

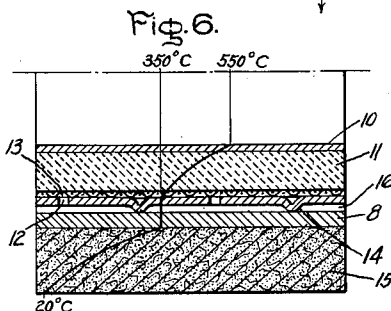
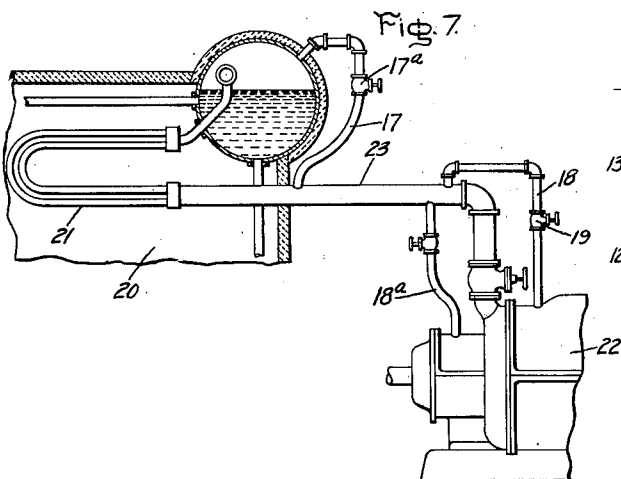
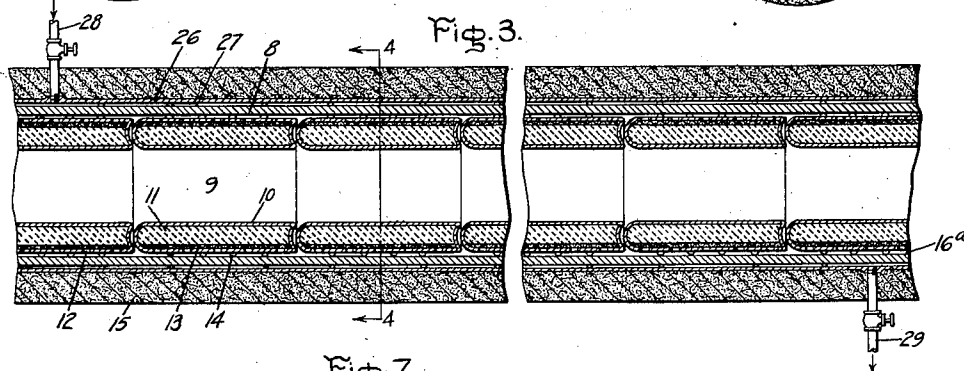
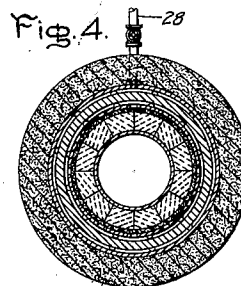
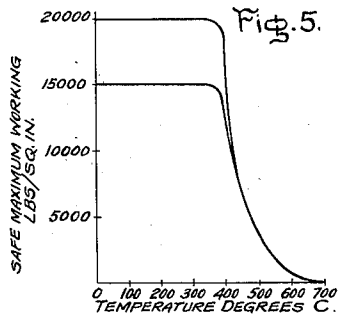
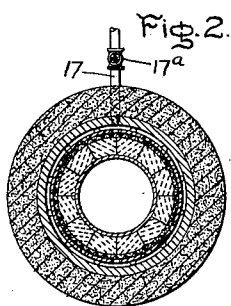
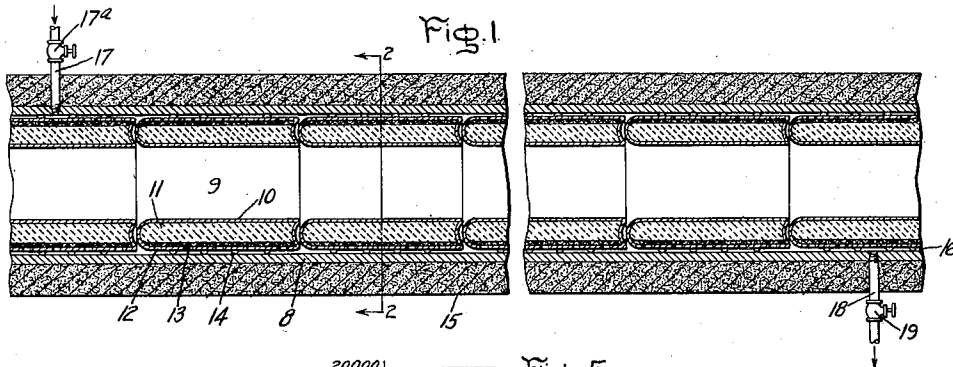
May 28, 1929.

F. P. COFFIN

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CONDUIT FOR CONVEYING HIGH TEMPERATURE FLUIDS

Filed June 25, 1928



Inventor:
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UNITED STATES PATENT OFFICE.

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CONDUIT FOR CONVEYING HIGH-TEMPERATURE FLUIDS.

Application filed June 25, 1928. Serial No. 287,913.

The present invention relates to conduits for conveying fluids, and especially to conduits for conveying fluids of high temperatures at substantial pressures.

5 The object of my invention is to provide an improved conduit of this type, and for a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims
10 appended thereto.

In the drawing, Fig. 1 is a longitudinal sectional view of a conduit embodying my invention; Fig. 2 is a sectional view taken on line 2—2 of Fig. 1; Fig. 3 is a longitudinal
15 sectional view of a conduit embodying a modified form of my invention; Fig. 4 is a sectional view taken on line 4—4 of Fig. 3; Fig. 5 is an explanatory diagram; Fig. 6 is a diagrammatic view indicating the temperature distribution in the walls of a conduit embodying my invention and Fig. 7 is a diagrammatic view showing the way in which a
20 conduit as shown in Figs. 1 and 2 may be utilized for conveying elastic fluid from a boiler to an elastic fluid turbine.

In connection with the production and utilization of fluids of substantial pressure and high temperature, such as for example, highly superheated steam, the problem of the
30 transportation of the fluid from its point of production to its point of utilization is a serious one in that the piping reaches a temperature of a value such that its strength may be impaired and in that, due to the high temperature, the loss of heat by radiation tends
35 to become excessive. At the present time, one of the factors marking the upper limits of temperature and pressure in connection with the utilization of elastic fluids of high temperature and pressure is that of providing
40 conduit means for conveying the elastic fluid. This will be appreciated from a consideration of the diagram shown in Fig. 5, wherein the safe maximum working pressure in pounds
45 per square inch low for carbon steel and for medium carbon steel has been plotted against temperature in degrees centigrade. It will be noted that in each instance, after a temperature somewhat greater than 400° C. is
50 reached, the safe maximum working pressure decreases at a rapid rate.

According to my invention, I provide a metal conduit and arranged inside of it a

heat-insulating lining of a character such that it is capable of withstanding the temperatures
55 to be met with and I then provide in connection therewith a means whereby a fluid of lower temperature may be circulated along a surface of the pipe for removing heat from
60 any parts of the pipe which may be receiving heat at a more rapid rate than the main portion of the pipe.

Referring to Figs. 1 and 2 of the drawing, 8 indicates a pipe formed of suitable material such as carbon steel, for example,
65 and which is to be utilized for conveying a fluid of high temperature and substantial pressure. Inside the conduit I provide an insulating lining comprising a plurality of cylinders 9 arranged end to end, each cylinder comprising a metal envelope or casing 10
70 in which is located a heat-insulating material 11. The heat-insulating material may be of any suitable character. I may use with advantage the material known as "rock wool".
75 This is a variety of mineral wool manufactured by fusing a suitable variety of natural rock and subjecting the molten material to a jet of steam which blows it into an atomized condition. It then crystallizes in long needles
80 or threads which settle in the form of a mass of wool. Such material is capable of withstanding temperatures of the order of 650° C. The outer wall of casing 10 is provided
85 with perforations 12 which serve to admit fluid from the conduit to the inside of the casing, thereby equalizing the pressures on all its walls. Covering the outer wall is a backing 13 which may be formed with advantage
90 from woven wire material.

The heat-insulating substance 11 may be placed in the casing as a continuous cylinder or it may be made up in a number of sections as is indicated in Fig. 2. The outer wall of the casing is provided with projections 14
95 which serve to space the casing from the inner surface of pipe 8.

The several sections 9 of the heat-insulating lining are spaced apart sufficiently to permit them to expand when heated. The arrangement is such that at the operating temperature they are substantially in engagement with each other, the joints being almost closed. When the conduit cools the joints will open
100 a little with the contraction of the metal owing to the fact that the metal will cool through
105

a greater range of temperature than the main pipe. Also, in certain instances, there may be a difference in the coefficient of expansion between the metal in the pipe 8 and that in casings 10.

The division into sections of the casing for the inner lining is also necessary for assembly in a pipe containing bends.

On the outside of pipe 8 I provide a suitable lagging as is indicated at 15.

With the described arrangement there is provided an annular passage or space 16 between the outer surfaces of the lining and the inner surface of the pipe 8. Connected to space 16 is a pipe 17 provided with a valve 17^a and a pipe 18 provided with a valve 19. These pipes may be utilized to supply to the annular space an auxiliary stream of the same fluid at a lower temperature than the main stream. This cooler fluid flows in through one of the pipes, then along the annular space and out through the other pipe. The circulation of this fluid serves to carry heat away from any hot spots in the pipe 8 thereby maintaining its temperature at a safe value throughout its entire length.

The temperature gradients through the internal and external laggings are shown diagrammatically in Fig. 6. It is here assumed that the temperature of the fluid flowing through the conduit is 550° C. The drop in temperature through the insulating lining is of the order of 200° C., bringing the temperature at the pipe down to 350° C. which is a safe temperature for the material of the pipe. A further drop of temperature to 20° C. may occur through the lagging 15.

The actual temperature of the metal wall of the pipe 8 will be determined by the relative thermal conductivities of the inner and outer laggings. If both laggings are made of the same material, rock wool for instance, the relative thicknesses should be so proportioned as to maintain the pipe at a temperature higher than the condensation temperature of the fluid at the usual working pressure. The temperatures indicated in Fig. 6 are suitable for use with steam under the highest pressures in common use, such as 1200 to 1400 lbs. per sq. in. Over this range of pressure condensation takes place at temperatures of approximately 298° to 310° C. Obviously, a safe margin of temperature is necessary to maintain the steam in a superheated condition where it fills the interstices of the rock wool or other insulating material in the pipe lining 11. Hence the condensation point of the fluid determines the minimum working temperature for the pipe 8, since it is necessary to maintain the insulating value of the lining by avoiding condensation.

At the same time, it is very desirable to maintain the pipe 8 at as low a temperature as is practicable in order to reduce the thermal expansion to a minimum since this can

only be taken care of by providing flexibility in the piping. This is an expensive matter to provide for.

Flexibility is provided in the metal casings for the insulating lining by means of the joints between the sections. At these points there will obviously be a larger flow of heat to the pipe 8. The same will be true at any points where the insulating filling material is accidentally displaced. At such points the temperature gradient will be disturbed so that the tendency will be for the metal of the pipe 8 to reach a higher temperature than at other points.

Similarly, if the external lagging is displaced at any point there will be a tendency for the pipe 8 to operate at a lower temperature so that local condensation might occur.

The function of the auxiliary stream of fluid in the annular spaces, 16, (Fig. 1) or 16^a, (Fig. 3) is to equalize the temperature of the metal wall of the pipe 8 throughout its entire length, by cooling the hotter spots and warming the cooler spots.

This auxiliary stream of fluid should be tapped from the superheater, or other source, at a temperature above the condensation point, and yet not too high. When admitted to the annular conduit 16, or 16^a, it will soon come to the mean temperature of the pipe 8 which is determined by the temperature gradient, (Fig. 6) and not by the initial temperature of the auxiliary stream of fluid.

In Fig. 7, 20 indicates an elastic fluid boiler provided with a superheater 21 and utilized for supplying elastic fluid to a turbine 22. 23 indicates a conduit of the type illustrated in Figs. 1 and 2 for conveying elastic fluid from the boiler to the turbine. The interior of the conduit is connected to the superheater of the boiler while pipe 17 is connected to the boiler drum. With this arrangement, superheated elastic fluid is conveyed through the interior of the conduit while saturated elastic fluid, which is of substantially lower temperature, is carried through the annular passage 16. The pipe 18 may be connected to any suitable point. In the present instance, it is shown as being connected to an intermediate stage of the turbine. Also, I have shown a pipe 18^a similar to pipe 18 connected to the high pressure packing of the turbine to provide sealing elastic fluid for the packing. Both or either of these pipes may be used as found desirable.

In Figs. 3 and 4 I have shown a modification of my invention wherein the cooling fluid, instead of being conveyed along the inner surface of pipe 8, is conveyed along the outer surfaces thereof. To this end, I provide a casing 26 which surrounds pipe 8 in spaced relation thereto to provide an annular passage 27 similar to passage 16 of Figs. 1 and 2 except that it is outside instead of inside pipe 8. I then provide pipes 28 and 29

which are connected to annular passage 27 and may be utilized for circulating a cooling medium through passage 27. With this arrangement I may, if desired, use for cooling 5 fluid a fluid different from that which flows through the pipe 8. For example, I may use air or other gas as a medium for carrying heat away from pipe 8.

In accordance with the provisions of the 10 patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the appa- 15 ratus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In a conduit for conveying high tem- 20 perature fluid, the combination of a metallic pipe, a heat-insulating lining in said pipe, and means whereby a fluid of lower temperature may be circulated along a surface of the pipe for equalizing the temperature through- 25 out the entire length of the pipe, by removing heat from the hotter portions and warming the cooler portions.

2. In a conduit for conveying high temper- 30 ature fluid, the combination of a metallic pipe, a heat-insulating lining in said pipe comprising a plurality of sections of heat-insulating material, and means whereby a

fluid of lower temperature may be circulated along a surface of the pipe for equalizing the temperature throughout the length of the 35 pipe.

3. In a conduit for conveying high temper- ature fluid, the combination of a metallic pipe, a heat-insulating lining in said pipe 40 comprising a plurality of sections of metal- encased, heat-insulating material, said sections being spaced longitudinally sufficiently to permit of their expansion and contraction relatively to each other, and means whereby 45 a fluid of lower temperature may be circulated along a surface of the pipe for equalizing the temperature throughout the length of the pipe.

4. In a conduit for conveying high temper- ature fluid, the combination of a metallic 50 pipe, a heat-insulating lining in said pipe comprising a plurality of sections of metal- encased, heat-insulating material, said sections being spaced longitudinally sufficiently 55 to permit of their expansion and contraction relatively to each other, and being spaced from the inner wall of said pipe to form an annular passage, and means whereby a fluid of lower temperature may be circulated 60 through said annular passage.

In witness whereof, I have hereunto set my hand this 21st day of June, 1928.

FRANCIS P. COFFIN.