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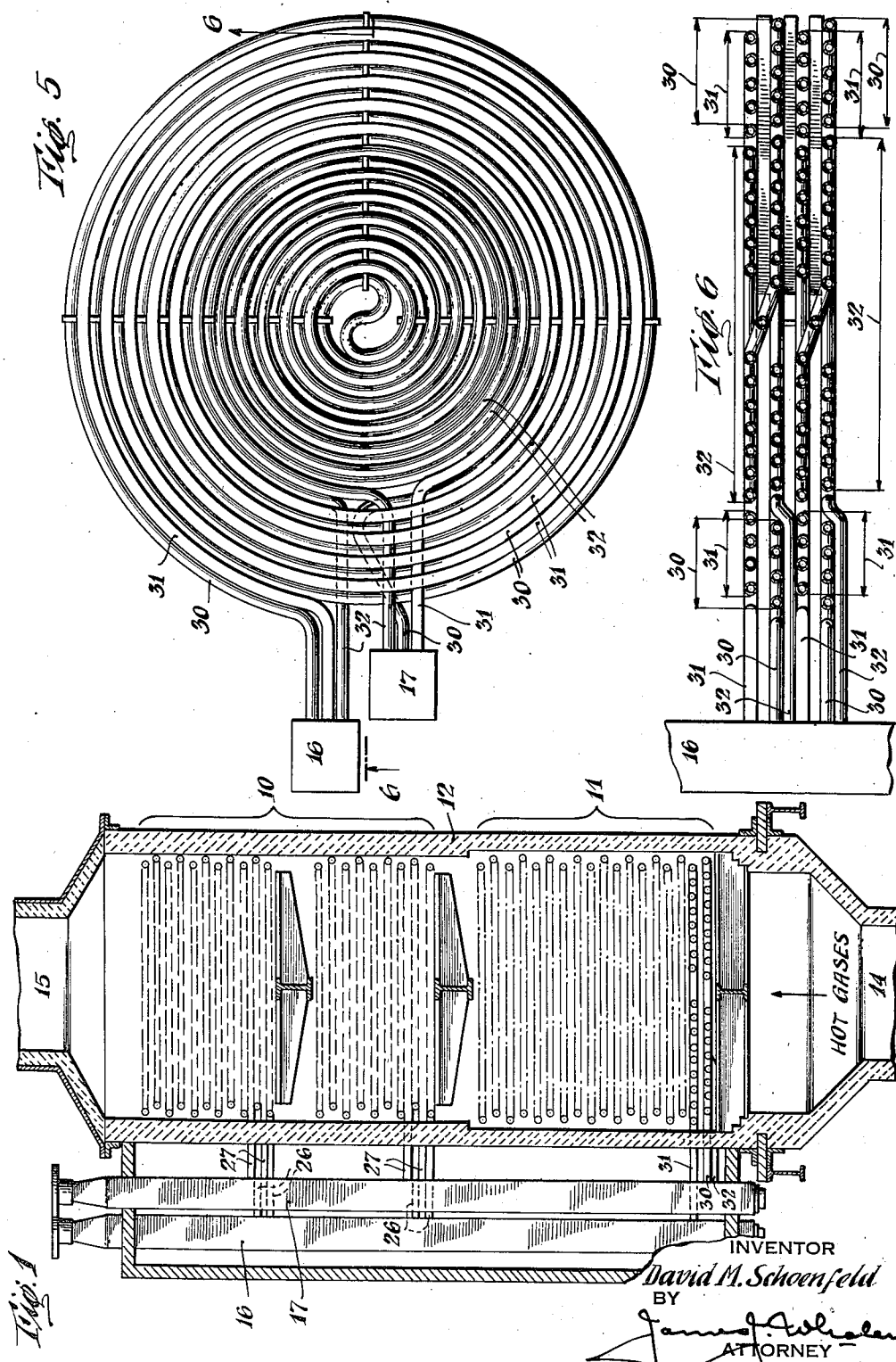
D. M. SCHOENFELD

2,300,634

TUBE COILS

Filed April 26, 1941

3 Sheets-Sheet 1



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Filed April 26, 1941

3 Sheets-Sheet 2

Fig. 2

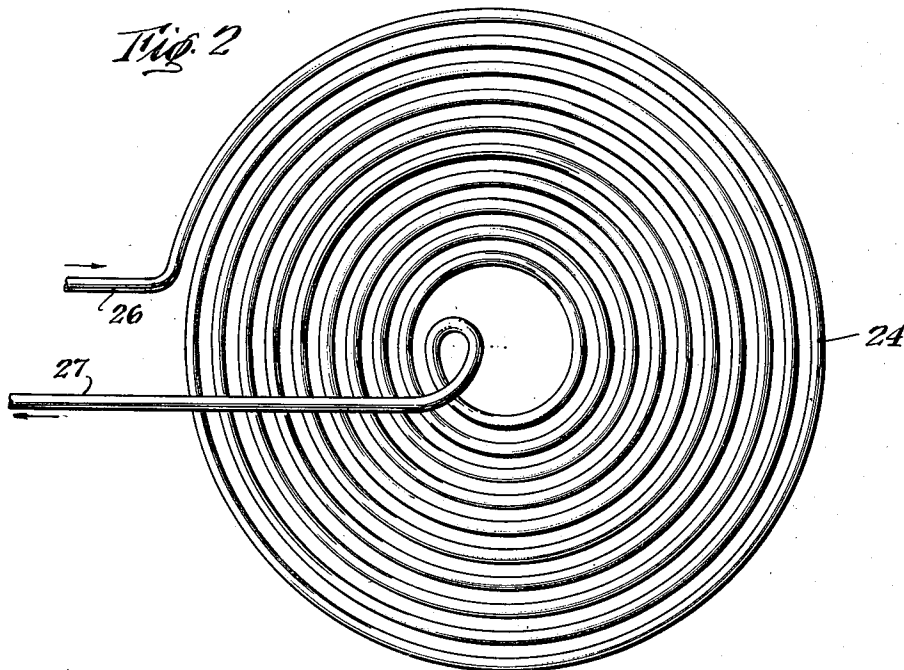


Fig. 3

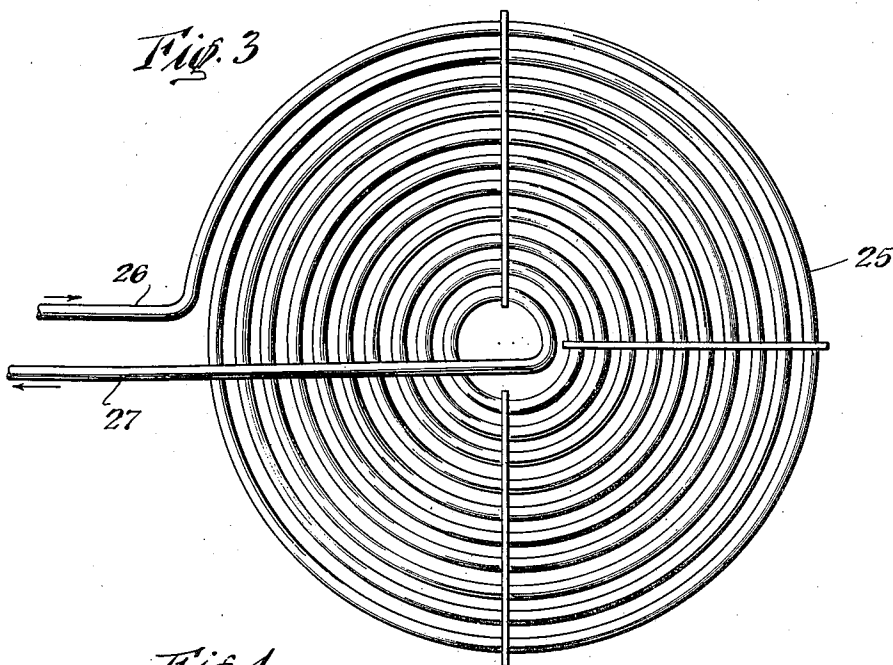
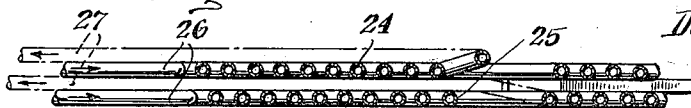


Fig. 4



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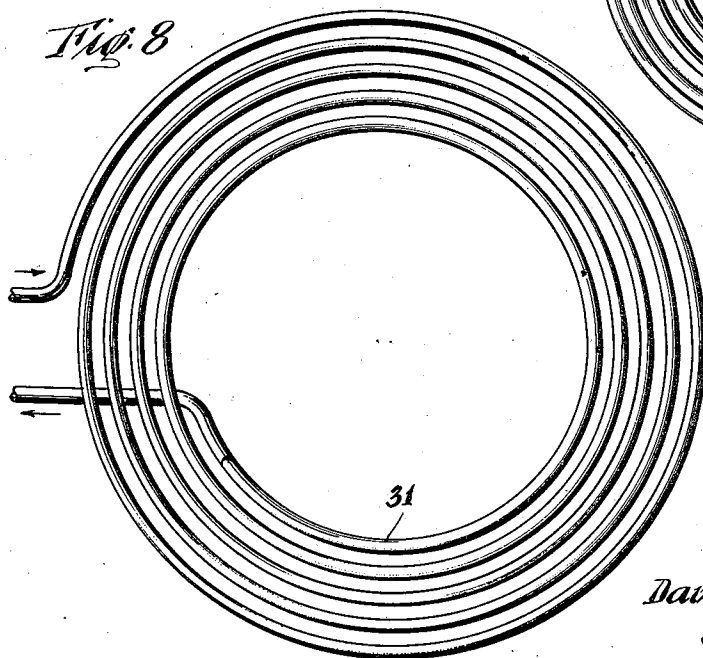
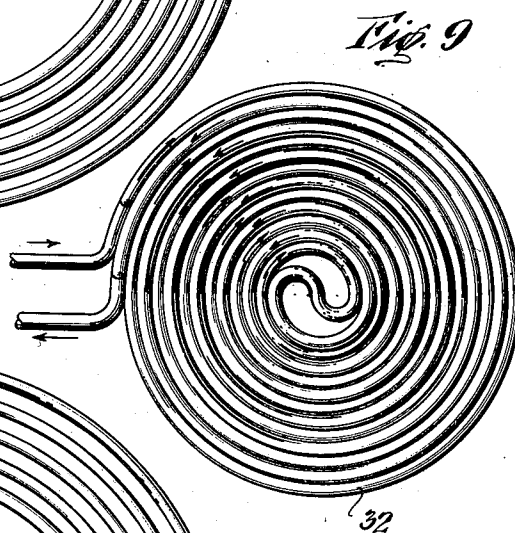
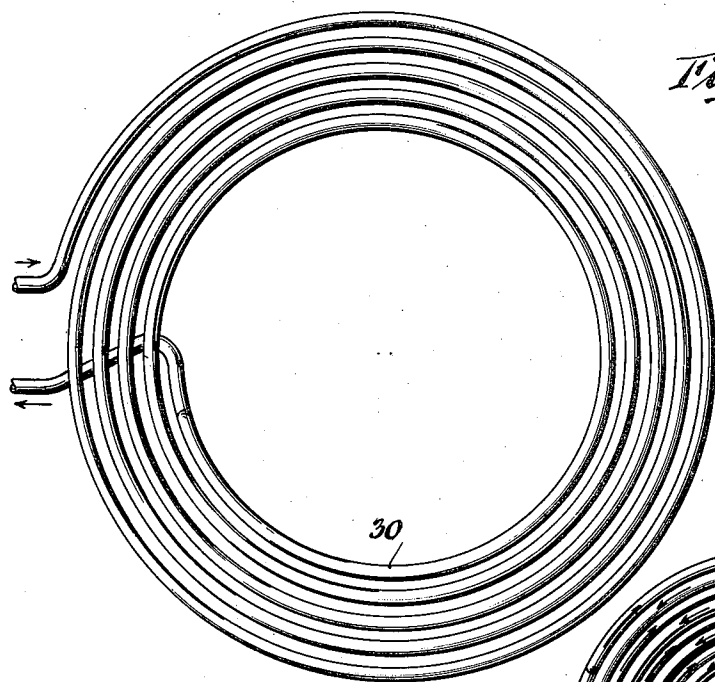
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2,300,634

TUBE COILS

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Application April 26, 1941, Serial No. 390,532

3 Claims. (Cl. 122—250)

This invention relates to improvements in tubular heat exchange elements adapted for use in forced circulation boilers and particularly in waste heat forced circulation boilers.

In waste heat boilers such as those used to extract heat from exhaust gases of gas engines, it is desirable to have the tubes arranged compactly so as to occupy a small space. A flat tube coil is a useful form of heat exchange element for constructing such a boiler. These coils are usually made by bending a continuous tube in a plane into a spiral between the circumference and the center and a plurality of such coils are arranged one upon another, the ends being connected into inlet and outlet headers for receiving and discharging the fluid to be heated. The assembled coils are usually mounted in a cylindrical casing which is suitable for resisting internal gas pressures. When these superimposed coils are all made alike, the lengths and diameters of tubes being equal, the resistance to fluid flow there-through varies considerably; the coils through which all liquid or nearly all liquid flows have a much lower pressure drop from end to end than those coils through which a major portion of vapor flows in the vapor liquid mixture. This relatively high resistance of the coils in which vapor predominates may cause a greater pressure drop therethrough than is warranted or can be economically met by the design since the power required to operate the circulation pump becomes excessive. To overcome this difficulty the coils, when made of tubing of the same tube diameter, may be varied in length, the coils in which vapor predominates being made relatively shorter than the coils in which the liquid predominates.

It is an object of this invention to provide in a forced feed vapor generator a plurality of spirally wound coils through which the fluid to be vaporized is forced in parallel circuits, the coils being divided into sets arranged in superimposed relation. The coils in one set are of different lengths than the coils in another set and so arranged that each of the assembled sets has substantially the same overall diameter and tube length, the same tube size and tube spacing in all groups, whereby the resistance to fluid flow through each of the coils is substantially the same.

How the foregoing, together with other objects and advantages as may hereinafter appear or are incident to my invention are realized, is illustrated in preferred form in the accompanying drawings wherein:

Figure 1 is an elevational view, partly in section, of a waste heat type boiler embodying tubular heat exchange elements formed in accordance with the present invention;

Figures 2 and 3 are plan views each illustrating one of the two coils forming the set illustrated in Figure 4.

Figure 4 is a sectional view on an enlarged scale through a set of elements utilized in the upper part of the boiler, the set consisting of two superposed tube coils having tube turns arranged in staggered relation;

Figure 5 is a plan view on an enlarged scale of one of the sets of tube coils utilized in the lower portion of the boiler, the set consisting of three tube coils;

Figure 6 is a sectional view on line 6—6 in Figure 5 and illustrates the relationship of the three coils forming the set shown in Fig. 5.

Figures 7 and 8 are plan views of two of the coils forming the set illustrated in Figs. 5 and 6;

Figure 9 is a plan view of the third coil in the set illustrated in Fig. 5.

Referring to Fig. 1, the heat absorbing surface of the boiler consists of tube coils divided into two groups designated as 10 and 11 and mounted in a cylindrical casing 12. When the boiler utilizes waste heat, the ends of casing 12 are suitably contracted at 14 for connection to a hot gas conduit at the bottom and at 15 for connection to an offtake flue 15. An inlet header 16 and an outlet header 17 are located exteriorly of the cylindrical casing 12 and are so connected to the tube coils as to supply the liquid to be vaporized to the coils and remove the vapor-liquid mixture therefrom.

In the embodiment shown in Fig. 1, the sets of coils in the boiler are divided into two groups, designated 10 and 11. Group 10 is farthest removed from the inlet for hot gases and relatively little steam is made in its tubes. It consists of sets of coils arranged as shown in Figs. 2, 3 and 4. Group 11 which is nearest to the hot entering gases and in which a major portion of the tubes are filled with steam, is constructed of sets of coils as shown in Figs. 5 to 9.

Figs. 3 and 4 show, respectively, the top and bottom tube coils making up one of the several sets of elements in group 10. Each set is made up of two superimposed tube coils 24 and 25. Liquid enters each coil through the ends 26 and 27 which connect with headers 16 and 17 respectively. The coils 24 and 25 are wound spirally on slightly spaced axes so that when assembled in superimposed relation as shown in Fig. 4, the

tubes of coil 24 are staggered with respect to the tubes of coil 25.

Figs. 5 and 6 show a set of elements in group 11, the assembled tube coils being illustrated in plan and section respectively. Each set is made up of three tube coils 30, 31 and 32, all being individually connected to inlet header 16 and outlet header 17 at their opposite ends. Fig. 7 shows a bottom coil 30 of a set in group 11. Similarly Fig. 8 shows a top coil 31 of an element of group 11. The tubes in coils 30 and 31 have convolutions wound to form flat ring coils, so that when assembled in superimposed relation as shown in Figs. 5 and 6 the tubes of the bottom coil 30 are staggered with respect to the tubes of the top coil 31. When the tube coils 30 and 31 are assembled there is a central opening in the set which is filled in by the tube coil 32 shown in plan in Fig. 9. Tube coil 32 differs from the remaining coils in that the continuous tube from which it is made is wound in two superimposed flat volute coils, one spiralling toward the center and the other toward the circumference, each volute coil being located in a plane with one of the tube coils 30 and 31 of the assembled set. The tubes of the volute of the upper part of coil 32 are staggered with respect to the tubes of the volute of the lower coil.

The two tube coils 24 and 25 forming a set in group 10 have substantially the same total tube length as the three tube coils 30, 31 and 32 forming a set in group 11, one tube coil 24 or 25 being one and one-half times as long as the length of one tube coil 30, 31 or 32. Since the velocity of fluid flow through the tubes of group 11 is greater than that through the tubes of group 10, the resulting greater resistances per unit length of the latter are offset by their shorter length of tubes and a closer uniformity of pressure drop for the groups is obtained.

What I claim is:

1. In a heat exchanger having a chamber provided with an inlet and outlet for circulating a heating gas therethrough; a plurality of heat absorbing units mounted in said chamber near the outlet thereto each comprising a tubular element wound in a plurality of closely spaced convolutions to form a flat volute coil disposed transversely of said chamber; a plurality of heat absorbing units mounted in said chamber near the

inlet thereof each comprising a tubular element wound in a plurality of closely spaced convolutions to form a flat ring coil disposed transversely of said flue; a plurality of tubular elements each wound in a plurality of closely spaced convolutions to form a double flat volute coil fitting within and concentric with two of said ring coils, one volute section being in the plane of one ring coil and the other volute section being in the plane of an immediately adjacent ring coil, the aggregate length of the tubular elements forming two ring coils and a related double volute coil being substantially the same as the length of two tubular elements forming a volute coil disposed near the outlet of said chamber and the diameters of all said tubular elements being the same; and inlet and outlet headers to which opposite ends of the tubular elements forming each coil are connected.

2. In a heat exchanger having a gas duct, and inlet and outlet headers for a fluid to be heated; a pair of heat absorbing coils located in said duct comprising tubular elements connected at opposite ends to said inlet and outlet headers and wound in a plurality of closely spaced convolutions about the longitudinal axes of said duct to form flat ring coils located in planes transverse of said duct, said two coils being located in immediately adjacent planes; and a tubular element wound spirally in one direction in spaced convolutions to form a flat volute coil disposed in the plane of one ring coil and wound specially in the opposite direction in closely spaced convolutions to form another flat volute coil located in the plane of a second immediately adjacent ring coil.

3. In a heat exchanger having a gas duct, and inlet and outlet headers for a fluid to be heated disposed longitudinally of said duct; a plurality of flat heat absorbing coils each constructed of the same size of tube disposed in parallel planes transverse of said duct and individually connected to said inlet and outlet headers, the length of a heat absorbing coil located in a heat zone near the inlet of said duct being less than the length of a coil located in a cooler zone near the outlet of said duct in approximate inverse proportion to the respective resistances to fluid flow therethrough per unit of length.

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