United States Patent [19]

Snook

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[54] **APPARATUS FOR PROVIDING EXPANSIBLE CHIMNEYS**

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[52] **U.S. Cl.** **98/58,** 98/60, 285/114, 285/187, 285/226

[51] **Int. Cl.** **E04h 12/28**

[58] **Field of Search** 98/58, 60; 110/184; 285/114, 187, 226

[56] **References Cited**

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2,661,963	12/1953	Brown et al.	285/187 X
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[57] **ABSTRACT**

A lined chimney having upper and lower support means for the liner, and at least two expansion joints separated by toggle sections between the upper and lower liner supports, at least one expansion joint having plural expansible or compressible hangers on the exterior thereof, and a method for providing the same.

12 Claims, 4 Drawing Figures

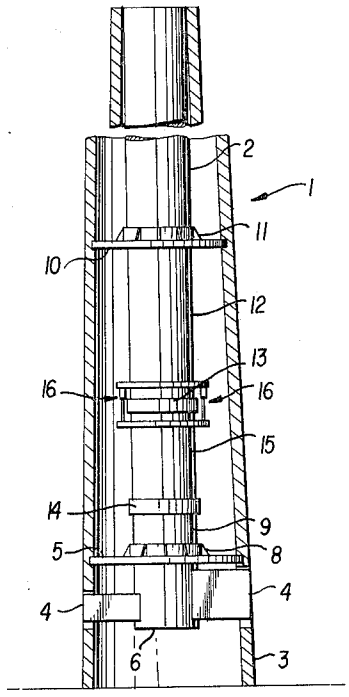
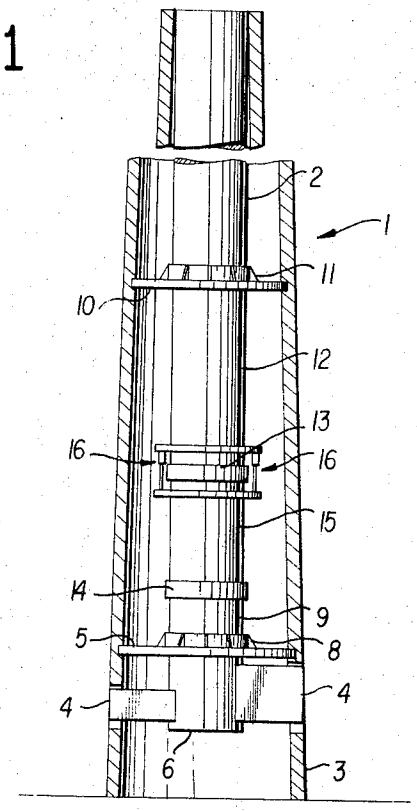


FIG. 1



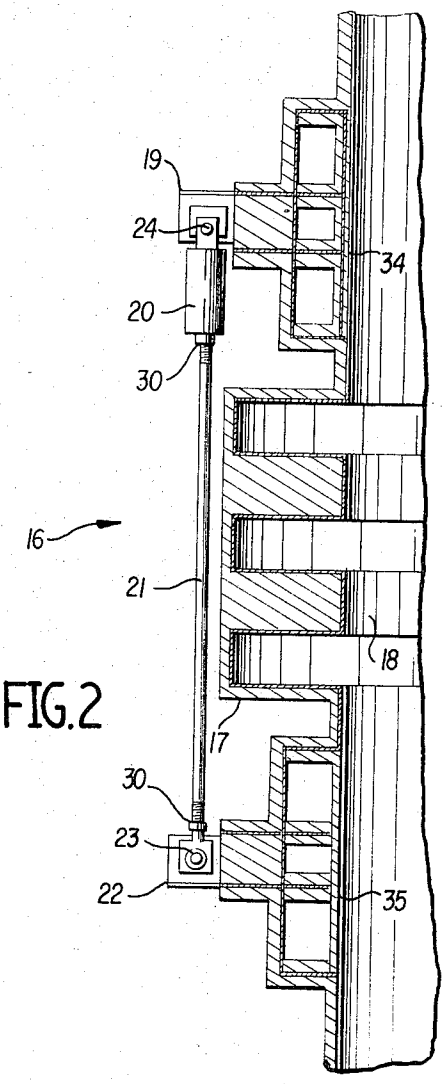


FIG. 2

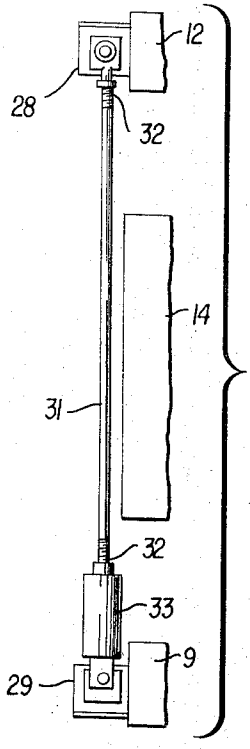


FIG. 4

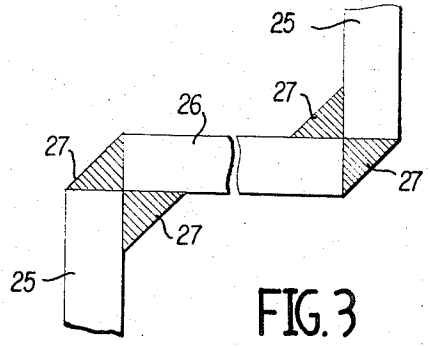


FIG. 3

APPARATUS FOR PROVIDING EXPANSIBLE CHIMNEYS

The present invention relates to lined chimneys or smokestacks. More particularly the present invention relates to the provision of expansion joints in the steel liners of chimneys, especially those used in industrial areas.

The prior art has recognized the need for the provision of expansion type joints in chimneys, and particularly in smokestacks wherein high temperature differentials occur. For example, U.S. Pat. Nos. 3,363,591 and 3,368,506, both to R. E. Lawrence, relate to the provision of expansion means in sectional smokestacks. In addition, it is well known to provide various types of expansion joints for overcoming material size changes due to thermal expansion and contraction.

However, although expansion joints are known in smokestacks, the chimney industry has been confronted with significant problems when a plurality of breeching openings are utilized for a single chimney. When such a plurality of breeching openings have been utilized, the feed gases are often diametrically opposed at their entry into the lined chimney, and very often there are significant temperature differences between each of the feed gases. Under these circumstances, uneven temperature distribution within the chimney often occurs and this uneven temperature distribution can cause buckling failure of the chimney liner. In addition, the rates at which each gas is fed often vary significantly, possibly creating even further variance in the temperature distribution. The present invention, on the other hand, overcomes these problems by allowing for both vertical and horizontal expansion in the lower section of the chimney and thus provides a means to greatly decrease, if not eliminate, the possibilities of buckling failure due to stresses created by such factors as overall thermal expansion and uneven thermal expansion due to variations in temperature across a chimney liner.

Thus, it is an object of the present invention to improve the design of chimney liners to correct the buckling problem.

It is a further object of the present invention to provide a chimney liner having plural expansion joints to allow for both horizontal and vertical expansion.

It is a further object of the present invention to provide an economical, simple chimney liner of improved reliability.

These and other objects are obtained by the provision of support means for the toggle section between expansion joints in chimney liners. The liner is supported at points above and below the expansion joints, where they are attached to sections of the liner, and the toggle section mounted therebetween and supported by expansible hangers attached to the upper supported liner section and the toggle section, or by compressible hangers attached to the lower supported liner section and to the toggle section. More than two expansion joints and more than one toggle section may be provided, depending upon considerations such as the size of the chimney, but at least one set of the expansible hangers or compressible hangers, preferably one for each toggle section, must be provided.

In the accompanying drawings:

FIG. 1 shows an elevation of one of the chimneys of the present invention;

FIG. 2 shows a single cut-away section of one expansion joint, including the expansible hangers used in one embodiment of the present invention;

FIG. 3 shows a corner structure in an expansion joint that may be utilized in the present invention;

FIG. 4 shows a cut-away section of an expansion joint when compressible hangers are used.

The present invention can be seen from FIG. 1 to include a generally conventional chimney 1 having a liner 2, support 3 which is usually concrete, and plural breeching openings 4. The chimney may be concrete, brick or any other conventional material and the liner is also conventional, being steel, brick, concrete, ceramic, etc., but is preferably steel. In the improvement of the present invention, a lower liner support 5 is provided just above breeching openings 4 and is attached to lower liner section 6. Lower liner support 5 is attached to the chimney at 7 and is provided with attaching means 8 to secure portion 9 of lower liner section 6 thereto, e.g., by welding a ring girder to both supports. A similar arrangement is provided at upper liner support 10, which may be the same as lower support 5 or may be different, wherein attaching means 11 is utilized for liner section 12, as well as the remainder of the liner 2. This attachment is also by conventional means. In this drawing two expansion joints 13 and 14 are provided, although a number over two may be utilized depending on various dimensions of the chimney as well as the expected stresses provided by the gases to be fed at breeching openings 4. However, since more complex stress problems can arise upon the use of more than two joints, it is preferable to use only two.

Intermediate between the expansion joints is toggle section 15 which provides for the motion and stress relief nessecary for the present invention. Also, shown alongside upper expansion joint 13 are expansible hangers, indicated by number 16, which can be provided at the upper expansion joint of the present invention but may as well be provided at any other expansion joints. However, support means either expansible or compressible must be provided which in effect independently support at least one toggle section.

While the number of, and location of, the toggle section supports depends on the specific chimney, the provision of these supports is the controlling factor of the present invention. Even though conventional expansion joints are provided, the supports provide the ease of both vertical and horizontal movement in the toggle sections of the present invention. The supports, and number thereof, are selected so that when construction is complete and the chimney is in use, the hangers are expanded or contracted to a point within the range of their travel so that anticipated changes in temperatures and flow rates of the gases in the chimney will not expand or compress any support to the limit of its travel. In this way, the toggle section is allowed to move in an arcuate manner relative to the supports and change the relative travel of individual toggle section supports as well as the relationship of the unsupported end of the toggle section to the adjacent fixed liner section. The allowable motion of the toggle section may be envisioned as describing a conical section. The optimum, e.g., for best performance, would be to have the supports at 50 percent of their travel at normal operation, i.e., where there is no axial derivation, but variations could easily be tolerated. However, the amount of travel available during use is not critical so long as suffi-

cient travel is available to allow for the twisting motion of the toggle section. In practice, the effect of this is to "suspend" the toggle section from the fixed upper liner section and support it from the lower liner section. That is, although the expansion joints are fixed to the liner sections so as to form a sealed unit, most of the weight of the toggle section is borne by the expansible or compressible hangers, and the toggle section would be suspended or supported by the hangers in about the same location if the expansion joints were removed.

In its preferred form the present invention contemplates the use of toggle section supports selected so that they, along with the adjacent corrugated expansion joint, are considerably stiffer than the other expansion unit, usually from 3 to 7, preferably about 5, times as stiff as the other expansion unit. However, when different expansion joints are used, this ratio can vary even as high as approaching infinity, but usually at least 3. In this way the "suspension" of the toggle section during operation is usually assured.

FIG. 2 shows a single expansion joint as provided in the present invention. The expansion joint shown is one having the expansible hanger **16** described with regard to FIG. **1.** As can be seen from the drawing, conventional insulation **17,** such as asbestos, fiberglass, mineral wool, etc. is provided on the surface of the expansion joint and the expansion joint **18** is formed by a plurality of connected adjacent perpendicular sections. By the provision of these expansion joints, both vertical and horizontal stresses can be relieved. Although only one particular expansion joint structure has been shown, it is obvious that other expansion joint types could be utilized in the present invention, for example those of a zig-zag nature or those having sections which generally represent a sinusoidal wave. However, the preferred type is approximately rectangular in shape or a type which is rectangular in nature but has rounded corners. The expansion joints are preferably steel and are welded to the preferably steel liner, but different materials and means of attachment may be utilized. Further, the number of expansible corrugations may vary from chimney to chimney as well as from upper joint to lower joint, depending on such factors as chimney size and expected temperature differentials during operation.

Although FIG. 2 shows a particular type of expansible hanger, other expansible hangers may be utilized. The expansible hanger shown in FIG. 2 has upper attaching means **19** provided with pin means **24,** e.g., bolts to pin expansible means **20** thereto, but to allow motion of the pin or bolt, not shown, in at least one direction. Rod **21** is adjustably attached to expansible means **20** by threads and nut **30** and further attached to lower attaching means **22** by means of, for example clevis **23** which is also shown with threads on rod **21** for adjusting nut **30.** However, any other suitable expansible hangers may be utilized providing the hangers are fixed, except for rotation, to both the liner and the toggle section. For example, hydraulic or mechanical hangers etc. may be utilized, when hydraulic units are used indepent pressure controlling means, not shown, may also be utilized, e.g. air with independent pressure control or hydraulic damper arrangements with pressure equalization units for each support. Any conventional or convenient means may be utilized to attach each of the expansion joints to each liner section, and toggle sections, e.g., bolting or welding, the means **24** shown in FIG. 2 being exemplary.

In FIG. **3,** one mode of preparing the expansion joints of the present invention is shown. In this mode, steel sections of cylindrical **25** and donut-shapes **26** having rectangular cross-sections are joined by welds **27** after being positioned. However, as noted above, other expansion sections may be utilized in the chimney of the present invention.

FIG. **4** shows the embodiment of the present invention, in section, wherein a compressible support **33** is utilized as the toggle section support means. Expansion joint **14** is shown without attachment to toggle section **12** or to lower liner section **9.** Support **33** is positioned by means of attaching means **28** and **29** respectively. The attaching means may be the same as that shown in FIG. **2** or different but, as shown, the support has adjustable rod **31** which is threaded at both ends and has adjusting nuts **32** on the threaded portions. Compressible support **33** may be any well known unit so long as the previously discussed requirements are met. That is, a spring within a housing which is under compression to preferably some of its travel during use may be utilized; in the alternative the pressurized air or hydraulic fluid units previously noted may be utilized. However, due to their simplicity, spring units are preferred.

The attachment of expansion joints **13** and **14** is by conventional means, however, the integral box type units shown as **34** and **35** in FIG. **2** are utilized for ease of construction since they include support for hanger support means **19** and **22** which reinforce the structure of the present invention.

In providing the chimney of the present invention, conventional chimney liner sections are provided as well as a conventional chimney, with the exception of the provision for points for locating the supports. During construction the plurality of expansion joints separated by toggle sections are installed between the upper and lower support sections attached to the chimney liner after securing of at least the upper liner section to the upper support.

The upper support chimney and liner section, as well as the remainder of the chimney above the expansion area, can be constructed by conventional means. However, after construction of the upper liner section and attaching of the upper expansion joint, the toggle section is then positioned with the expansible hangers held in an extended position, e.g., by bars previously welded to the attaching means. The amount of extension depends on the size of the chimney as well as the expansion joint size etc. The hangers are extended an amount sufficient to allow for the upper expansion joint to be attached to the toggle section after attachment of the hangers to the upper liner section and the toggle section. That is, the upper joint may be slightly compressed or expanded if desired, but such compression or expansion to allow attachment to the toggle section should not be sufficient to jeopardize later operation of the joint. After attaching of the hangers and the toggle section to the expansion joint, the hangers may be released and the toggle section allowed to be suspended by the hangers, or the lower expansion joint may be attached to the toggle section and the lower liner section and then the hangers released. The order of these operations is not critical so long as no undue stresses are placed on the expansion joints. Further, the time of positioning and attaching of the lower liner section to the

expansion joint and the lower support are not critical so long as the above stress considerations are obeyed. The construction is thus effected so that both expansion joints are preferably open when the complete chimney is cold, and thus since the lower joint is open, the weight of the toggle section is borne by the expansible hangers.

When toggle section supports are to be utilized at the bottom of the section, the order of attaching is reversed, i.e., lower expansion joint is positioned after the upper and lower liner sections are completed, then the toggle section with the compressible supports fixed in a predetermined compressed position is welded or otherwise attached, followed by attachment of the upper expansion joint in the manner of the lower joint when the toggle section supports are attached as above.

By means of this process either upper or lower toggle section supports in accord with the structure of the present invention, as previously defined, may be provided and thus a chimney in accord with the apparatus of the present invention may be constructed.

What is claimed is:

1. In a lined chimney having at least two breeching means to said liner, the improvement comprising lower and upper liner supports attached to said liner and the chimney, and an expansion section in said liner intermediate said supports, said section containing at least two vertically arranged expansion joints, both the upper and lower joints of said at least two joints being attached to said liner, at least one toggle section between said joints and a plurality of separately vertically movable, compressible and expansible toggle section support means pivotally attached to said liner and at least one toggle section adjoining the liner whereby said toggle section is supported in a movable relationship with said liner.

2. The chimney of claim **1** wherein said expansion joints are expanded when said chimney is not in use.

3. The chimney of claim **1** wherein one toggle section and two expansion joints are utilized.

4. The chimney of claim **3** wherein the compression strength of the combination of the expansion joint adjacent the toggle section support means and the support means is at least **3** times the compression strength of the remaining expansion joint.

5. The chimney of claim **4** wherein the ratio in compressive strength is **5.**

6. The chimney of claim **3** wherein the toggle section support means are adjacent the upper expansion joint.

7. The chimney of claim **3** wherein the toggle section support means are adjacent the lower expansion joint.

8. The chimney of claim **1** wherein the liner material is steel.

9. The chimney of claim **1** wherein the liner is externally insulated.

10. The chimney of claim **9** wherein the insulation is fiberglass.

11. The chimney of claim **1** wherein the toggle section support means are at least from 30 percent to 70 percent of their vertical travel during operation.

12. The chimney of claim **11** wherein said support means are at at least 50 percent of their travel during operation.

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