

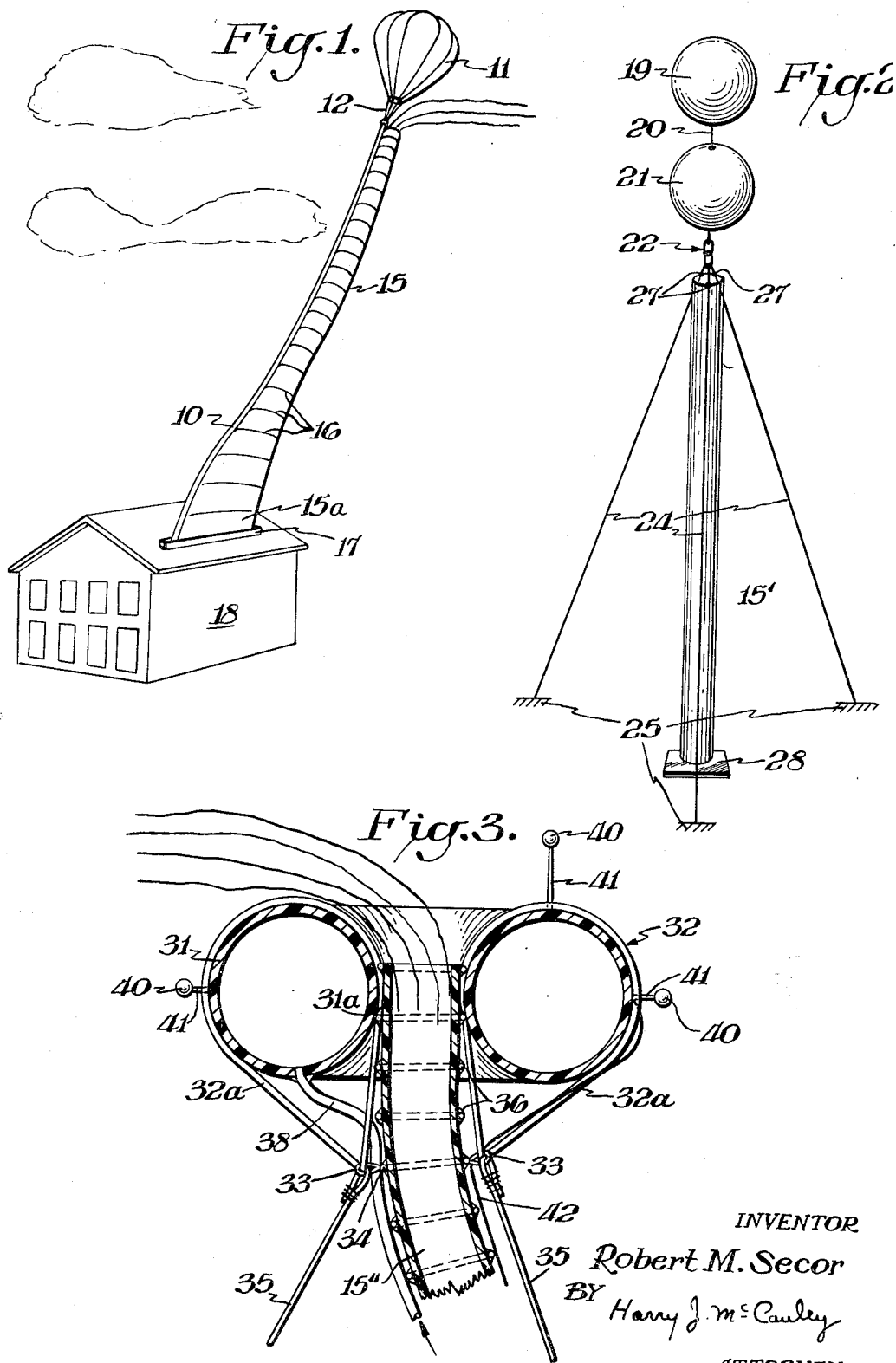
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BUOYANT WASTE DISCHARGE STACK

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BUOYANT WASTE DISCHARGE STACK

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1 Claim

ABSTRACT OF THE DISCLOSURE

A waste gas discharge stack of collapsible structure buoyantly supported with discharge end high above ground level and the other end connected to receive waste gases to be exhausted.

BRIEF SUMMARY OF THE INVENTION

Generally, this invention comprises a buoyant waste gas discharge stack embodying a tubular length of collapsible construction provided with means for lighter-than-air buoyant support of one end at substantial elevation above ground level and means at the opposite end of the tubular length for introduction of waste gases to be vented from the stack.

DRAWINGS

The design of several embodiments of apparatus according to this invention, together with details of construction, are shown in the partially schematic drawings, in which:

FIG. 1 shows a waste gas discharge stack supported aloft by a single balloon attached adjacent the upper end and moored to the ground structure by a single line to which the tubular length is secured along the full length,

FIG. 2 shows a waste gas discharge stack supported aloft by a pair of balloons attached one above the other adjacent the upper end of the tubular length, with guy restraint provided by three tether lines secured to the balloon lift tackle and also to the discharge end of the stack, and

FIG. 3 shows the upper end only of another design of waste gas discharge stack, wherein the upper end of the tubular length is supported by a toroidal balloon receiving the end of the discharge stack within its bore.

DETAILED DESCRIPTION

Efforts to alleviate air pollution caused by waste gas discharge have resulted in the construction of higher and higher exhaust chimneys, with the objective of obtaining increased dilution of waste products by clean atmospheric air and broader area-wise deposition of fall-out, wherever this has to be reckoned with, as with fly ash and other particulate substances. The construction of such stacks, particularly with elevations of 1000 ft. or greater, is extremely expensive and thus difficult to justify as a plant investment except for very large size installations having a constant effluent problem.

This invention is intended to provide apparatus for extremely high elevation waste gas exhaust which is relatively low in cost and which can be easily raised or lowered at will to affect repairs or to serve on an intermittent or temporary basis, if this is desired.

In accordance with the invention there is employed as waste gas stack a collapsible, relatively light-weight length of tubing, one end of which is buoyantly supported aloft whereas the waste gases to be disposed of are introduced into the secured other end of the tubing.

To minimize the tensile load applied to the stack tubing, it is preferred to apply the buoyant lift to mooring cables, tether lines or the like, supporting the stack tubing

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from these cables or lines as shown in the designs of FIGS. 1-3, inclusive.

Thus, in FIG. 1, a single mooring cable 10 is employed having its upper end maintained aloft by a conventional helium-filled balloon 11 provided with a conventional shroud-line harness 12 for attachment of the upper end of the cable and for even distribution of the load carried thereby to the buoying balloon. The collapsible waste gas stack 15 is, in this construction, secured to the length of cable 10 at a multiplicity of points, as through the agency of relatively rigid hoops denoted schematically at 16, attached at suitably spaced intervals along the outside of the stack tube, which hoops contribute stiffness to the construction safeguarding against inward collapse of the stack under relatively severe wind loads.

As shown in FIG. 1, stack tube 15 is flared to a rectangular cross-section at its base end 15a to facilitate attachment to a slot-like stub stack 17 exhausting waste gas from an industrial facility 18, a convenience quite readily accomplished through the use of the waste stack tubing employed with this invention as hereinafter described.

Lightweight polymeric materials are ideally suited as materials of fabrication for the waste stack tubing because of their high strength, low moisture absorption characteristic, general toughness and resistance to exposure to both corrosive waste gases on the one hand and sunlight, rain and the atmosphere on the other. Polyamides of the nylon type are particularly preferred, some species of which have a relatively high temperature resistance; however, polytetrafluoroethylene can be employed either alone or in conjunction with a polyamide or similar back-up material in multi-ply constructions where waste gases of extremely high temperature must be vented.

The tubing can be readily fabricated from film-type material or, of course, can be made up from woven or non-woven mesh products sealed or protected against corrosion or heat damage where necessary by a wide variety of commercially available coatings applied from liquid suspension or solution.

To permit the easy raising and lowering of the stacks from a relatively small area site, a collapsible construction is resorted to, by which is meant that, when the buoying lift is discontinued, as by reeling in the balloon, deflation of the buoying gas or other action, the tubing will retract in length to a compact form under gravitational forces, which, for the design of FIG. 1, would be a vertical stack of hoops 16, where tubing of sufficient inherent flexibility is employed to permit lengthwise contraction of the stack wall material between adjacent hoops into loose loops or bellows-like folds.

However, it will be particularly understood that the stack materials of construction are not necessarily limited to flexible tubing throughout. Thus, it is entirely feasible to employ a multiplicity of relatively long (e.g., 100 ft. or longer) stiff tubular sections which are tapered to telescope in upright vertical arrangement one within the other in descending order, with adjacent ends provided with remotely operated, as for example, by electric solenoids, disengageable locking means securing the sections in prolongation one with another during the stack-raising ascent. Alternatively, there can be provided integral end-to-end joining lengths of flexible tubing interconnecting adjacent sections of stiff exhaust pipe, which are adapted to retract inwardly of the stiff tubes in reverse folds during the telescopic retraction of the stack.

Another design employing stiff tubular sections throughout can utilize hinge members between adjacent sections, permitting an alternating length-for-length fold-down re-

traction, which again is facilitated by remotely operated auxiliaries, such as electric solenoid types or the like.

Referring to FIG. 2, there is shown a design of waste stack utilizing two lighter-than-air inflated balloons 19 and 21 secured in tandem one with the other by a connection 20, indicated only schematically in the drawing. Lowermost balloon 21 is provided with depending tackle gear, denoted generally at 22, to which is secured the upper ends of three tether lines 24 attached to ground anchors indicated generally at 25, preferably spaced equiangularly of one another at 120° angles around the circumference of a circle drawn from the ground center of stack 15' as center. To limit the tensile loads applied to stack 15', the buoyant forces of balloons 19 and 21 are applied to tether lines 24 only, the upper end of the stack being supported from these tether lines through conventional shackle or similar connections to each at the points denoted 27, the details of these connections being omitted in this figure because of the small scale employed.

The exhaust gas introduction to stack 15' can be made via a suitable adapter fitting, the base plate 28 solely of which appears in FIG. 2, the waste gas generating facility being omitted from the showing because of space limitations. Alternatively, the waste gases can be supplied through a side port connection, not detailed, opening laterally into stack 15', in which case element 28 would constitute an anchor piece for the base end of the stack.

For exceptionally high waste stacks, or wherever it is desired to exert the buoyant lifting action in a stage-wise manner to individual sections of the stack tubing length, it is preferred to employ a multiplicity of balloons, preferably suspended at different elevations by offset mooring lines maintaining them laterally clear of the stack length, attached to individual tether line rings encircling the stack at preselected intervals along its length. Such a construction distributes the application of buoyant support at multiple atmospheric levels, which tends to average out the effects of different direction air currents, besides providing a safety factor against the loss of all lift in the event that a single or even several balloons become deflated for any reason whatever.

A particularly preferred construction for the stagewise buoyant support of a waste stack according to this invention is that shown in FIG. 3, utilizing a toroid-shaped balloon 31. While only the uppermost balloon is detailed in this figure, it will be understood that a multiplicity of similar balloons can be disposed at suitable intervals along the stack length where staged buoyancy is desired by attachment means such as that hereinafter described for the topmost.

Thus, the toroidal balloon is adapted to receive the discharge end of stack 15'', or any intermediate diameter thereof located elsewhere along the length of the tube as regards lower support balloons, within the interior bore 31a of the toroid. The stack tubing can be attached to the balloon skin itself by cement, sewing, riveting or in other known manner, or can, if desired, be attached exclusively to lines of the shroud structure, denoted generally at 32. The shroud structure consists of a harness made up of a multiplicity of lines 32a loosely looped around the balloon circular cross-section at equal intervals therearound, the lower extremities of which are passed through eyelets 33 spaced around the outside periphery of a tether ring 34 loosely encircling the outside periphery of the stack tubing. A multiplicity of tether lines 35, fastened at their top ends to eyelets 33, anchor the structure to the earth in the same manner as already described for the construction of FIG. 2.

Hoops 36, firmly attached to the exterior periphery of stack 15'', are stiff, light rings which can optionally be employed to assist in maintaining the stack form at various critical locations, or, in fact, along the full length, if this is wished.

It is desirable to provide a gas replenishment supply line 38 running from each balloon 31 to ground level, so that balloon inflation can be maintained at all times during service, since there is usually a constant if slow seepage loss of gas through the balloon fabric. Line 38 can conveniently be passed through the tether ring-stack tube inter clearance seen in FIG. 3, to thereby retain the line snugly against stack 15'' on its downward run.

Aircraft beacon lights 40 are disposed at conspicuous points around the balloon structure by suitable attachment of the standards 41 to shroud 32, the electrical power supply line for the lighting circuit being denoted at 42, run to ground level by placement within the eyelet 33 stack 15'' clearance space in the same manner as already described for gas replenishment supply line 38.

To afford protection from lightning, it is desirable to also incorporate lightning rods, which can be conveniently mounted on shroud 32 with grounding line run to earth in the same manner as hereinbefore described for beacon lights 40 and their electrical supply line 42.

It will be understood that a wide variety of support balloons can be employed for buoyant support of waste gas discharge stacks according to this invention. Thus, special shapes such as dirigible, airfoil and the like possessing superior aerodynamic characteristics are especially preferred. Moreover, if the waste gases are vented hot in sufficient quantity and at a relatively steady rate, enhanced lift can be provided by discharge thereof into the filling neck of a hot gas type balloon envelope secured above the stack discharge. Such an envelope can be fabricated from a porous cloth preserving controlled escape of the gases therethrough, so that a steady replenishment of the buoying lighter-than-air inflating gas is constantly maintained.

Another construction adapted to buoyant stack support is to make the stack double-walled, the interspace between the walls being then inflated with a suitable lighter-than-air buoying gas, such as helium or the like. It will be understood that the interspace can be compartmentalized in a direction lengthwise of the stack in order to permit erection height selection at will. Such a construction has advantages of substantial inherent stiffness, with reduced necessity for guy wire steadying, while being collapsible to an extremely compact deflated storage volume.

It will be apparent that this invention can be modified extensively without departure from its essential spirit, and it is intended to be limited only by the scope of the following claim.

What is claimed is:

1. A buoyant waste gas discharge stack comprising a tubular length of collapsible construction provided with means for lighter-than-air support of one end at a substantial elevation above ground level comprising a toroid-form balloon for individual preselected fractions of said tubular length inflated with a gas having a density less than air, within the bore of which is disposed said tubular length of waste gas discharge stack, and attachment means between said balloon and said tubular length, and means at the opposite end of said tubular length for introducing waste gases to be vented from the stack.

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