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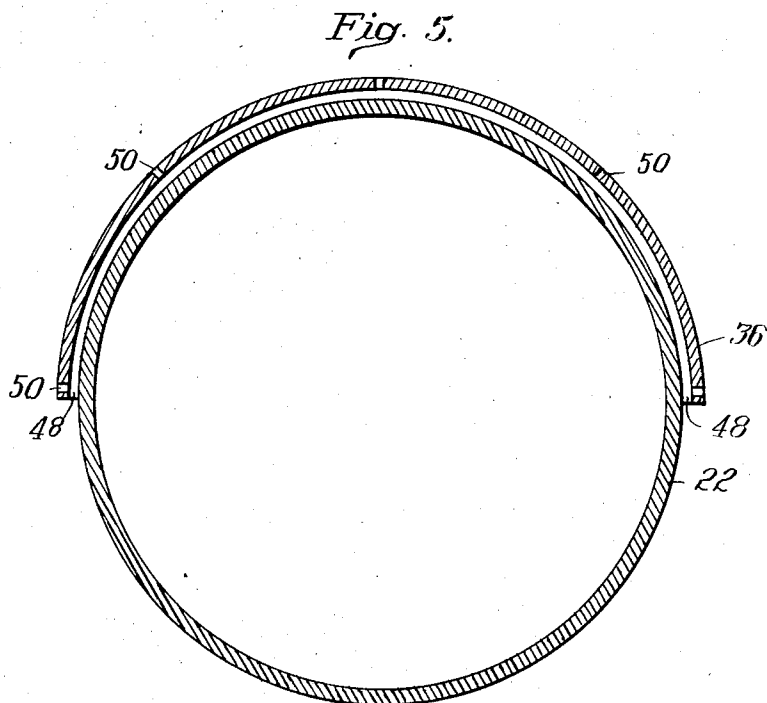
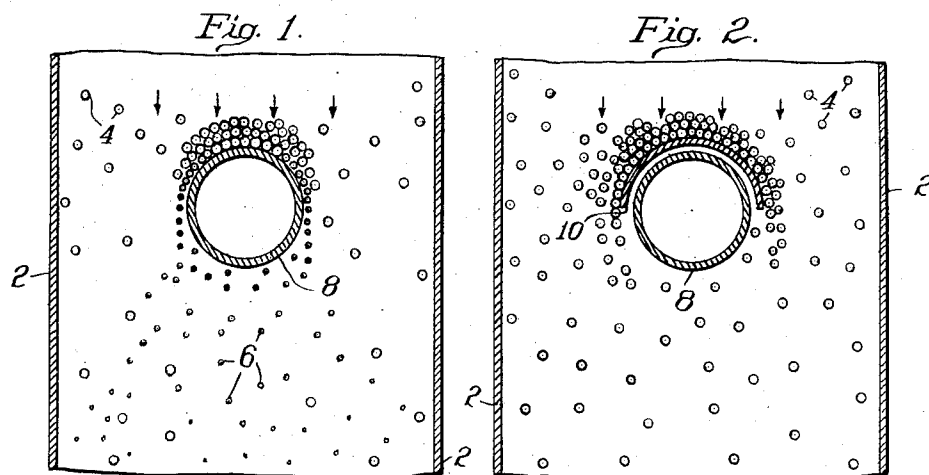
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2,853,279

HEAT TRANSFER RETARDING SHIELDS

Filed Nov. 27, 1953

2 Sheets-Sheet 1



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Fig. 3.

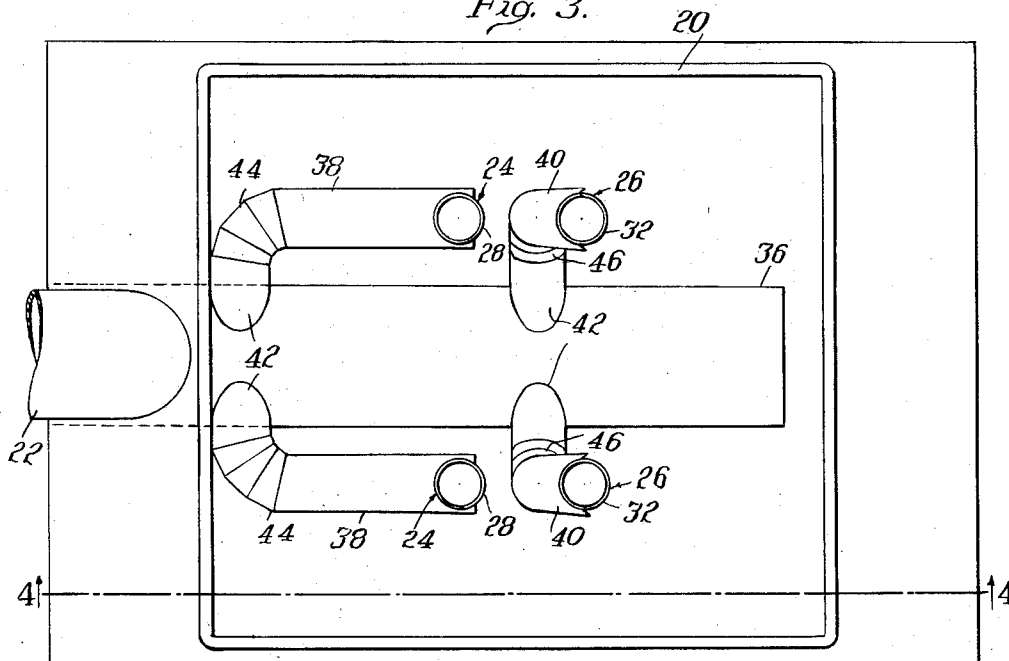
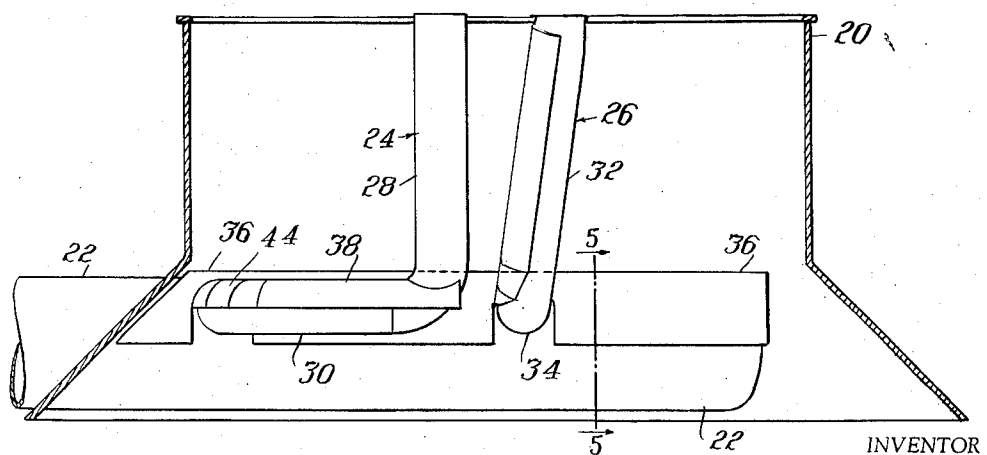


Fig. 4.



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HEAT TRANSFER RETARDING SHIELDS

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2 Claims. (Cl. 257—241)

This invention relates to heat transfer retarding shields, and, more particularly, to the shielding of potential heat transfer surfaces from impingement by a moving fluid.

Space limitations and other design considerations sometimes lead to the positioning of a member inside a duct carrying a fluid stream the temperature of which is different from the temperature of the member. Impingement of the moving fluid against the surface of the member so agitates the fluid adjacent the surface of the member as to give it a high film coefficient and to make the heat exchange between the member and the fluid very efficient.

Other factors may also contribute to the exchange of heat. For example, where the fluid is a relatively cool gas carrying particles of liquid suspended therein and where the surface of the member is relatively warm, the moisture particles striking the member will adhere thereto to form a liquid film on the member surface, and the film coefficient will be quite high as compared to that which would exist in the absence of the liquid. Furthermore, the liquid can absorb a relatively large amount of heat from the member without any appreciable rise in its temperature.

According to the present invention, such heat transfer, which in many cases results in a total loss of the transferred heat, is minimized by placing a shield adjacent the upstream surface of the member to intercept the moving fluid stream. The shield is formed by one or more metal plates secured to spacers mounted on the surface to be protected.

Although the ultimate effect of this invention, that is, the reduction of the rate of heat transfer, is the same as that produced by insulating with conventional materials, the invention has several advantages over the latter practice. Conventional insulating materials would have to be completely sealed or jacketed to avoid soaking in a wet atmosphere. This procedure results in a bulky structure in which access to the covered surfaces is difficult. Furthermore, there is a limitation upon what materials may be used as insulation, and it may not be possible in some instances to select a material which would not cause contamination of the flowing fluid. In contrast, the shields of this invention are compact, they may be removed for access to the covered surfaces and reused without damage, they may be made of materials which will not contaminate the fluid, and they will serve to protect the covered surfaces against erosion.

The principles of this invention have been found to be particularly useful in steam turbine power plant installations where the feed water heaters or the extraction steam lines must pass through the condenser neck and be subjected to contact with the relatively cool exhaust steam passing to the condenser. In such installations, the heat loss attributable to the transfer of heat from the extraction lines and heaters to the exhaust steam may be reduced radically by providing the surfaces of the pipes and heaters facing toward the oncoming exhaust steam with shields.

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Various other advantages of the invention will become apparent as the detailed description thereof proceeds in connection with the accompanying drawings, in which:

Fig. 1 is a diagrammatic view representing the prior art and showing an unshielded pipe in a moving stream of gas containing liquid particles;

Fig. 2 is a diagrammatic view similar to Fig. 1 but showing a pipe shield positioned over the pipe in accordance with the present invention;

Fig. 3 is a plan view of a condenser neck section of a steam power plant installation showing various surfaces shielded in accordance with this invention;

Fig. 4 is a vertical sectional view taken along line 4—4 on Fig. 3; and

Fig. 5 is a detail vertical sectional view taken along line 5—5 on Fig. 4.

In Figs. 1 and 2, the numeral 2 designates a conduit or duct carrying a downwardly moving stream of moist steam or some other gas having particles of liquid suspended therein. For purposes of illustration, the liquid particles 4 in the gas are greatly enlarged in Figs. 1 and 2. Also, the sizes of the particles are uniform except where heat has been transferred to them to cause partial evaporation thereof. Small liquid particles are indicated by the numeral 6 in Fig. 1. Positioned within the conduit 2 in the path of the fluid stream is a pipe 8 which carries a fluid at a higher temperature than the temperature of the fluid stream moving downwardly in the conduit 2.

In the prior art arrangement shown in Fig. 1, the downwardly moving fluid stream in the conduit 2 impinges against the upper surface of the pipe 8. This impact of the fluid particles increases the turbulence of the surface film adjacent the surface of the pipe 8 to increase the rate of heat transfer. Additionally, the liquid particles 4 striking the upper surface of the pipe 8 tend to collect thereon so as to increase the density of the surface film and further increase the heat transfer coefficient of the film. Still another factor contributing to the efficiency of heat transfer from the pipe 8 to the downwardly moving fluid stream in conduit 2 is the fact that the liquid particles 4 in the surface film adjacent the upper surface of the pipe 8 may absorb a large amount of heat without lowering substantially the temperature differential between the pipe surface and the film. As heat is added to the liquid, portions thereof merely evaporate and the temperature remains about the same.

According to the present invention, diagrammatically illustrated in Fig. 2, the rate of heat transfer from the pipe 8 to the fluid stream in conduit 2 is greatly reduced by positioning an arcuate shield 10 a short distance above the upper surface of the pipe 8. With this shield in place, the downwardly moving stream in conduit 2 does not impinge against the surface of the pipe 8, and as a result the surface film adjacent pipe 8 is relatively static and there is no tendency for the liquid particles to collect on the surface. The pipe 8 is insulated from the shield 10 by the space therebetween which contains a small body of relatively static, superheated gas, the spacing between the shield and pipe being kept at a sufficiently small value to prevent the establishment of efficient convection currents in the space. It is pointed out that in Fig. 2 all of the water particles 4 are about the same size. This is due to the fact that there is very little evaporation of the liquid when the shield 10 of this invention is used.

Turning now to Figs. 3 to 5 which show a practical installation embodying the principle of this invention, the numeral 20 is applied to a section of the conduit conducting cool, moisture laden exhaust steam from the last stage of a steam turbine to the steam condenser. This conduit 20 is commonly referred to as the condenser neck.

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The steam delivered to the condenser is at such a low temperature that recovery of heat therefrom is impractical, and this heat is rejected as waste to a river, a lake, or the atmosphere.

Extending into the condenser neck 20, because of space limitations or some other design consideration, are a horizontally disposed feed water heater 22 and a plurality of pairs of extraction lines or pipes 24 and 26 for conducting steam from an intermediate stage of the turbine to the feed water heater 22. Each of the lines 24 includes a vertical portion 28 and a curved horizontal portion 30. Each of the lines 26 includes a portion 32 inclined slightly to the vertical and a horizontal portion 34.

The heater and the extraction lines disposed within the condenser neck are shielded in accordance with this invention by providing a sheet metal shield adjacent all portions of the surfaces thereof which face the oncoming stream of exhaust steam and have an extent in a direction transverse to the direction of stream flow. The upper half of the heater 22 is covered by a large, arcuate, heater shield 36 of rolled steel. The upper half of the horizontal portion of each pipe 24 is covered by an arcuate shield 38, and the entire upwardly facing surface of the pipe 26 is covered by a shield 40.

Each of the shields 38 and 40 is made up of a plurality of differently shaped pieces of steel fitting together so as to give the shield a shape approximating that of the pipe portion covered. Individual reference numerals have not been applied to all of the pieces of each shield because this does not appear to be required to fully understand the illustrations. There are, however, several features which should be particularly pointed out.

It should be noted that the innermost piece 42 of each pipe shield has an inner edge contour corresponding to the contour of the adjacent edge of the heater shield 36 so that the junction points between the heater and the extraction pipes will be covered. It should also be noted that some of the curves in the shielded pipes require nothing more than a change in the direction of extent of the shield at that point, while other curves in the shielded pipes require a change in the circumferential position of the shield relative to the pipe as well as a change in the direction of its extent. The curves 44 in the pipes 24 are examples of the first-mentioned type of curves, and the curves 46 in the pipes 26 are examples of the second-mentioned type.

Fig. 5 is an enlarged, detail view showing how the heater shield 36 is secured to the upper surface of the feed water heater 22. Spacers in the form of butt straps such as the one designated by numeral 48 are spaced along the upper surface of the heater 22 and welded thereto. The shield 36 has several holes 50 drilled therein in the areas which overlie the butt straps 48 so that it may be plug welded to the butt straps. The pipe shields are secured to their respective pipes in a similar manner.

In an actual installation similar to the one illustrated in Figs. 3 to 5, the provision of the shields as shown resulted in a reduction in the rate of heat transfer to the exhaust steam from 300 to 500 B. t. u. per hour per square foot of surface per degree F. temperature difference to approximately 3 to 5 B. t. u. per hour per square foot of surface per degree F. temperature difference. In this

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embodiment the steam in the heater 22 was at about 140° F., the exhaust steam contained moisture in amounts varying from 5 to 15% of the weight of the steam and was at a temperature of about 80° F., and the exhaust stream was flowing during full load on the machine at approximately 190 miles per hour.

While this invention has been described with particular reference to a steam power plant, it will be appreciated that the broad principles thereof are applicable to other situations. Such situations may be found in the petroleum industry, the chemical industry, and in steel mills.

Since various modifications and applications will be apparent to persons skilled in the art, the above description is to be considered as exemplary only, and the scope of the invention is to be determined from the claims which follow.

I claim:

1. In apparatus comprising a conduit for a moving cool moisture laden fluid and a member disposed in said conduit so that a portion of its surface has an extent in a direction transverse to the direction of flow of said fluid and being at a temperature different from that of the moving fluid, said portion including sections disposed at an angle with respect to each other, a plurality of spacers secured to said portion of the surface of said member and a plurality of relatively angularly disposed pieces of metal secured to said spacers and fitting together to form a shield spaced a short distance from and covering entirely said transverse portion of the surface of said member to prevent impingement of said moving fluid against said portion of said surface.

2. In combination, a conduit for a moving low temperature wet exhaust steam, a feed water heater mounted in said conduit and having a wall portion facing said moving wet steam, a pipe in said conduit having a wall portion facing said moving wet steam terminating in angularly related sections connected to said feed water heater, said pipe adapted to feed steam at a higher temperature and pressure to the feed water heater than that in the conduit, a plurality of spacers secured to said portions of said heater and pipe, a metal shield secured to the spacers on said heater, a plurality of relative angularly disposed pieces of metal fitting together and secured to the spacers on the pipe to form a shield, said shields spaced a short distance from and covering said entire wall portions to prevent impingement of said moving wet steam against said wall portions.

References Cited in the file of this patent

UNITED STATES PATENTS

657,366	Smith	Sept. 4, 1900
782,929	Stewart	Feb. 21, 1905
1,688,413	Delas	Oct. 23, 1928
1,756,987	Morgan	May 6, 1930
1,811,302	Church	June 23, 1931
1,815,932	Sieder	July 28, 1931
2,234,423	Wittmann	Mar. 11, 1941
2,564,153	Comeau	Aug. 14, 1951
2,646,818	Bimpson	July 28, 1953

FOREIGN PATENTS

280,920	Germany	Dec. 3, 1914
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