

Jan. 25, 1927.

1,615,451

T. R. HARRISON

THERMOCOUPLE

Filed Feb. 1, 1926

2 Sheets-Sheet 1

FIG. 1,

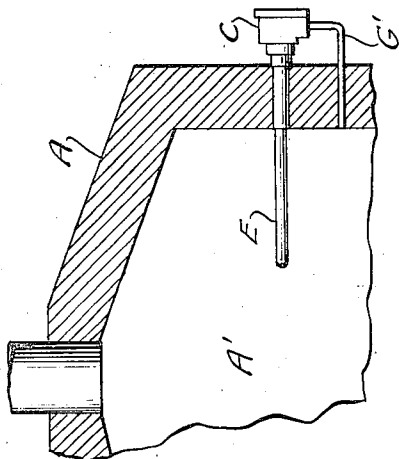


FIG. 2,

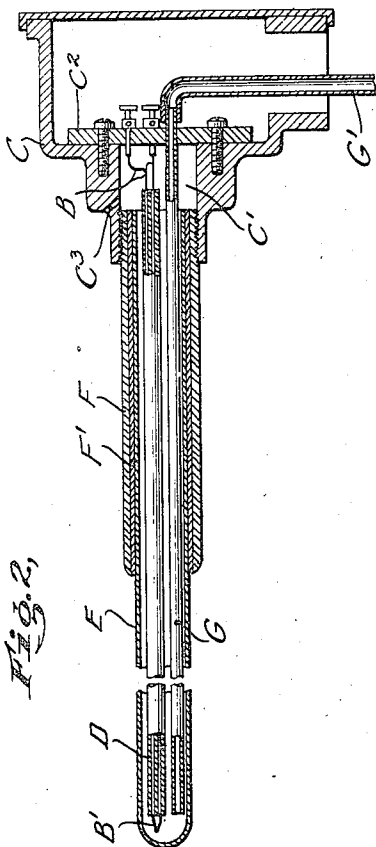
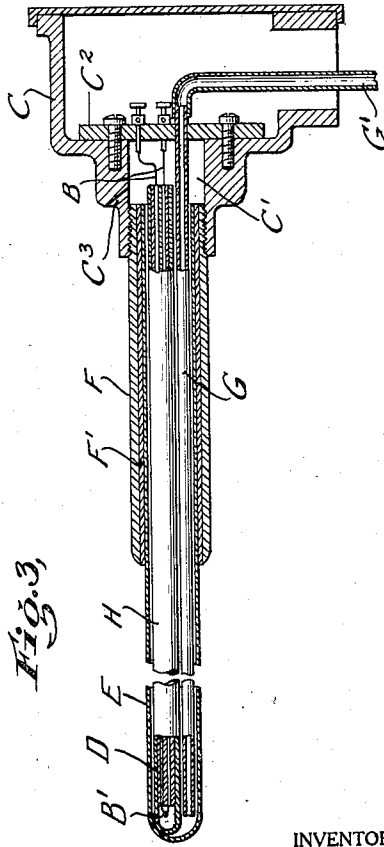


FIG. 3,



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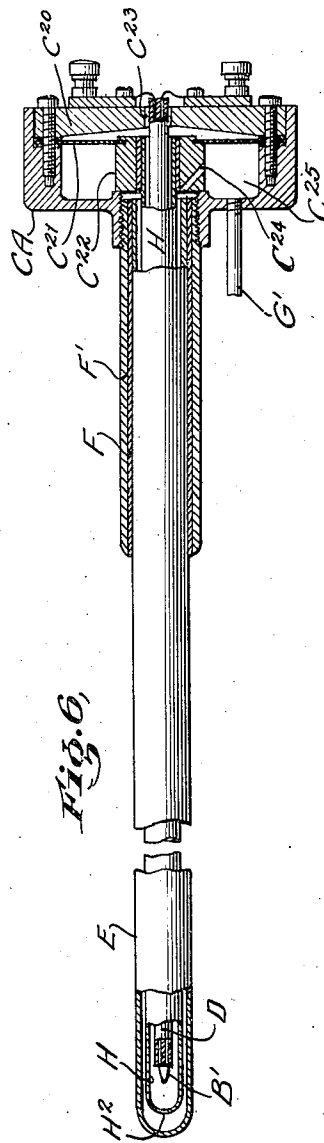
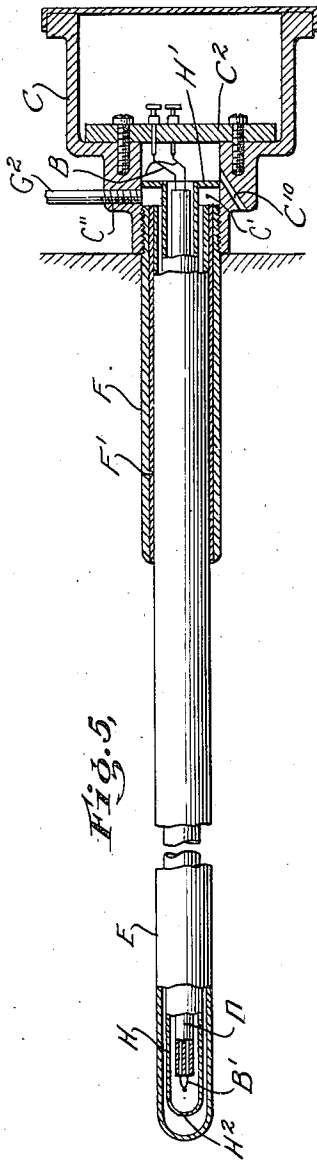
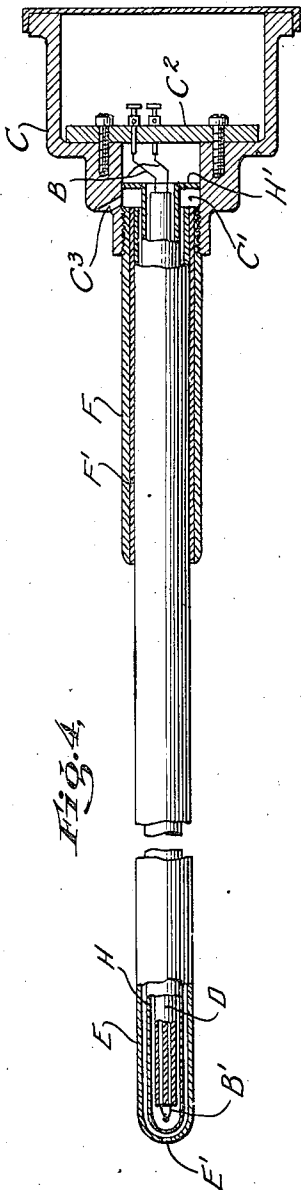
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

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THERMOCOUPLE.

Application filed February 1, 1926. Serial No. 85,176.

The general object of the present invention is to provide simple and effective means for protecting thermo-couples employed in measuring the high furnace temperatures from injurious contact with the furnace gases. Heretofore serious troubles have been experienced as a result of the deteriorating action of furnace gases on the thermo-couple conductors both when the thermo-couple elements are the so-called noble metals employed in measuring high furnace temperatures as for example in burning refractories where the thermo-couple may be exposed to furnace temperatures as high as 2700° F. or above, or are the base metals employed in measuring temperatures not higher than 1800° F. or thereabouts. In thermo-couples employed under such conditions the active portions of the thermo-couple conductors, including the hot junction of the thermo-couple are commonly surrounded by a tube or casing of non-metallic material such as unglazed porcelain, fire clay, or analogous material, the purpose of such tube or casing being to prevent the furnace gases from coming into contact with the thermo-couple conductors. In practice, however, when such a protective tube becomes highly heated in use, furnace gases frequently pass through the pores of, or through cracks in the protective tube in amount sufficient to corrode and destroy or impair the effectiveness of the thermo-couple.

In accordance with the present invention, thermo-couples for measuring high furnace temperatures are protected against injurious contact with furnace gases in a simple and practically feasible manner, by maintaining a minute flow of air through the interior of the protective casing of the thermo-couple. This flow of air must be relatively minute in quantity to prevent it from having any appreciable or significant cooling effect which would make the thermo-couple indications lower than they should be, but only a very minute flow of air through the thermo-couple casing is required to eliminate the injurious consequences of furnace gas leakage into the thermo-couple casing. To secure the desired flow of air through the thermo-couple casing, I may employ the furnace draft, as by providing an outlet connection from the thermo-couple casing to a portion

of the furnace in which a minus pressure exists while at the same time providing an inlet to the casing for atmospheric air which is sucked through the casing by the furnace draft suction. In lieu of using the furnace draft suction in this manner, any other suitable and convenient aspirating means may be employed. For instance, in some cases I may provide a thermo-couple casing with a vertical outlet pipe extending upward from the thermo-couple casing along the outer wall of the furnace and open at its top to the atmosphere so that the heat of the furnace coupled with the heat absorbed by the thermo-couple casing will provide a stack action giving the necessary draft.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this application. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred embodiments of my invention.

Of the drawings:

Fig. 1 is a sectional elevation of a portion of a furnace and thermo-couple for measuring the temperature therein;

Fig. 2 is an enlarged section of the thermo-couple shown in Fig. 1;

Figs. 3, 4, 5, and 6 are views taken similarly to Fig. 2 each illustrating a different modification.

In the drawings and referring first to Figs. 1 and 2, A represents the wall of a furnace. Into a high temperature portion A' of its interior extends a thermo-couple, which as shown in Figs. 1 and 2, comprises thermo-couple elements or conductors B united at B' to form a hot junction and connected at their opposite ends to the usual terminals provided in the thermo-couple head C. The two elements B which are encased and separated by suitable refractory insulating material D, are surrounded by a porcelain or analogous tube E having its inner end closed and its outer end connected to the thermo-couple head C. The connection as shown, comprises a metal sleeve F threaded into a socket formed for the purpose in the head C, and a cement packing F' between

the metal tube F and the casing E. The outer end of the casing E is open to a chamber C' in the head C sealed from the external atmosphere by the terminal supporting plate C² except for a fine inlet port C³ through which atmospheric air may enter the chamber C' and pass into the space within the casing E surrounding the insulated elements B which do not fill the casing E. G represents a small tube of refractory material which is located in the casing C alongside the elements B, and which has its open inner end located in proximity to the hot junction B' of the thermo-couple. The pipe G which extends through the plate C² is connected by a pipe G' to the furnace chamber A' as shown in Fig. 1, wherein a pressure less than that of the atmosphere is assumed to exist.

With the arrangement shown in Fig. 1, the furnace draft suction transmitted to the inner end of the casing E through the pipes G and G', draws atmospheric air into the chamber C' in the thermo-couple head C through the port C³, and thence through the casing E to the inner end of the latter from which the air passes into the open inner end of the tube G. The air flow thus set up through the casing tube E and out of the latter through the tube G carries with it any furnace gas passing through the pores of, or cracks in the porcelain tube E, and only a relatively minute stream of air is required to prevent a furnace gas content in the atmosphere surrounding the thermo-couple elements B sufficiently large to make that atmosphere injurious to the thermo-couple elements. In particular, the flow of air required to prevent injurious contamination of the atmosphere surrounding the thermo-couple elements need and should not be large enough to have any significant cooling action on the hot junction B' of the thermo-couple. The cross sectional areas of the passages, and particularly the bore of the inlet passage C³ and of the pipes G or G' should be made small enough relative to the furnace draft suction so as to keep the air flow through the thermo-couple casing suitably small.

Various modifications of the apparatus shown in Figs. 1 and 2 may be made, and some of these are shown by way of example in Figs. 3, 4, 5, and 6. The arrangement shown in Fig. 3 differs from that shown in Fig. 1, merely in that the thermo-couple elements B and their insulation D are enclosed in a separate casing tube H having a closed inner end and ordinarily formed of material similar to that of the thermo-couple casing tube E proper, which surrounds the tube H and the tube G. With the arrangement shown in Fig. 3, the atmosphere which may leak through the pores of, or cracks in the tube H is not a furnace gas at-

mosphere, but an atmosphere of air admixed with a small portion only of the furnace gases which may leak through the tube E.

The arrangement shown in Fig. 4 differs from that shown in Figs. 1, 2, and 3, in that the pipes G and G' are dispensed with, and in lieu thereof a small port E' is formed in the inner end of the casing tube E, so that the furnace draft suction draws atmospheric air into the chamber C', and thence through the port C³, tube E, and port E' into the furnace chamber. As shown in Fig. 4, the casing H is centrally disposed in the casing E and is supported at its outer end by a flange or cross head part H'.

The arrangement shown in Fig. 5 differs from that shown in Fig. 4 in that atmospheric air entering the portion of the chamber C' at the outer side of the cross head or flange portion H' through a port C¹⁰, is drawn through the member H to the inner end of the latter and thence through a port H² in the inner end of the casing member H, into the space between the casing member H and surrounding casing E, the air then passing back through said space to the portion of the chamber C' at the inner side of the flange or cross head portion H' and escaping through the outlet port C¹¹. The outlet port C¹¹ may be connected to the interior of the furnace chamber with which the thermo-couple is used by a pipe similar to the pipe G' of Figs. 1, 2, and 3, but as shown, the port C¹¹ is connected to the lower end of an uprising pipe G² which is adapted to serve as a sort of a stack or chimney for producing the desired flow of air through the thermo-couple casing. The stack draft created by the pipe G², may obviously be augmented by locating the pipe G² adjacent the hot outer wall of the furnace with which the thermo-couple is used so as to thereby increase the temperature and decrease the density of the column of air in the pipe G².

The arrangement shown in Fig. 5 possesses the advantage over the constructions previously referred to, in that an increase in furnace chamber gas pressure cannot cause the furnace gases to back up in the thermo-couple casing through the pipe G², as they may through the pipe G' of Figs. 1, 2, and 3, or through the port E' of Fig. 4.

It will be understood, of course, that the thermo-couple casing and head may vary in form from those illustrated in Figs. 1 to 5. For example, as shown in Fig. 6, the head CA may be provided with a support C²¹ for a bushing C²² which surrounds and supports the outer end of the inner thermo-couple casing H, and closes the outer end of the casing E. In Fig. 6 the terminal support C²⁰ is formed with an aperture C²³ to permit atmospheric air to enter the outer end of the member H which is formed at its in-

ner end with a port H^2 opening into the surrounding space within the casing member E. Air is drawn out of the annular space between the casing members E and H through a port C^{24} formed in the bushing C^{22} into the chamber C^{25} in the head CA to which a pipe G' is connected as in the constructions shown in Figs. 1, 2, and 3. It will be understood further that while insulator D must be an electrical non-conductor, the refractory tubes E and H may be of electrical conducting material such as metallic alloys or of clay, porcelain, carborundum, etc. If tube E is metallic, it may be a continuation of sleeve F.

While in accordance with the provisions of the statutes, I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. A thermo-couple comprising thermo-couple conductors and a casing receiving said conductors and provided with means forming a path of flow for a stream of air adapted to sweep out noxious gases leaking into said casing.

2. In a thermo-couple for measuring high temperatures, the combination with thermo-couple conductors united to form a hot junction, of an elongated casing formed with a longitudinally extending chamber receiving

said conductors and having one closed end adjacent which said hot junction is located, and means providing an air channel within and extending longitudinally of said casing and communicating with said chamber adjacent its closed end.

3. A thermo-couple comprising thermo-couple conductors and an elongated casing receiving said conductors and provided with means forming a flow path and means for creating an air flow along said path adapted to sweep out noxious gases leaking through said gases.

4. The combination with thermo-couple conductors united to form a hot junction, of an elongated casing formed with a longitudinally extending chamber in which said conductors are received and having one closed end adjacent which said hot junction is located, means providing an air channel within and extending longitudinally of said casing and in communication with said chamber adjacent its closed end, and means for creating an air flow longitudinal of said casing in one direction through said chamber and in the opposite direction through said channel.

5. The combination with a furnace, of a thermo-couple extending into the furnace and comprising thermo-couple conductors and a refractory protective casing for said conductors, and means for utilizing the furnace draft to create a small air flow through said casing to thereby protect said conductors against injury from furnace gases leaking through said casing.

Signed at Philadelphia, in the county of Philadelphia, and State of Pennsylvania, this 29th day of January, A. D. 1926.

THOMAS R. HARRISON.