20, and a boiler or steam generating section 26.

Positioned within the upper drum interior is enclosure means 22, which forms a plurality of chambers or compartments which extend the length of the upper drum. Enclosure means 24 contained in the lower drum interior likewise forms a plurality of chambers or compartments which extend the length of the drum.

Feedwater is fed to the uppermost compartment 34 in the upper drum by way of feedwater inlet pipe 32. The compartment 34 is connected to the lowermost compartment 52 in the lower drum by a row of economizer tubes. The compartment 52 is likewise connected to the next uppermost compartment 36 in the upper drum by another row of economizer tubes. So also are all of the other compartments contained in the upper and lower drums serially connected to one another by adjacent rows of economizer tubes. Thus the feedwater entering compartment 34 flows serially through each adjacent row of economizer tubes until it is eventually discharged into the interior of upper drum 16.

The water flows from upper drum 16 to lower drum 18 through some of the boiler tubes (downcomers), and flows in the reverse direction through other of the boiler tubes (risers). A mixture of steam and water is discharged from the riser tubes into the upper drum. The steam separates from the upper drum, and flows through outlet 28 to its ultimate point of use.

The turbine exhaust gases, after traversing the rows of boiler and economizer tubes, and giving up heat thereto, are exhausted into the atmosphere through stack 30.

Lower drum 18 contains a drain outlet 58 by means of which the boiler can be drained for cleaning and maintenance purposes. A removable closure plate 56 forms one wall of each of the lower drum compartments 44, 46, 48, 50 and 52. Upon removal of this plate 56, the water contained in all of the economizer tubes will drain into the lower drum interior.

The plate 56 can be removably secured in any suitable

2

manner, for example by being bolted on. Access opening 54, which is closed by a suitable cover during boiler operation, permits workmen to gain access to the lower drum interior when it is desired to drain the economizer, or perform maintenance work.

From the above it can be seen that a compact boiler arrangement is provided, including an integral, drainable economizer section. The heat recovery is high, since the gas flow is countercurrent to the flow of water and steam; i.e. the turbine exhaust gases first encounter the steam generating tubes, and the gases leaving the unit encounter last the row of economizer tubes containing feedwater at its lowest temperature. In one particular unit, the gas turbine exhaust gases entered the boiler at approximately 820° F., and was exhausted to atmosphere at 420° F. The feedwater entered the economizer section at 220° F., and was discharged into the upper drum interior at 316° F. Saturated steam was discharged from the upper drum at 366° F. and 165 p.s.i.

There are a number of reasons for making the economizer drainable. In many small boilers the generated steam is used as process steam at the plant site, and thus the feedwater is almost 100 percent makeup water. Thus if the water is not too clean or pure, a large amount of impurities will build up and deposit in the tubes if they are not periodically drained and cleaned. Also, the operation of many boilers is intermittent, for example when they are utilized in combination with a gas turbine. It is advantageous to drain the tubes when the boiler will be out of operation for some time.

FIGURE 3 shows an alternative arrangement of a gas turbine, waste heat boiler combination including a drainable economizer. This arrangement is the same as that shown in FIGURE 1, with the exception that the feedwater inlet pipe 32' is connected to the lowermost compartment 52' instead of to the uppermost compartment in the upper drum. One additional row of economizer tubes is utilized and also one more lower compartment 43 is needed so that the water flowing from the economizer section is again discharged into the upper drum 16. This enables better natural circulation in the boiler tubes, and also makes the stability better, for if by chance there is any steam generated in the last row of economizer tubes, such steam would want to flow upwardly.

Whereas the preferred embodiments of my invention have been shown and described, it is to be understood that the invention may be utilized in alternative arrangements. I therefore do not wish to be limited in the scope of my invention except as may be required by the claims.

What I claim is:

1. In combination, top, bottom and side walls forming a horizontal passageway through which hot combustion gases pass, the passageway having an inlet end and an outlet end, a first cylindrical drum located adjacent the top wall and positioned such that its axis is transverse to the axis of the passageway, a second cylindrical drum located adjacent the bottom wall and positioned such that its axis is transverse to the axis of the passageway, first wall means cooperating with a portion of the first drum wall for forming a plurality of vertically spaced, completely enclosed first compartments within the first drum interior, second wall means cooperating with a portion of the second drum wall for forming a plurality of vertically spaced, completely enclosed second compartments within the second drum interior, a portion of the second wall means being removable, said portion being of such a size and located such that when it is removed all of the second compartments are drainable into the second drum interior, a feedwater inlet tube connected to the uppermost of the first compartments, a first row of economizer tubes extending from the uppermost first compartment

3

to the lowermost second compartment, a second row of economizer tubes connecting the lowermost second compartment to the next uppermost first compartment, a third row of economizer tubes connecting the next uppermost first compartment to the next lowermost second compartment, the rest of the first and second compartments being likewise connected together by rows of economizer tubes, and the uppermost second compartment being connected with the first drum interior by means of a last row of economizer tubes, whereby the feedwater flows serially through the economizer tubes from the first row of economizer tubes to and through the last row of economizer tubes, each row of economizer tubes being in spaced alignment in the gas passageway, with the first row of economizer tubes being closest to the passageway outlet end, and the last row of economizer tubes being closest to the gas passageway inlet, a plurality of rows of boiler tubes extending between the first and second drums, which boiler tubes are located upstream of the rows of economizer tubes, in which boiler tubes steam is generated, each row of economizer and boiler tubes containing a plurality of tubes which are spaced across the width of the passageway, and a discharge tube connected to the upper portion of the first drum, through which generated steam is discharged.

2. The combination set forth in claim 1, including a gas turbine, the inlet of the gas passageway being connected to the exhaust of the gas turbine.

3. In combination, top, bottom and side walls forming a horizontal passageway through which hot combustion gases pass, the passageway having an inlet end and an outlet end, a first cylindrical drum located adjacent the top wall and positioned such that its axis is transverse to the axis of the passageway, a second cylindrical drum located adjacent the bottom wall and positioned such that its axis is transverse to the axis of the passageway, first wall means cooperating with a portion of the first drum wall for forming a plurality of vertically spaced, completely enclosed first compartments within the first drum interior, second wall means cooperating with a portion of the second drum wall for forming a plurality of vertically spaced, completely enclosed second compartments within the second drum interior, a portion of the

4

second wall means being removable, said portion being of such a size and located such that when it is removed all of the second compartments are drainable into the second drum interior, a feedwater inlet tube connected to the lowermost of the second compartments, a first row of economizer tubes extending from the lowermost second compartment to the uppermost first compartment, a second row of economizer tubes connecting the uppermost first compartment to the next lowermost second compartment, a third row of economizer tubes connecting the next lowermost second compartment to the next uppermost first compartment, the rest of the first and second compartments being likewise connected together by rows of economizer tubes, and the uppermost second compartment being connected with the first drum interior by means of a last row of economizer tubes, whereby the feedwater flows serially through the economizer tubes from the first row of economizer tubes to and through the last row of economizer tubes, each row of economizer tubes being in spaced alignment in the gas passageway, with the first row of economizer tubes being closest to the passageway outlet end, and the last row of economizer tubes being closest to the gas passageway inlet, a plurality of rows of boiler tubes extending between the first and second drums, which boiler tubes are located upstream of the rows of economizer tubes, in which boiler tubes steam is generated, each row of economizer and boiler tubes containing a plurality of tubes which are spaced across the width of the passageway, and a discharge tube connected to the upper portion of the first drum, through which generated steam is discharged.

4. The combination set forth in claim 3, including a gas turbine, the inlet of the gas passageway being connected to the exhaust of the gas turbine.

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KENNETH W. SPRAGUE, *Primary Examiner.*