Jan. 18, 1966 F. VOLLHARDT 3,229,762

WELDED HEAT EXCHANGER

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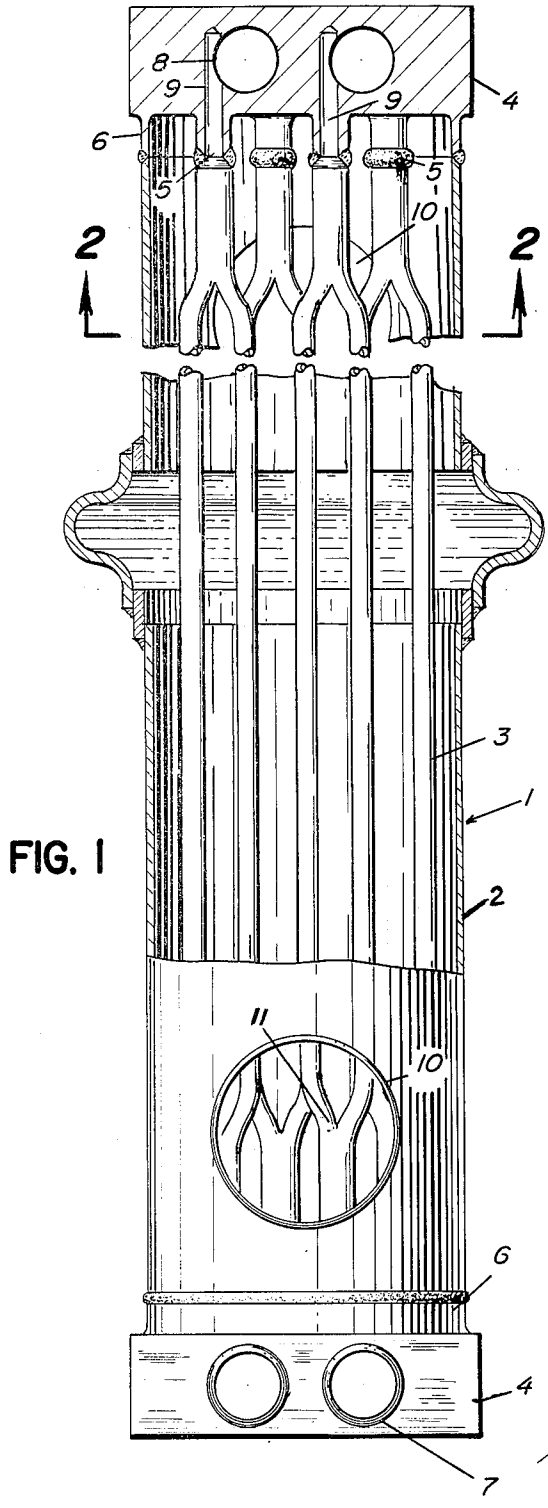

FIG. 1

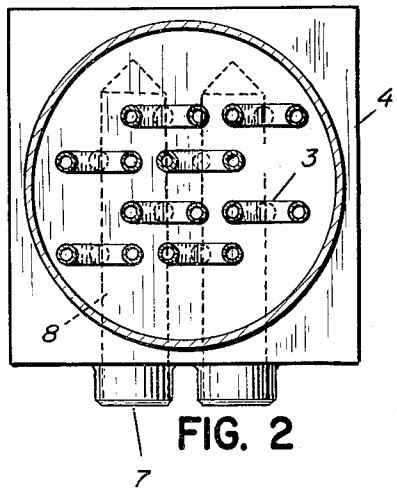

FIG. 2

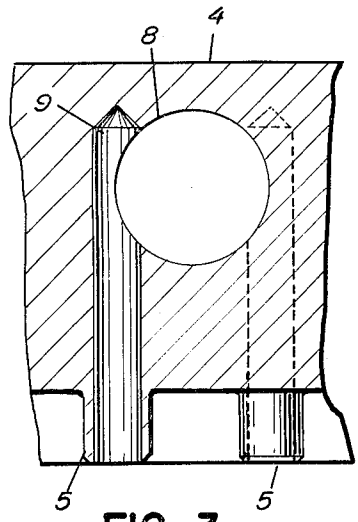

FIG. 3

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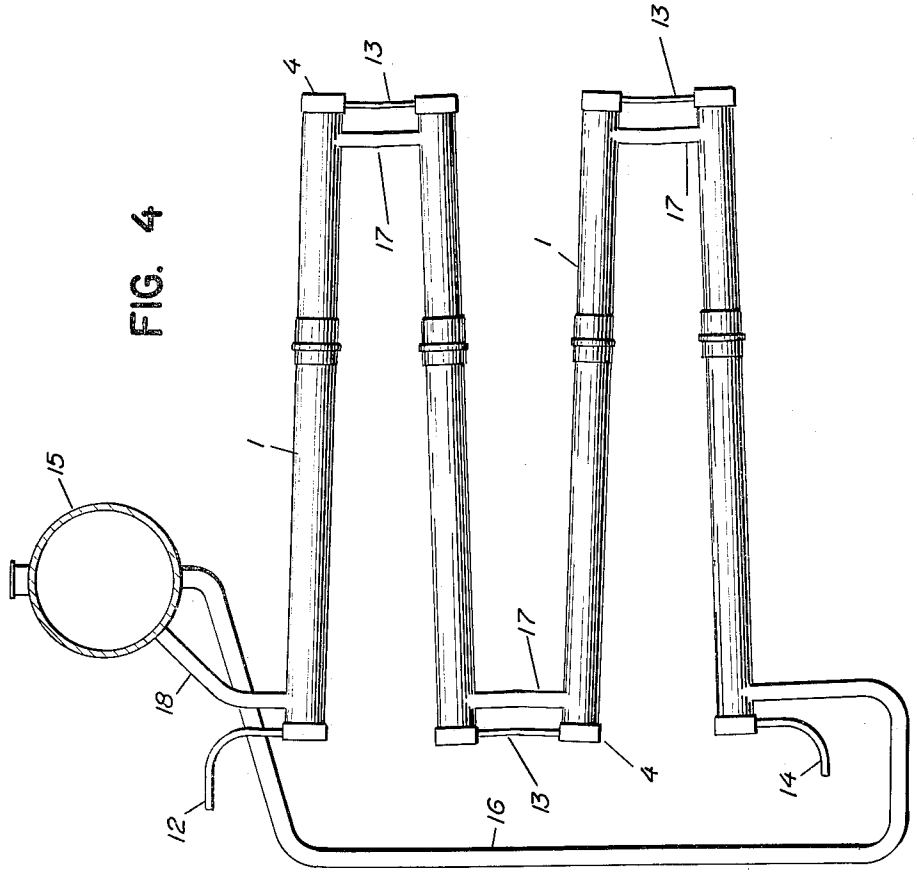
FIG. 4



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WELDED HEAT EXCHANGER

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2 Claims. (Cl. 165—157)

The present invention relates to a heat exchanger or evaporating element of welded construction for waste-heat boilers, or similar heat exchangers, especially for heating by gaseous heating mediums at very high pressure.

An object of the invention is to provide a structure of heat exchanging tubes located in a shell or jacket with collecting or distributing heads placed on each of the ends of the shell or jacket serving as conductors for the heating medium back and forth between the heat exchanging tubes.

Means are well known in the prior art for forming the heating surfaces of boilers from individual evaporating elements which consist of a water enclosed or jacketed barrel through which a number of heating tubes extend. The ends of the heating tubes are mounted in an upper and a lower tube head. In most of these known constructions, the heating medium is fed to the heating tubes through a hood or chamber, covering the tube heads and functioning as distributors, and is conducted away through a similar chamber serving as collector, which covers the other tube head.

Such heat exchanging elements are deficient for heating with gaseous heating media, which must be supplied at very high pressure, since both the chamber and the tube head are inadequate for such pressure loads. For instance, if the heating medium is a synthetic or ammonia gas which is under 300 to 500 atmospheric pressures and more, as is not uncommon in present high-pressure synthesis, and the medium should be cooled by heat exchanging, in which event the tangible heat of the gas should be utilized at the same time for the production of useful vapor, for example of pressure above 10 atmospheres, then, first of all, the evaporating elements must be of such structure that there is adequate warranty that the high-pressure heating medium cannot break through in the area of the heat exchanger through which the cooling medium passes. Such a penetration of the heating medium certainly leads to a complete destruction of the heat exchanger. For this reason, large welding seams should be avoided in the structure of the evaporating elements. This requirement may not be easily met by prior constructions of heat exchangers so that those of the usual construction are unsuitable. It is a further object of the invention to remedy the above disadvantages.

The instant invention compared to the prior, constructs the heads in one piece and of solid construction and are provided at their surfaces, which face the ends of the shell or jacket, with extensions machined from the solid material, for the connection of the heat exchanging tubes and with a suitably constructed connecting web for their connection with the shell or jacket as well as extensions at the side wall for the inflow and/or outflow of the heating medium.

A further object is to provide bores piercing the extensions for the heat exchanging tubes and the bores for the inflow and/or outlet of the heating medium are so driven into the interior of the heads that the bores are directed towards each other.

A still further object is to provide a heat exchanging or evaporating element fully capable of the required high pressure loads because the heads themselves have no welding seam and the only welding seams on the high-pressure side are the circumferential seams of the tubes which connect the heat exchanging tubes with the extensions of the heads. Thus, there are only a few short welded joints. The longer connecting seams between the web of the heads and the ends of the shell or jacket are in an area of lower pressure.

Through appropriate arrangement of the extensions and the bores on the heads it is easily possible to arrange the inlet as well as the outlet of the heating medium at one head, which presents a great freedom in the installment of the evaporating elements for their interchanging with the heating surface groups of a waste-heat boiler.

A further advantageous development of the heat exchanging or evaporating elements of the present invention consists in that Y piece sets, which are known in the prior art, are provided as heat exchanging tubes. With this measure it is possible to reduce the number of the required circumferential seams of the tubes essentially without thereby reducing the potential heating surface for each element unit.

With the above and other objects which will become apparent from the detailed description below, a preferred modification of the invention is shown in the drawings, in which:

FIGURE 1 shows a side view of a heat exchanging element with parts in cross section,

FIGURE 2 is a section on section line 2—2 of FIGURE 1,

FIGURE 3 shows a portion of a cross-sectional view of the head according to FIGURE 1 on an enlarged scale, and

FIGURE 4 shows a diagrammatical view of a waste-heat boiler composed of the heat exchanging elements of the present invention.

The heat exchanging or evaporating element **1** consists of the shell or jacket **2** inside of which the heating tubes **3** are located. The ends of the heating tubes **3** are connected to an upper and a lower head **4**. The heads **4** are placed on the ends of the shell or jacket **2** and are welded to the jacket, and form the collectors and distributors for the heating medium.

The heads **4** are of one piece and solid, e.g. they are machined from solid material. They are provided at their surfaces which face the interior of the jacket, with extensions **5** machined from the solid material. The heating tubes **3** are welded to these extensions **5**.

For the welding of the shell or jacket **2** with the heads **4**, the latter are provided with a web **6** which is also machined from the head material. At the side wall of the heads **4** are the extensions **7** for the inlet and/or outlet of the heating medium. These extensions **7**, too, are machined from the solid head material. The bores **8** are projected through the extensions **7** into the interior of the heads. Bores **9** advanced through the extensions **5** cut the bores **8** so that a connection between the extensions **7** and the extensions **5** and therefore between the heating tubes **3** is obtained.

The shell or jacket **2** is provided with the supply and delivery sockets **10** for the cooling medium.

The heating tubes **3** are developed as Y piece units **11**, in which way the number of the required circumferential seams of the tubes is reduced to a minimum.

In FIGURE 4, several of the heat exchanging elements are interchangeably connected with a waste-heat boiler. The heating medium is supplied to the inlet **12**, converted by the transfer tubes **13** from one heat exchanging element to the other and then conducted away through the outlet **14**. The cooling medium is supplied from a steam barrel **15** over a fall tube **16** to the heat exchanging elements **1** and is converted by the overflow tubes **17** from

one heat exchanging element to the other. The resulting steam mixture evaporates through the tube **18** into the steam barrel **15**.

Through the selection of certain definite sizes of the various heat exchanging elements, it may be possible to assemble comprehensive performance data for waste-heat boilers and gas coolers by interchanging groups of elements in the assembly of groupings of prefabricated machine parts.

It is thought that the invention and its advantages will be understood from the foregoing description and it is apparent that various changes may be made in the form, construction and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing its material advantages, the form hereinbefore described and illustrated in the drawings being merely a preferred embodiment thereof.

I claim:

1. A heat exchanging or evaporating element of welded construction for waste-heat boilers or similar heat exchangers, especially for heating with gaseous heating media of very high pressure, comprising a jacket, heat exchanging tubes located in said jacket conveying the heating medium, distributing heads located at both ends of said jacket serving as conductors of the heating medium to and from said heat exchanging tubes, said heads being of solid integral construction having at their surfaces facing the ends of said jacket, extensions machined from the solid construction of said heads for receiving the ends of said heating tubes, an integral cylindrical web upon said heads for connection with said jacket, additional extensions on a side wall of said heads integral with the material thereof for the inlet and outlet of the heating medium, bores which extend into said heads from said extensions for said heating tubes and bores which extend from said extensions for said inlet and outlet of the heating medium intersecting within said heads said first named bores.

2. A heat exchanging or evaporating element as set forth in claim **1** wherein said heating tubes comprise two parallel pipe lengths united at both ends to form common throats.

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