April 12, 1966 YIAN-NIAN CHEN 3,245,177

SLENDER STRUCTURE

Original Filed May 1, 1961

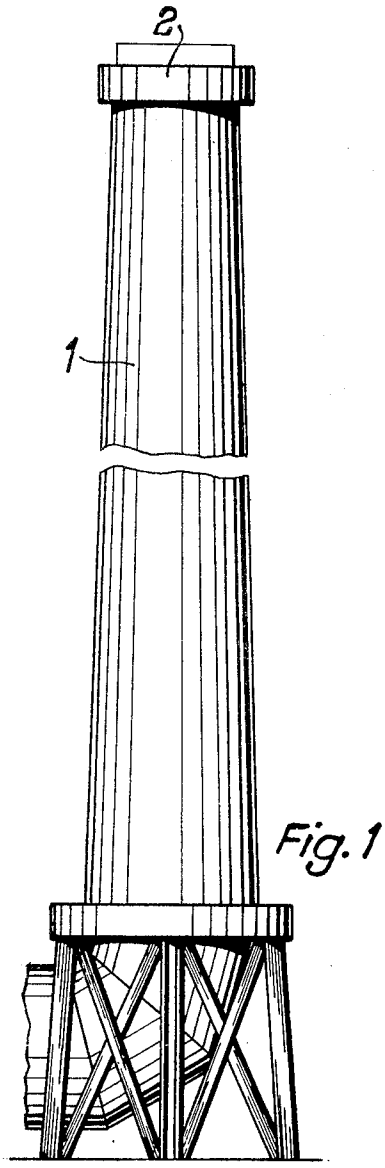


Fig. 1

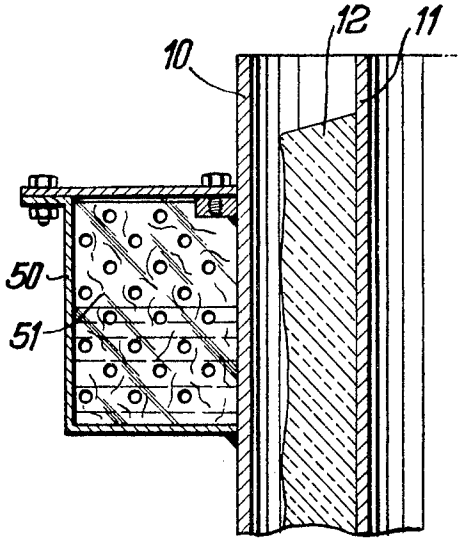


Fig. 2

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SLENDER STRUCTURE

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Original application May 1, 1961, Ser. No. 106,772, now Patent No. 3,174,589, dated Mar. 23, 1965. Divided and this application June 10, 1964, Ser. No. 374,035
Claims priority, application Switzerland, May 6, 1960, 5,170/60
2 Claims. (Cl. 52—1)

The present application is a division of copending application Serial No. 106,772, filed May 1, 1961, now Patent No. 3,174,589, issued on March 23, 1965.

The invention relates to slender structures subjected to repeated bending, such as, for example, chimneys, towers, masts and the like, and relates more particularly to novel damping means for said structures.

Chimneys and other slender structures, in addition to withstanding the static loading caused by wind pressure in the plane of wind movement, also have to deal with those periodic forces which are produced by eddy cavitation, and are operative transversely of the wind direction thus causing the structure to oscillate. The oscillations produced become critical when the frequency of eddy cavitations reaches the natural frequency of the structure. In masonry chimneys and riveted metal plate chimneys the internal damping is usually of sufficient magnitude so that the oscillatory energy of relatively small oscillatory amplitudes is readily absorbed. However, this is generally not the case with welded sheet metal chimneys. These structures require special measures to ensure that dangerous resonance cannot occur. The known means of achieving this object are to alter the natural frequency of the chimney and also to release the strain by bracing the chimney with wire ropes. The disadvantage of varying the natural frequency of the chimney is that chimney size and design often cannot be the most suitable for the particular purpose required and, for instance, uneconomically large thicknesses of sheet must be used just to alter the natural frequency. Where dangerous oscillations occur in existing chimneys, the method cannot be used at all. The second method—bracing by wire ropes—is expensive and is aesthetically unsatisfactory. Accordingly, it is an important object of this invention to provide means to reduce the oscillations of structures of the foregoing type without incurring the disadvantages inherent in the known expedients, said means comprising at least one dynamic oscillation damper. Other objects will appear from the following detailed description.

The invention will be described with reference to an embodiment illustrated in the drawings wherein:

FIG. 1 illustrates a chimney according to the invention incorporating an oscillation damper of this invention.

FIG. 2 is a section through the damper shown in FIG. 1 on a somewhat enlarged scale.

Referring to FIG. 1, the chimney **1** made of steel plate carries the oscillation damper structure **2** at its top end. FIG. 2 is a sectional view of the oscillation damper structure **2** and also includes the top end of the chimney. The chimney **1** comprises an outer generated surface **10** and a lining **11** with heat insulation **12** being therebetween.

FIG. 2 illustrates an oscillation damper operating by liquid friction. An annular vessel **50** secured to the outer chimney surface **10** comprises radial perforate metal plates **51**, and the sectors bounded by the plates **51** are filled with a porous loose fill, such as steel swarf. The vessel **50** is about half filled with a liquid forming the damping mass. As liquid there is used preferably an oil having a flat viscosity-temperature pattern and a low coagulation point, such as silicone oil. The advantage of the embodiment shown in FIG. 2 is that damping is provided at very reduced oscillations. The liquid in the vessel **50** can be loaded with suspended particles; if required, relatively coarse and non-suspendable particles, such as sand, stones, metal scrap and so on, can be added to the liquid and can move together therewith as the chimney oscillates. If such a filling is used in the vessel **50**, the plates **51** and the porous loose fill can be omitted.

I claim:

1. In an elongated vertical structure fixed at one end and free to oscillate at the other on being subjected to a bending stress, the combination with the free end of said structure of oscillation damping means, said damping means comprising a sealed chamber mounted on the free end of said structure, perforate plates within said chamber and dividing the same into a plurality of interconnected compartments, and a fluid within said chamber, whereby said fluid upon the oscillation of said structure moves through said perforate plates from compartment to compartment thereby to convert at least part of the energy of said oscillation to heat and effect the desired damping.

2. A structure in accordance with claim **1** wherein said sealed chamber also contains a mass in each of said compartments formed of a plurality of particles movable relative to each other.

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