July 23, 1968 C. D. JUCHTERN 3,393,665

SUPPORT TIE FOR TUBULAR WALLS OF A FURNACE AND ADJACENT TUBE BANK

Filed Dec. 14, 1966 2 Sheets-Sheet 1

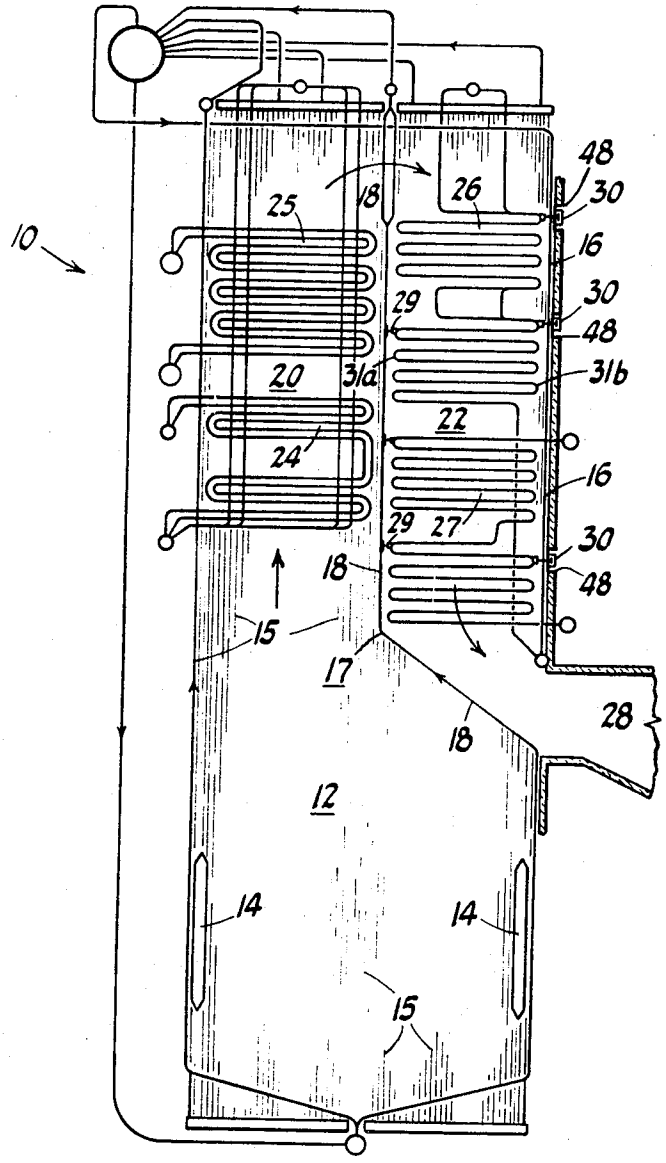


FIG. 1

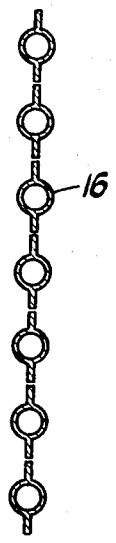


FIG. 2

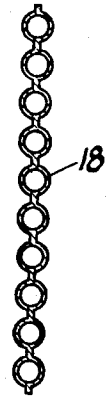


FIG. 3

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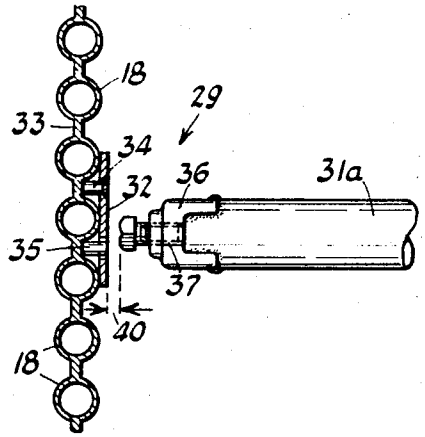


FIG. 5

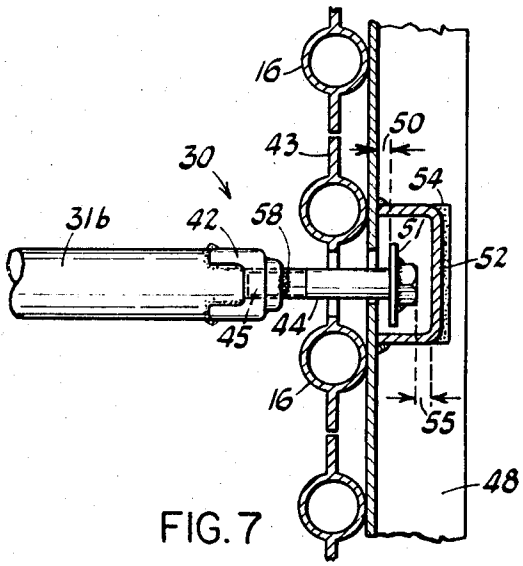


FIG. 7

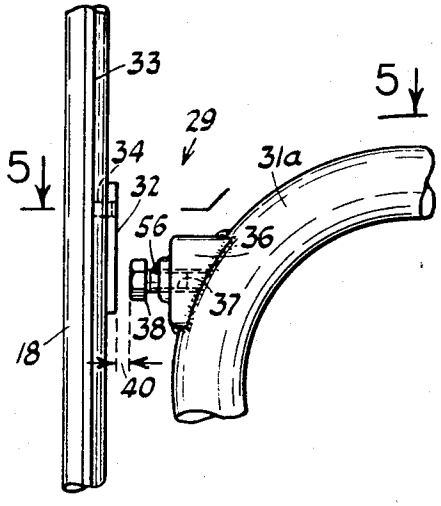


FIG. 4

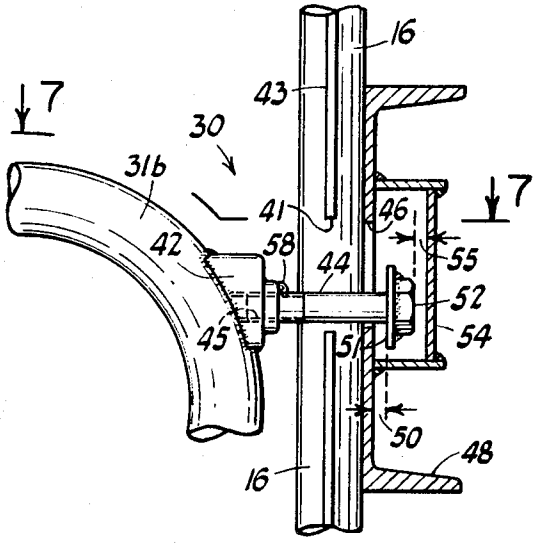


FIG. 6

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SUPPORT TIE FOR TUBULAR WALLS OF A FURNACE AND ADJACENT TUBE BANK

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5 Claims. (Cl. 122—510)

ABSTRACT OF THE DISCLOSURE

A limit stop device attached to adjacent portions of a tube bank and a furnace wall, and having an adjustable feature connecting the wall and tube bank to limit relative movement and prevent distortion and damage to the furnace wall due to lateral forces caused by differential gas pressure, furnace puffs, and/or seismic disturbances, and at the same time permit thermal expansion of the furnace wall and the tube bank.

Background of the invention

The invention relates to steam boilers and boiler furnaces having tubular outside walls and interior baffle walls. The invention more specifically deals with lateral supports of these walls in connection with tube banks suspended in the furnace or in an adjacent gas passage.

In boilers equipped with a so-called box type furnace, a baffle wall is provided between the combustion chamber and the vertical rear gas pass. This baffle wall generally consists of a single row of relatively small diameter tubes, with the baffle wall forming part of the rear wall of the combustion chamber as well as the wall of the rear gas pass or duct. The gas region above the furnace is accordingly divided into two portions having different static pressure, the gas pass directly above the combustion chamber and the vertical rear gas pass. In modern large boilers where this static pressure difference may reach a value as high as 80 inches w.g. (water gauge) and where the great height of the baffle wall imparts considerable flexibility to the wall, substantial distortion of the baffle wall may take place. Furthermore, minor gas explosions or so-called furnace puffs are experienced in the furnace during operation, especially at low loads. These puffs add to the distortion of the baffle wall and often cause damage to the structure of the wall of overstressing the tubes. Heating surfaces in the form of tube banks are suspended from the furnace roof and extend into the upper portion of the combustion chamber and into the rear gas pass in close proximity to the baffle wall. Steam boiler construction for operation in part of the world where the possibility of seismic disturbances is great, must be designed with the action of these additional lateral forces in mind and their effect upon the safety of the baffle wall. The possibility of damage to the baffle wall is great since the baffle wall in contrast to the outside walls of a furnace is very flexible and is not structurally supported against bending and distortion by buckstays. Attempts have been made in the past to protect the baffle wall in box-type boilers by so-called puff ties and seismic ties. However, because of the necessity of making corrections for unavoidable shop irregularities in the fabrication of the tube banks and the furnace and baffle walls, extensive field work such as welding and cutting had to be resorted to during the erection of the unit for the purpose of adjusting the ties to the required erection clearances. This work, partly because of the inaccessibility of the work site, provided to be very costly and time consuming.

Summary of the invention

The invention provides adjustable means which prevent lateral forces due to seismic disturbances and other causes from damaging the baffle wall by collision with adjacent tube banks. It also provides for such means to be applied to baffle walls and tube banks in such a manner that costly and time-consuming field work is thereby avoided. Furthermore, in accordance with the invention these means are designed to accomplish the above without interfering with individual thermal expansion of the baffle wall and the tube bank. To accomplish the above objects, the invention discloses a puff and seismic tie of a construction which makes it possible during erection of the unit speedily to adjust to the desired limit of relative movement of each individual portion of the baffle wall and of the tube bank which is provided with a puff and seismic tie. It further provides means for readily fixing and securing the stop limit members of the tie at a desired predetermined value after the distance between these members has accurately and conveniently been set.

Brief description of the drawings

FIG. 1 is a diagrammatic vertical cross section through a steam generator of the type having a box type furnace and having baffle wall and tube banks to which the invention is applied.

FIG. 2 is a horizontal cross section through a part of a typical furnace wall.

FIG. 3 is a horizontal cross section through a part of a typical baffle wall.

FIG. 4 is an elevational view of a stop limit wall support between a tube bank and the adjacent baffle wall portion, with the stop limit being effective in one direction.

FIG. 5 is a plan view of the stop limit wall support of FIG. 4 when taken on line 5—5.

FIG. 6 is a wall support similar to that of FIG. 4, however, with the stop limit being effective in two opposing directions.

FIG. 7 is a plan view of the stop limit wall support of FIG. 6 when taken on line 7—7.

Description of the preferred embodiment

Referring now to FIG. 1, a steam generator generally designated as **10** is equipped with a furnace **12** of rectangular configuration having burners **14** through which fuel and air are supplied for burning. The walls of the furnace **12** are lined with water carrying and steam generating tubes **15** with those of the rear wall being designated **16**. A baffle wall **17** comprising tubes **18** divides the upper furnace portion into an uptake gas passage **20** and a downflow or rear gas passage **22**. Tubular heating surfaces such as tube banks **24** and **25** are positioned within the passage **20**. These tube banks may constitute superheater and reheater heating surfaces or other heating surfaces. Tube banks **26** and **27** are provided in the down-flow gas pass **22**. These heating surfaces may constitute reheater, superheater and economizer surfaces or other heat absorbing surfaces.

During operation the combustion gases generated in the lower furnace **12** rise upwardly through passage **20** and after reversing direction flow downwardly through passage **22** and out through gas exit **28** as indicated by the arrows.

The great height of modern steam generators requires a baffle wall **17** of substantial length. As a rule, the tubes **18** of which this baffle wall is constructed and which are arranged in a single row, are of relatively small diameter and are welded throughout their length to form a gas-tight baffle wall. Accordingly, the baffle wall is exceedingly flexible with very little horizontal and vertical stiffness.

As earlier set forth herein uncontrollable lateral forces act upon the tube banks and baffle wall and cause relative movement and possible collision of these structures. Accordingly, stop limit devices such as **29** and **30**, illustrated in FIGS. 4, 5, 6, and 7, are provided at horizontal and vertical intervals to limit movement of the baffle wall tubes, with respect to the tube banks. Tube banks **26** and **27** generally comprise rows of sinuously wound horizontal tubes with return bends **31***a*, **31***b* at their ends.

Turning now to FIGS. 4 and 5, a strike plate or bumper plate **32** is welded to the fins **33** of tubes **18** by way of a stud **34**. A second stud **35** fits loosely in a hole provided in plate **32** to prevent turning. A bracket **36** which may be a one-piece casting or which may be fabricated of steel plate, is welded to the return bend **31***a* of tube banks **26** and **27**. Bracket **36** has a threaded opening **37** into which a threaded stud **38** is fitted. After erection of the baffle wall **17** and tube banks **26** and **27**, the exposed length of stud **38** is adjusted at the several locations across the furnace width to correct for unavoidable irregularities in the baffle wall and tube bank, until a desired distance **40** between the head of the stud **38** and the strike plate **32** is obtained.

Turning now to FIGS. 6 and 7, a bracket **42** similar to bracket **36** is welded to the upper portion return bend **31***b* in the shop. A threaded stud **44** is fitted into the threaded opening **45** provided in bracket **42**. The stud **44** is of a length which extends through slotted opening **41** provided in fins **43** between tubes **16** and through slotted opening **46** provided in horizontal buckstay **48**. The extending portion of stud **44** is adjusted to obtain a desired distance **50** between washer **51** welded to head **52** of stud **44**, and the inside face of channel **48**. After this adjustment has been made, the cover plate **54** is welded in place, maintaining a predetermined distance **55** from stud **44** to allow for expansion between the rear wall **16** and tube banks **26** and **27**.

Strike plate **32** of FIG. 4 and cover plate **54** of FIG. 6 are positioned in elevation so that the unsupported length of baffle wall tubes **18** will not result in excessive bending stresses in the baffle wall due to external forces. They are sized to provide a bearing surface for the heads of studs **38** and **44** throughout the range of relative vertical expansion between the tube banks and the baffle wall tubes **18** and between the tube banks and the rear wall tubes **16** during operation of the steam generator. Also openings **41** and **46** are positioned such that free thermal expansion of the baffle wall and the rear wall with respect to studs **38** and **44** can take place.

The clearances between the head of stud **38** and strike plate **32** in FIG. 4 and between the head of stud **44** and cover plate **54** in FIG. 6 will permit the tubular units to freely expand horizontally with relation to the furnace walls during normal operation.

After adjustments of studs **38** and **44** have been made to obtain the desired clearances **40** and **50**, respectively, the position of the sutds is secured by spot welds **56** (FIG. 4) and **58** (FIG. 6).

To fully protect the baffle wall **18** against distortion due to the lateral forces, it is desirable that the stop limit device of FIGS. 4, 5, 6, and 7 be spaced at frequent intervals such as every few feet across the width of the furnace.

From the above it can be seen that the movement of baffle wall **17** due to static pressure differential and furnace puffs is strictly limited to distance **40** and that in acccordance with the invention this distance can be accurately set after erection by means of stud **38** regardless of irregularities in the baffle wall **17** or in the length of the tube element of the tube banks **26** and **27**. Furthermore, the effect of seismic disturbances upon tube banks **26** and **27** is limited to the movement over the distance **50**, thereby preventing collision of the tube banks with the baffle wall and damage to tubes **18**; and that in accordance with the invention this distance can be accurately set by means of stud **44** after erection of the rear wall **16** and tube banks **26** and **27**, while taking into account irregularities in the fabrication and erection of these structural members.

While I have illustrated and described a preferred embodiment of my invention, it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes as fall within the purview of my invention.

I claim:

1. In a hot gas duct having an upright tubular wall, a tube bank suspended within the duct in spaced relation with said wall, said wall and said tube bank being subject to forces causing lateral displacement of the wall and the tube bank with respect to each other, the improvement comprising:

first and second limp stop members attached to said wall and to said tube bank, respectively, in facing relation with each other, and at least one of said first and second limit stop members being adjustable for adjusting and setting the distance between said first and said second limit stop members to limit movement of said wall and said tube bank relative to each other and to prevent distortion of said wall due to said lateral forces.

2. The apparatus as defined in claim **1** wherein a threaded structure is provided in cooperation with at least one of said first and second limit stop members for adjusting and setting said distance.

3. The apparatus as defined in claim **1**, wherein means are provided to fixedly secure said first and said second limit stop members and the distance between them.

4. In a furnace defined by rectangularly disposed furnace walls; a baffle wall generally co-directional with the furnace walls dividing the furnace into a first high static pressure gas region and a second low static pressure gas region; said baffle wall comprising a row of spacedly arranged tubes; a tubular heat-absorbing element laterally extending across one of said gas regions between said baffle wall and a furnace wall; the furnace walls, baffle wall and heat absorbing element being subject to thermal expansion; the improvement comprising:

a first limit stop member and a second limit stop member cooperating with said baffle wall and with said heat-absorbing element, to limit movement of said baffle wall in lateral direction with respect to said heat absorbing element; and

adjustable bridging structure means cooperating with said first and second limit stop members for bridging, adjusting and setting the distance between said baffle wall and said heat absorbing element at a predetermined value to prevent distortion of said baffle wall due to extreme difference in static pressure between said first and said second gas regions.

5. Apparatus as defined in claim **1** being additionally provided with welded means to fixedly secure said bridging structure means and said predetermined distance between said baffle wall and said heat-absorbing element.

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