July 10, 1962 G. F. DAVEY 3,043,055

EXPANSION JOINT

Filed Feb. 26, 1957 2 Sheets-Sheet 1

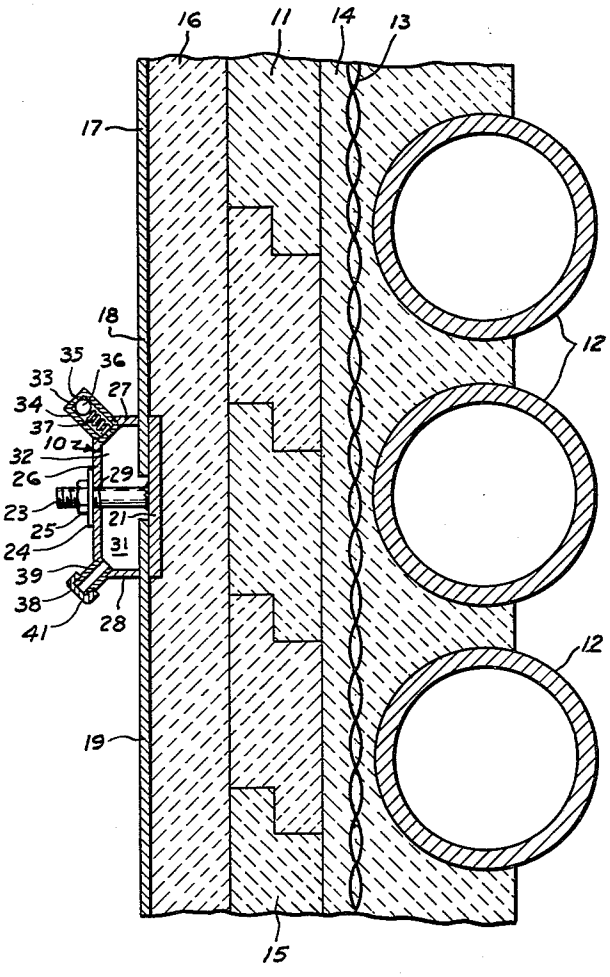


Fig. 1

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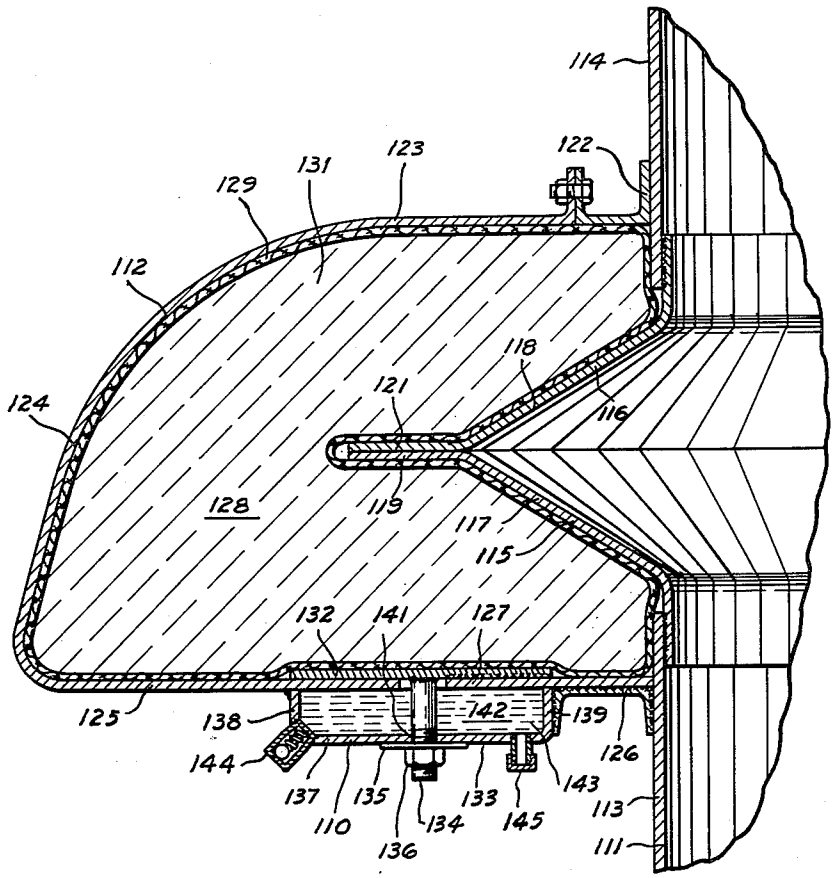


Fig. 2

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EXPANSION JOINT

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This invention relates to an expansion joint and more particularly to a means for providing a gas-tight, high-temperature connection for use in furnaces, ducts, and the like.

In industries which make use of high temperature gases and the like, a considerable problem is presented by the fact that enclosures must be constructed in such a manner that they are gas-tight and yet capable of expansion and contraction with changes of temperature. This is true, for instance, in the case of the furnace associated with a steam generating unit, which furnace in many cases may involve considerable wall areas and, thus, considerable amounts of expansion and contraction. In the same way, the expansion and contraction of long metal ducts containing gases of varying temperatures presents considerable difficulties because of the possibility of buckling. Attempts have been made in the past to solve this problem by the use of fittings of various shapes and configurations in the joints. Such fittings are subject to fatigue failure and eventual leakage of gas and in some situations are very expensive. These and other deficiencies of the prior art have been obviated in a novel manner by the present invention.

It is therefore an outstanding object of the present invention to provide an expansion joint for joining two sheet metal members, which joint is gas-tight and fully capable of permitting free motion of the sheet metal members.

Another object of this invention is the provision of the expansion joint which is inexpensive to manufacture, easy to maintain, and is capable of a long life of useful service.

It is a still further object of the present invention to provide an expansion joint making use of a semi-fluid, gas seal.

A still further object of the instant invention is the provision of an expansion joint capable of operation at wide extremes of temperatures.

Another object of this invention is the provision of an expansion joint formed of substances which are not subject to chemical attack or erosion.

Although the novel features which are believed to be characteristic of this invention will be particularly pointed out in the claims appended hereto, the invention itself as to its objects and advantages, the mode of its operation and the manner of its organization may be understood by referring to the following description, taken in connection with the accompanying drawings, forming a part thereof, in which:

FIGURE 1 is a sectional view of a furnace wall embodying the principles of the present invention, and

FIGURE 2 is a sectional view of the wall of a duct making use of the invention.

Referring to FIGURE 1 the expansion joint, designated generally by the reference numeral **10**, is shown in use in association with the wall **11** of a furnace. In this particular showing the furnace is part of a steam generating unit and includes parallel water wall tubes **12** arranged with a slight space therebetween. A sheet **13** of expanded metal is tackwelded to the side of the tubes facing away from the furnace interior. This sheet forms an anchoring means to lock in place a layer **14** of plastic refractory overlying the back surfaces of the

tubes and extending into the spaces therebetween. Next to the outer flat surface of the layer **14** of plastic refractory is placed a layer **15** of block insulation having interlocking joints to hold them together. Over the other surface of the layer **15** is placed a blanket **16** of wall type insulation. Covering the exterior of the wall described above and holding the blanket **16** in place, is a casing **17** consisting of a plurality of large steel sheets **18** and **19** and so on. At every position where the steel sheets abut each other an expansion joint **10** is provided. In the embodiment of the invention shown, the steel sheets **18** and **19** are jointed by the expansion joint **10** in the manner shown.

The expansion joint **10** comprises an inner member **21** and an outer member **27** between which the sheets **18** and **19** are clamped. Both the inner and outer member extend longitudinally along the edges of the sheets a considerable distance in a direction at right angles to the plane of the drawing. The inner member **21** consists of an elongated steel strip wide enough to overlap the edges of the sheets **18** and **19** a considerable distance. The inner member extends transversely away from the edges of the sheets by an amount at least equal to the amount by which the outer member so extends, so that there is little or no force couple on the edge of the sheets to inhibit free sliding action. To the flat surface that contacts the sheets in the central portion thereof are fastened by welding a number of studs, similar to the stud **23**, each having a threaded outer end adapted to receive a washer **24** and a nut **25**. The outer member **22** consists of an elongated channel member having a central web **26** and inwardly directed flanges, **27** and **28**. The central web **26** is provided at intervals with circular apertures **29** situated to permit the passage therethrough of the stud **23**. It can be seen then that the action of the nut **25** is to cause the inner and outer members to clamp the edges of the sheets **18** and **19**. A central web **26** and the flanges **27** and **28** of the outer member **22** define an inner chamber **31** in which is located a body **32** of mastic. This mastic is of the type designed for use at about 400 degrees Fahrenheit and consists of a mixture of asphalt and powdered asbestos. Extending through the flange **27**, is a fitting **33**, which may be similar to the well-known Zerk fitting adapted to permit the introduction of mastic into the chamber **31** by use of a grease gun. The fitting consist of a generally tubular main body **34**, threaded into an aperture in the flange **27** and having on its outer end an inwardly directed flange defining a small aperture **35**. A ball **36** is pressed against the inner surface of the aperture by a coil spring **37**. A flange **28** of the outer member is provided with an air-release member **38** consisting of a tubular member **39**, threaded into an aperture in the flange and having external threads at its outer end. A cap **41** is threaded on the said outer end and serves as a closure therefor.

The operation of the apparatus will be readily understood in view of the above description. In the operation of the furnace, there is usually a pressure differential between the inside and the outside. In the present case, let us suppose that the furnace is pressurized, that is to say, the pressure on the inside of the furnace is greater than that on the outside. There will be a seepage of gas through the elements of the furnace wall **11** which will be largely uninhibited by the layers of insulation. The casing **17**, being made of steel, is relatively impervious and prevents a leakage of gas, except where a joint occurs. In the present case, the leakage of gas around the edges of the sheets **18** and **19** is prevented by the presence of the mastic therein. The mastic is introduced into the chamber **31** by means of a grease gun under considerable pressure. Of course, as the furnace is brought from a cold condition to a hot con-

dition, these sheets **18** and **19** expand and the edges thereof tend to come together or to draw apart, depending on the particular part of the furnace in which the joint is located. Although the inner and outer members of the expansion joint clamp the edges of the sheet, they do not clamp it with sufficient force to prevent such movement of the edges. As a matter of fact, the movement of the edges in this manner is desirable and must take place to prevent buckling of the sheets. The mastic, therefore, acts as a lubricant between the inner and outer member and the edges of the sheet which they clamp; at the same time the mastic under pressure prevents the leakage of gas past the joint. At higher temperatures, of course, the mastic will be of a lower viscosity but the proper selection of mastic will insure that the viscosity never will be low enough to permit the passage of gas thereby. When the mastic is introduced through the fitting **33** it is necessary that some means be provided for the removal of the air residing in the chamber, and this function is served by the member **38**. The member **38** also provides a means of inspecting the interior of the chamber.

FIGURE 2 illustrates the manner in which the invention can be applied to a duct through which heated gas may pass. Problems presented by a duct, of course, are somewhat more complicated than those presented by the case in the furnace wall, since in the case of the furnace wall, movement of the sheets at the joint is probably in one plane only. In the case of a duct, the portions of the duct connected by the joint may move relative to each other in several modes as will be explained fully hereinafter. The expansion joint **110** is shown in use with a duct **111** and with an auxiliary joint member **112** associated therewith. For the purpose of illustration let us assume that the duct **111** is a circular craft section, and consists of 2 portions **113** and **114**, whose ends are somewhat separated. A sheet metal shield **115** is tack-welded to the end of the portion **113** while a similar shield **116** is similarly fastened to the end of the portion **114**. These shields incline upwardly toward one another to form conical portions **117** and **118** which are provided at their outermost portions with radial flanges **119** and **121**, respectively. Sufficient resilience is provided in the flanges **119** and **121** to assure that they slide and contact each other despite the normal movements of the portions **113** and **114**. Welded to the portion **114** is a ring **122** to which is fastened a housing member **123**. This housing member is provided with a curved portion **124** whose surface extends from the ring **122** outwardly and longitudinally of the duct to a point overlying the portion **113** of the duct, at which point is formed a radially inwardly-directed flange portion **125**. A channel-like ring **126** to which is welded a radially-directed sheet metal ring **127**. Edges of the ring **127** and the inwardly directed flange **125** reside adjacent to each other but are somewhat spaced to form an annular space extending entirely around the duct. The housing **123** and the shields **115** and **116** form a chamber **128** within which resides an asbestos cloth bag **129** which conforms closely to the inner surfaces of these members. The bag **129** is filled with a body **131** of bulk insulation.

The expansion joint **110** consists of an inner member **132** and an outer member **133**. The inner member is of a flat, sheet metal construction, and in the case of a circular duct would, of course, be an annular ring. At spaced intervals the inner member has attached in the central portion thereof studs **134**, each having a threaded outer end adapted to receive a washer **135** and a nut **136**. The inner side of the inner member **132** is welded to the outer edge of the ring **127** and is fixed thereto. The outer member **133** has a generally channel-shaped cross-section and, in the case of a circular duct, would be annular; it is provided with a central web **137** and longitudinally extending flanges **138** and **139**. The flange **139** which is nearest to the duct **111** is welded to the ring **126** and is therefor fixed thereto; the central flange **137** is provided with suitable apertures **141** through which extend the studs **134**. The central web **137** and the flanges **138** and **139** of the outer member **133** define with the edges of the flange **125** and the ring **127** a chamber **142** in which resides a body **143** of the type of mastic described in connection with the apparatus of FIGURE 1. At suitable intervals on the outer member are provided fitting members **144** for the admission of mastic into the chamber **142** by means of a grease gun. A suitable air vent and inspection member **145** extends through the central web **137** at suitable intervals.

The operation of this embodiment of the invention is very similar to that described in connection with the species shown in FIGURE 1. However in this case, it will be observed that the inner and outer members of the expansion joint are fastened to the portion **113** of the duct and the only motion which takes place relative thereto is that of the flange **125** which moves in and out according to the positioning of the portion **114** of the duct. Movement of the portions of the duct toward and away from one another are taken up in the housing **123** and movement in a bending manner, i.e., changes in angularity of the portions **113** and **114**, will be absorbed in the same manner. Transverse movement of the portions **113** and **114**, i.e., sideways dislocation thereof, will be absorbed in the expansion joint, and, as a matter of fact, the other modes of relative motion of the portions involve a certain amount of lateral dislocation which will also be absorbed in the expansion joint. For instance, in the case of bending motion, i.e., angular dislocation of the portions of the duct, the flange **125** will be drawn away from the portion **113** at one side and will move inwardly toward it on the other side. Both of these motions will be permitted by the use of the expansion joint of the invention. The shields **115** and **116** tend to prevent the transmission of heat into the outer portions of the joint, but they do not tend to prevent leakage of gas to any great extent. Cloth bag **129** and the body of insulation **131** absorb vibrations and tend to dampen any motions that take place, but they do not present an appreciable obstacle to the leakage of gas; it is the expansion joint **110** which provides this function.

While certain novel features of the invention have been shown and described and are pointed out in the annexed claims, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention.

The invention having been best described, what is claimed is new and desired to secure by patent is:

1. An expansion joint for use with sheet metal enclosures containing gas under a pressure differential and subject to extreme temperature variations, comprising an inner member, an outer member, means for drawing the members together to clamp adjacent edges of the enclosure between them, the inner member extending transversely away from the said edges of the enclosure by an amount at least equal to the amount by which the outer member so extends, the members defining a chamber within which the edges reside, a body of thermo-plastic mastic residing in the chamber, the mastic being in a plastic state at the normal operating temperature of the joints, and means for introducing mastic into the chamber under pressure to allow expansion and contraction of the enclosure without leakage of gas.

2. An expansion joint for use with the sheet metal casing of a furnace containing gas under pressure and subject to extreme temperature variations, comprising an inner member, an outer member of channel form, a screw fastening for drawing the members together to clamp adjacent edges of the enclosure between them, the inner member extending transversely away from the edges of the enclosure by an amount at least equal to the amount by which the outer member so extends, the outer member defining a chamber in which the edges reside, a body of thermoplastic mastic residing in the chamber, the mastic being in a plastic state at the normal operating temperature of the joint, and a fitting extending through the outer member for

introducing mastic into the chamber under pressure to allow expansion and contraction of the enclosure without leakage of gas.

3. An expansion joint for a pressurized furnace, comprising a casing formed of sheets of metal having edges adjacent one another, an inner member, an outer member of channel form having two inwardly-directed flanges, the inner member extending transversely away from the edges of the sheets by an amount at least equal to the amount by which the outer member so extends, means drawing the members toward one another so that the edge of one sheet is clamped between one flange and the inner member and the edge of the other sheet is clamped between the other flange and the inner member, the outer member and the sheets defining a chamber, a fitting extending through the outer member for introducing a high-temperature thermoplastic mastic into the chamber under pressure to allow expansion and contraction of the sheets without leakage of gas.

4. An expansion joint for a duct containing gas under pressure and subject to extreme temperature variations, comprising two generally aligned duct portions having their ends spaced from one another, an outwardly-extending sheet metal ring extending from one portion, a housing

member attached to the other portion and having an inwardly-directed sheet metal flange, the edges of the ring and flange residing adjacent one another, an inner member, an outer member, the inner member extending transversely away from the edges of the flanges by an amount at least equal to the amount by which the outer member so extends, means drawing the members toward one another to clamp the edges of the ring and the flange therebetween, the members defining a chamber in which the said edges reside, and a fitting extending through one of the members for introducing into the chamber a high-temperature thermo-plastic mastic under pressure to allow expansion and contraction of the enclosure without leakage of gas.

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