N. H. HILLER.

HEAT EXCHANGER.

APPLICATION FILED MAR. 20, 1911.

998,292. Patented July 18, 1911.

Fig: 1,

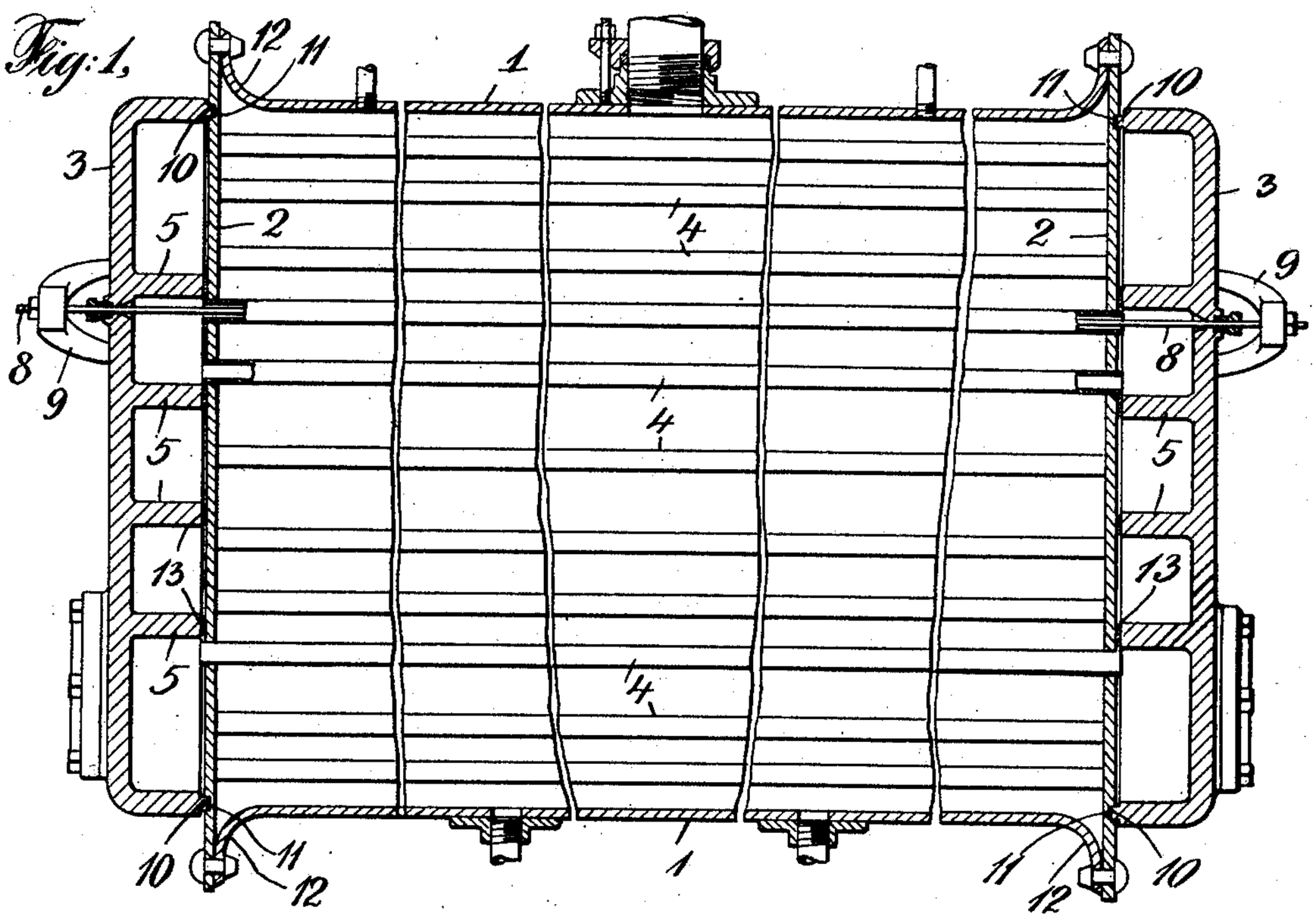
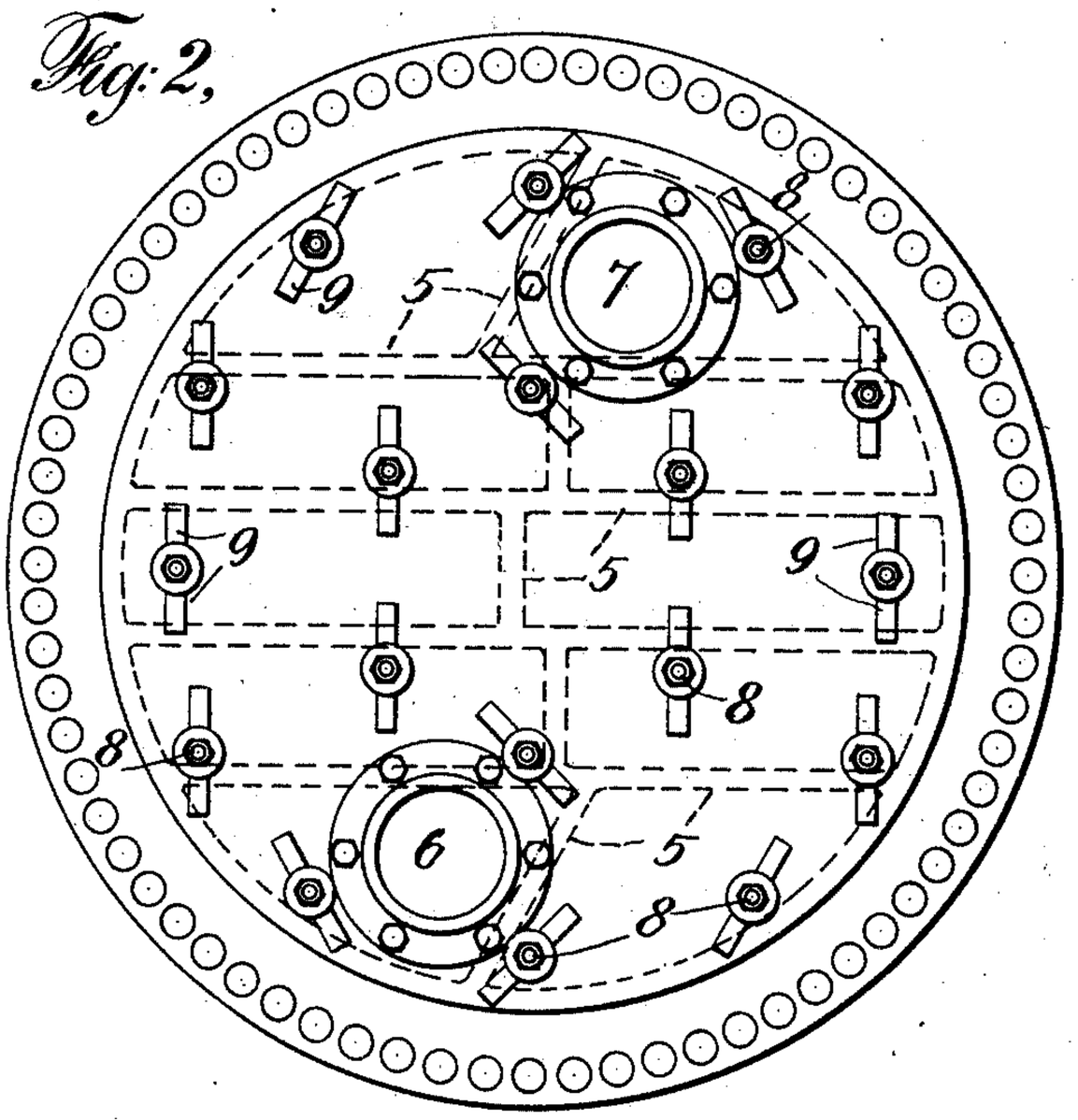


Fig: 2,



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UNITED STATES PATENT OFFICE.

NICOLAI H. HILLER, OF CARBONDALE, PENNSYLVANIA.

HEAT-EXCHANGER.

998,292. Specification of Letters Patent. **Patented July 18, 1911.**

Application filed March 20, 1911. Serial No. 615,491.

To all whom it may concern:

Be it known that I, NICOLAI H. HILLER, a citizen of the United States of America, and a resident of Carbondale, county of Lackawanna, and State of Pennsylvania, have invented a certain new and useful Heat-Exchanger, of which the following is a specification.

My invention relates to heat exchangers, such for example as condensers, coolers, heaters, etc., and comprises a novel construction of tube sheet whereby the apparatus is able to respond to rapid and great temperature changes without development of leaks.

It is well known that heat exchangers such as referred to, are very apt to develop leaks if their temperature be changed rapidly through wide ranges, or if different parts are heated unequally. The conditions obtaining in brine coolers and like parts of refrigerating apparatus are particularly severe; the tubes being frequently, for a time, at a temperature greatly different from that of the shell. The resulting unequal expansion or contraction of the tubes with respect to the shell impose very great stresses on the tube sheets and the joints between the tube sheets and tubes. Also, it frequently happens that as such coolers are constructed, the tubes are used in groups connected, one group with another, in series; and when such is the case, the tubes in one part of the cooler may be at a temperature quite different from that of tubes in another part of the cooler and from that of the shell.

According to my invention I provide the tube sheets with grooves, near where they are secured to the shell, the consequent slight weakening of the tube sheets at such grooves, and consequent increased flexibility at such points, causing the portions of said tube sheets, outside of said grooves, to flex as required by expansion or contraction of the shell with reference to the tubes, or vice versa, without imposing material stresses on the tubes or on the joints between the tubes and tube sheets.

The objects of my invention are to avoid leaks in heat exchangers and like apparatus, to avoid excessive and unequal stresses on the parts of such apparatus, and to make such apparatus more durable and reliable.

In the accompanying drawings I illustrate one type of heat exchanger constructed in accordance with my invention.

In said drawings: Figure 1 shows a longitudinal section of the heat exchanger, and Fig. 2 shows an end view thereof.

In said drawings, 1 designates the shell of the apparatus, 2, 2 designate tube sheets secured to the ends of said shell, and 3, 3, designate heads, and 4, 4, tubes extending from one tube sheet to the other. It will be understood that ordinarily there will be a large number of these tubes, though a few only are shown for the sake of clearness. The particular heat exchanger shown in the drawings is a brine cooler, and, as is common in such apparatus, the heads 3 are provided with internal partitions or baffles 5, whereby the space between the tube sheets and said heads is divided into a plurality of chambers, each serving as a header for a corresponding group of tubes 4. These baffles 5 may be arranged in various ways. I have indicated in dotted lines in Fig. 2, an arrangement of baffles for one of the heads. Customarily the baffles in the other head will be arranged in complementary fashion, so that the several groups of tubes are connected in series from the brine inlet 6 to the brine outlet 7. Such construction is familiar, and is referred to herein only so far as is necessary to identify the parts illustrated. I have shown the heads 3 held in place by means of through bolts 8 passing through certain of the tubes 4 and through glands in the heads and provided at their ends with yokes 9.

The side flanges 10 of the heads 3 are reduced in width, near their ends, such reduced portions fitting into corresponding grooves 11 of the tube sheets; suitable packing being commonly placed in the bottom of each such groove, to form a tight joint between the tube sheet and the head 3. The principal reason, however, for providing the grooves 11, is to cause the portion of the tube sheet, outside of said groove and of the head 3, to bend back and forth, as required by expansion or contraction of the shell 1 with reference to the tubes 4, or vice versa, with imposing material stress on the joints between the tube sheet and the tubes 4, and without imposing material stress on the portion of the tube sheet within the head 3. By reason of this construction, the temperature of the tubes may change greatly and suddenly, without corresponding change of temperature of the shell, or vice versa, without imposing stress to any excessive degree on the tube sheets or on the joints be-

tween the tubes and tube sheets. In fact, the portion of each tube sheet outside of the groove 11, bends with reference to the portion of the tube sheet within the groove, very much as if hinged to such portion within the groove, and thus is enabled to follow freely the expansion and contraction of the shell with reference to the tubes, and vice versa, thereby avoiding a great source of trouble heretofore present in such apparatus.

Instead of flanging the ends of the shell 1 over abruptly, to provide flanges for attachment of the tube sheets, I prefer to curve the end portions of the shell outward with a curve of considerable radius, as shown at 12, thereby distributing bending stresses through a considerable length of the shell, avoiding localized stresses, and securing a certain flexibility of the flanges of the shell, whereby the required degree of flexure of the outer portions of the tube sheets is decreased somewhat.

The shell 1 is provided with suitable inlet and outlet connections, numbered 14 and 15 respectively as shown. A gasket, 13, is commonly provided between the tube sheet and each baffle 5, whereby leakage from one compartment of the head to adjacent compartments is avoided. Such gasket may be of rubber or of other suitable material.

What I claim is:—

1. Apparatus such as described, comprising a shell, tube sheets secured thereto, and tubes connecting said tube sheets, said tube sheets reduced in section between the tubes and said shell, whereby the portions of said tube sheets outside of said grooves may flex with expansion or contraction of said shell, or with expansion or contraction of said tubes, without imposing excessive stresses on the joints between the tube sheets and tubes.

2. Apparatus such as described, comprising a shell, tube sheets secured thereto, and tubes connecting said tube sheets, said tube sheets grooved between the tubes and said shell, whereby the portions of said tube sheets outside of said grooves may flex with expansion or contraction of said shell, or with expansion or contraction of said tubes, without imposing excessive stresses on the joints between the tube sheets and tubes, and chambered heads fitting over said tube sheets and comprising flanges seated in said grooves of the tube sheets.

3. Apparatus such as described, comprising in combination a tubular shell having at its ends flanges formed by curved portions of the shell having a large radius of curvature, and transverse tube sheets connected to said flanges and tubes connecting said tube sheets.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

NICOLAI H. HILLER.

Witnesses:
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