

Sept. 27, 1966

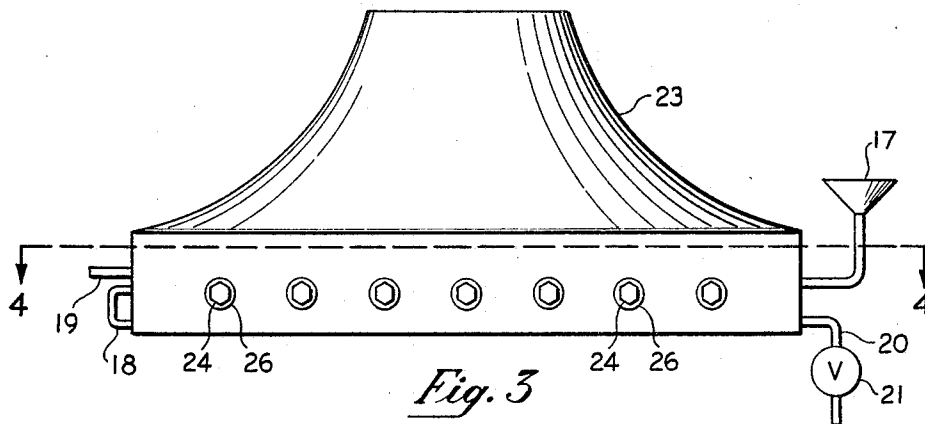
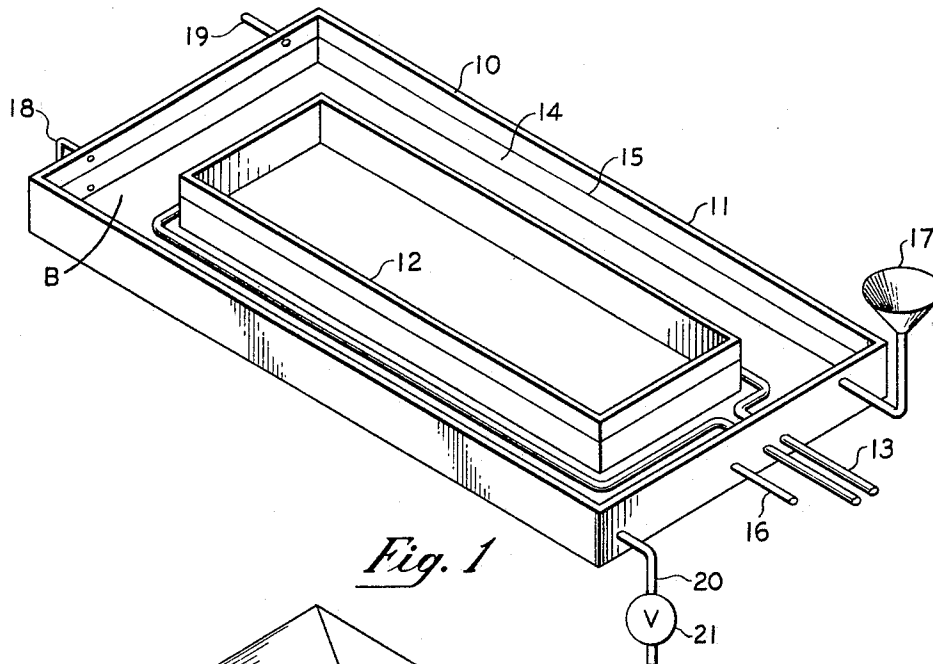
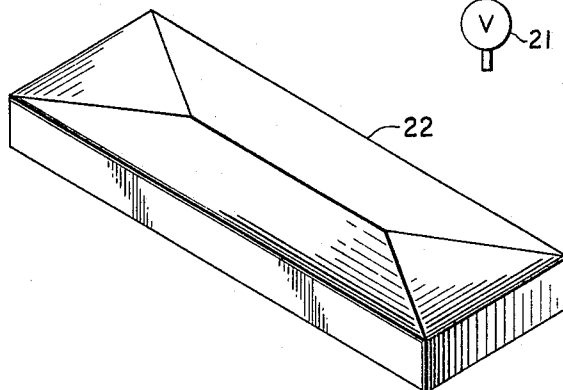
E. J. MAGUIRE, SR., ETAL

3,274,700

GENERATING APPARATUS FOR USE IN REMOVING FLAMMABLE
MATERIALS FROM DUCTS

Original Filed June 21, 1960

3 Sheets-Sheet 1



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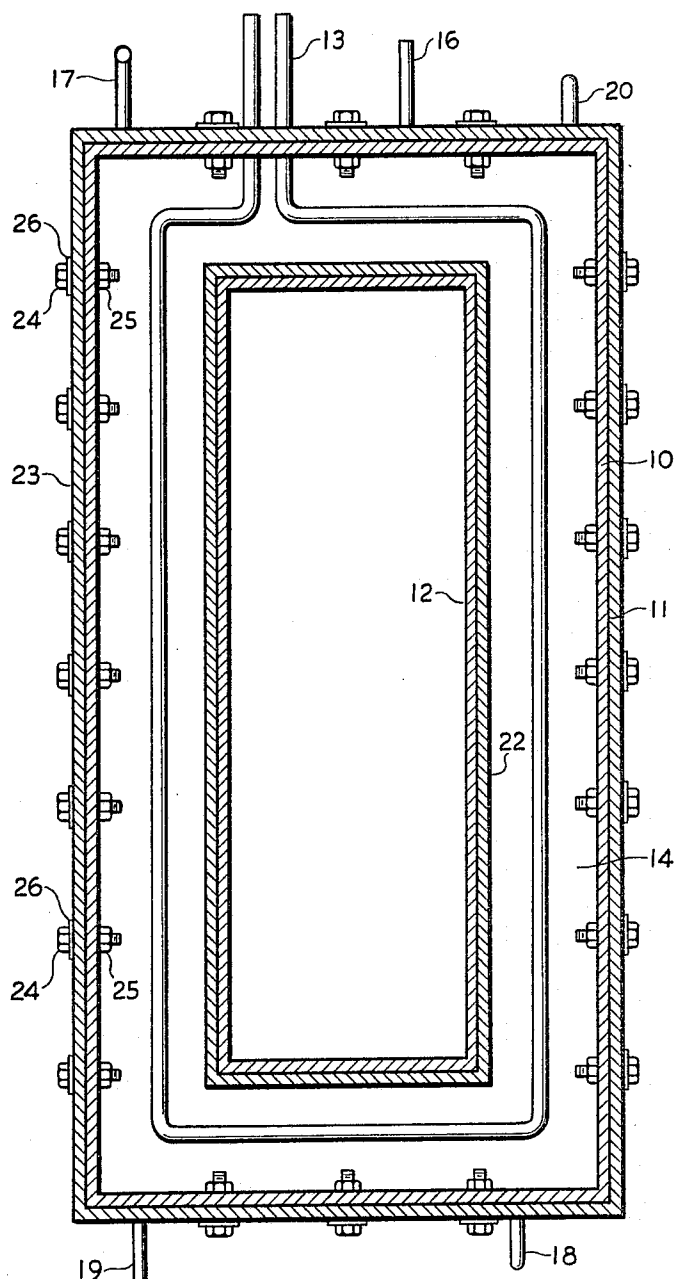


Fig. 4

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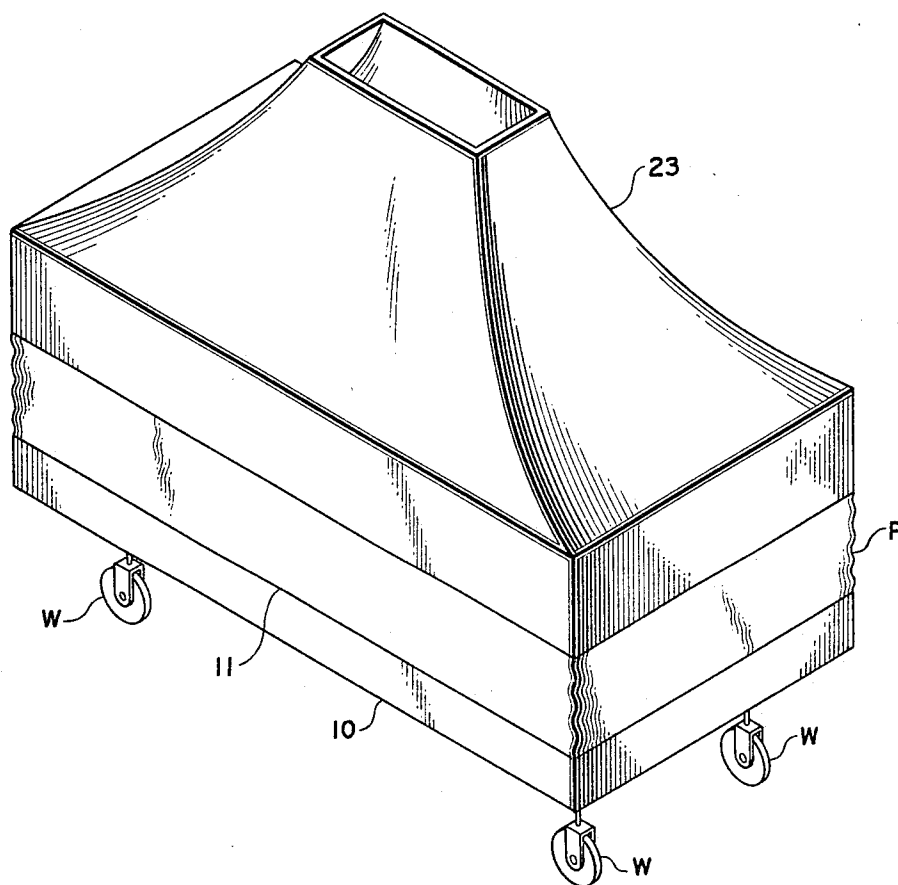


Fig. 5

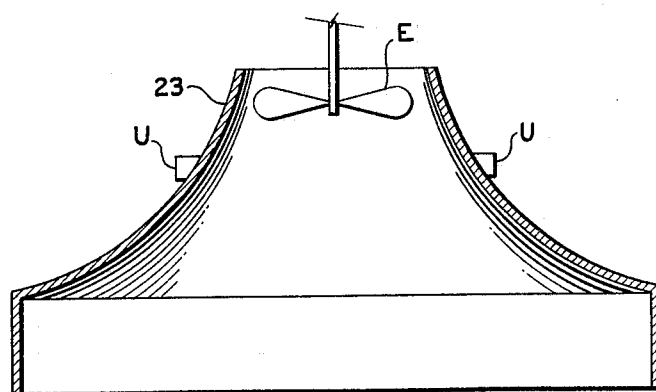


Fig. 6

1

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3,274,700

GENERATING APPARATUS FOR USE IN REMOVING FLAMMABLE MATERIALS FROM DUCTS

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Original application June 21, 1960, Ser. No. 37,617. Divided and this application July 1, 1965, Ser. No. 483,385

1 Claim. (Cl. 34—104)

This application is a division of our co-pending application Serial Number 37,617 filed June 21, 1960, now abandoned.

This invention relates to apparatus for cleaning ducts, hoods, chimneys, columns, and the like, and more particularly it relates to apparatus for cleaning flammable materials from the surfaces of ducts, hoods, and other surfaces which are not readily accessible, which apparatus utilizes a chlorinated hydrocarbon as the cleaning solvent.

Chlorinated hydrocarbon solvents such as trichloroethylene have been used extensively in the degreasing of metal workpieces covered with mineral oil and the like. For example, U.S. Patent 2,852,417, issued September 16, 1958, to Thomas J. Kearney, discloses a method and apparatus for degreasing metal objects wherein the object is first sprayed with a chlorinated liquid hydrocarbon and is then immersed in a bath of liquid chlorinated hydrocarbon while the bath is subjected to ultrasonic vibration. Although the techniques of this patent are suitable for treating small, movable objects, such techniques are not suitable for cleaning relatively large, stationary objects, such as ducts, hoods, and the like.

In restaurants, bakeries, food processing plants, industrial plants, and the like, it is customary to provide a ventilated hood and duct system to remove smoke and other foreign matter produced in cooking and baking operations. As the smoke passes through the hood and duct, various foreign matter in the smoke, such as grease, fat, oil, carbon, and the like, is deposited on the surfaces of the hood and duct. Since such materials are highly flammable, serious fire hazards are created when these materials are deposited. Since the hood and duct work are not easily accessible, fires which occur therein are difficult to control and may cause serious injury to personnel and great property damage before they can be brought under control. Accordingly, in an attempt to prevent such fires, the duct work and hood are frequently cleaned to remove the flammable deposits. Normally, such cleaning must be done manually and is a tedious, time consuming and costly operation. Adding further to the cost of such manual cleaning operation is the loss of the cooking or other equipment during the down time necessary to effect the cleaning. Moreover, because the duct work is often not well ventilated, a serious health hazard may be encountered by the personnel carrying out the cleaning operation.

It is, therefore, an object of the present invention to provide a novel apparatus which overcomes the disadvantages inherent in the prior art techniques for cleaning ducts and the like.

Another object of the present invention is to provide a novel apparatus which is suitable for cleaning flammable materials such as grease and the like, from the surfaces of ducts.

Another object of the present invention is to provide an apparatus which may be used for extinguishing fires in ducts and the like, in addition to its utility in cleaning processes.

These and other objects will become apparent to those skilled in the art from the description of the invention which follows.

In the drawings which are attached hereto and form a part hereof, FIGURE 1 is a perspective drawing of novel cleaning apparatus of the present invention;

FIGURE 2 is a perspective drawing of a cover for the novel cleaning apparatus;

FIGURE 3 is an elevated view of a duct having the novel cleaning apparatus secured thereto;

FIGURE 4 is a detailed plan sectional view taken on the line 4—4 of FIGURE 3;

FIGURE 5 is a perspective view of a portable cleaning apparatus secured to the duct; and

FIGURE 6 is an elevational view of the duct with ultrasonic transducers and exhaust fan.

In all of these drawings and the following specification, like characters of reference are used to designate corresponding parts.

Pursuant to the above objects, the present invention includes a gas generating apparatus, suitable for use in removing flammable materials from the interior surfaces of a stationary duct, which apparatus comprises a horizontally disposed trough having endless inner and outer vertically disposed wall sections and an endless horizontally disposed base section, said endless inner wall defining an opening of sufficient cross-sectional area to permit passage of a gas therethrough and said inner, outer and base sections defining an endless, open-top channel adapted to contain a fire-resistant solvent liquid which is to be converted to the gaseous state. A heating element is positioned in the lower portion of the trough and located in a generally parallel relationship with the base section, the heating element, by supplying heat to the fire resistant solvent liquid in the channel, effecting controlled generation of gas therefrom. The apparatus is further provided with a securing means for connecting the trough with a duct desirably at the lower extremity thereof, so that the trough is positioned to receive condensate flowing from the duct.

It will be appreciated that for purposes of clarity, the apparatus of the present invention is described as applied to conventional hood and duct work, normally used in removing smoke and fumes produced by cooking stoves, ovens and the like. It will be recognized by those skilled in the art, however, that this apparatus may be employed in cleaning the interior surfaces of flues, chimneys, stacks, still columns, conduits and other surfaces that are not easily accessible. Additionally, it is to be appreciated that the word "duct" as used throughout the specification and claim is intended to include ducts, hoods, conduits, chimneys, stacks, still columns, flues, and the like, while the term "flammable material" is intended to include grease, fats, oils, protein, carbon, and other smoke or vapor residues that may be produced by the heating of carbonaceous materials during cooking, combustion, evaporation, distillation, and similar operations.

Referring now to the drawing, the novel cleaning apparatus of the present invention is comprised of a horizontal trough 10, having an outer perimeter or endless outer wall section 11, a base section B, and an inner perimeter or endless inner wall section 12. The opening created by the inner perimeter 12 is of sufficient cross sectional area to permit passage of gas therethrough under the usual operation of the stove, oven, or the like. The horizontal trough 10, as shown in the drawing, is an open-topped channel defined by the inner, outer and base sections and having a rectangular form. It will be recognized by those skilled in the art, however, that the trough may have curved sides and may have a circular form or other form to conform to the duct work which is to be

3

cleaned. The trough may be constructed of sheet metal, plastic, or other suitable materials of construction.

A heating element is positioned in the area adjacent to the bottom of the trough to effect heating of a chlorinated hydrocarbon solvent 14, which is placed in the trough up to the level 15. As shown in the drawing, this heating element is an electrical heating element 13, which may be connected directly to line voltage (not shown) either with or without the use of a reostat control (not shown). Although, from the standpoint of mobility of the cleaning apparatus, electrical heating elements are preferred, it will be appreciated that other types of heating elements may be used, as for example, a steam line, hot air line, or the like. Whatever type of heating element is used, it is activated during the cleaning and/or fire extinguishing operation, to effect vaporization of the chlorinated hydrocarbon solvent.

If desired, a thermometer 16, or other temperature measuring and sensing device may be inserted through the perimeter 11. In addition, the thermometer 16 may be wired, by conventional means, to the electrical heater 13, so as to maintain the desired vaporizing temperature in the chlorinated hydrocarbon solvent.

Chlorinated hydrocarbon solvent 14, is fed into the trough 10, by means of liquid inlet 17. A sight glass 18 is positioned in the perimeter 11 in order to determine the chlorinated hydrocarbon solvent level. An overflow line 19 is also positioned in the perimeter 11 to remove excess chlorinated hydrocarbon solvent. The overflow line 19 is located at the point of maximum hydrocarbon solvent level which is desired. A discharge line 20 is positioned in the perimeter 11 at a point at the bottom of the trough so as to permit complete drainage of the chlorinated hydrocarbon solvent from the trough 10. If desired, a strainer (not shown), such as a screen or filter cloth, may be secured to the end of the discharge line 20 on the inside of the trough 10 to separate any suspended solids that may be present in the chlorinated hydrocarbon solvent which is removed through the discharge line. A valve 21 is provided in the discharge line 20 to control the removal of the solvent.

A cover 22 is provided to cover the opening formed by perimeter 12 and thus prevent chlorinated hydrocarbon solvent and flammable materials from dropping through the opening when the cleaning apparatus is in operation. The top of cover 22 preferably slopes downwardly from the center to the outer edge so as to permit drainage of the liquid chlorinated hydrocarbon solvent into the trough 10. The bottom of the cover 22 is, of course, supported by the vertical inner wall of perimeter 12. During normal operations, i.e., when cooking, baking or the like, are being carried out, the cover 22 is removed to permit smoke and fumes to be discharged through the duct 23.

Trough 10 is positioned horizontally at the lower extremity of the duct 23 and may be secured thereto by bolts 24 and nuts 25, having washers 26 which serve to prevent leakage of the solvent from the trough 10. Other means suitable to secure or connect the cleaning trough to the duct, such as welding, clamps, or the like, may be employed in place of the bolts and nuts. As shown, the duct 23 is positioned vertically or, it may be a duct system, at least a portion of which is in a substantially vertical position.

An exhaust fan, E, shown in FIGURE 6, is provided at the gas discharge end of the duct 23 to convey the chlorinated hydrocarbon solvent vapors from the trough 10 throughout the length of the duct when the cleaning apparatus is in operation.

If desired, an ultrasonic transducer, U, may be secured to the outer or inner surfaces of duct 23 to assist in removal of the flammable materials from the interior surfaces of the duct during the cleaning operation. In FIGURE 6, transducers, U, are shown as being secured to the outer surfaces of the duct 23.

4

In another modification of the apparatus, rollers, casters, or similar wheeling means, W, as shown in FIGURE 5, may be secured to the end or sides of trough 10 to make the trough portable so that it may be more readily moved to the area adjacent to the duct. In this modification, cover 22 is placed over the opening formed by perimeter 12 and a flexible duct or curtain type hood, F, as shown in FIGURE 5, is releasably secured at one end to outer perimeter 11 and at the other end to the bottom of duct 23, thereby permitting vapors generated in trough 10 to pass upwardly from the trough past the flexible duct into duct 23, and permitting the resulting condensate to pass downwardly past the flexible duct into trough 10. Thus, the flexible duct functions to prevent migration of the gaseous chlorinated hydrocarbon solvent, thereby insuring its delivery to duct 23, and also serves to convey the condensed solvent vapors or condensates from duct 23 back into trough 10.

During normal cooking, baking, combustion or other operations which produce smoke containing flammable materials, and prior to the cleaning operation, cover 22 is removed and the trough 10 is preferably empty. When it is necessary to clean the duct, baking, cooking, combustion or the like operations are discontinued, cover 22 is placed over side 12, valve 21 is closed and a chlorinated hydrocarbon 14 is fed into the trough 10, through the feed inlet 17, up to the level 15.

Any suitable chlorinated hydrocarbon solvent which is capable of dissolving flammable materials from the surface of the duct may be employed. Exemplary of such solvents are trichloroethylene, tetrachloroethylene, tetrachloroethane, trichloroethane, methylenechloride, carbon tetrachloride, and mixtures thereof. Of these trichloroethylene is the preferred chlorinated hydrocarbon solvent and, hence, hereinafter primary reference will be made to this material.

After the trichloroethylene has been introduced into the trough 10, the electrical heating element 13 is turned on and sufficient heat is supplied to effect vaporization of the chlorinated hydrocarbon solvent. The fan may also be activated so as to convey the vapors throughout the length of the duct which is to be cleaned. As the vapors contact the interior surfaces of the duct, the vapors condense and dissolve substantially all of the flammable materials adhering to the interior surfaces of the duct. When an ultrasonic transducer is employed, removal of the flammable material from the interior surfaces of the duct is materially aided. Insoluble materials such as carbon particles which adhere to grease and other soluble flammable materials on the interior surface of the duct are suspended in the condensed chlorinated hydrocarbon solvent. The solvent, containing dissolved flammable materials as well as the suspended insoluble particles flows downwardly on the interior surfaces of the duct and passes into the trough, where further evaporation of the solvent is effected and the cycle is repeated.

Water, which may also be present in the duct, also condenses and is conveyed to the trough with the chlorinated hydrocarbon solvent. To prevent contamination of the solvent with water, a liquid silicone, preferably having a specific gravity between 1.0 and about 1.05, may be added in small amounts to the chlorinated hydrocarbon solvent. The silicone floats on top of the chlorinated solvent and any water introduced into the trough then floats on top of the silicone without contaminating the chlorinated hydrocarbon solvent.

If desired, during the cleaning operation, an aromatic compound having a pleasant odor, such as peppermint or the like, may be admixed with the solvent or sprayed into the duct to prevent odors, such as pungent chlorinated hydrocarbon solvent odors, from passing throughout the kitchen, bakery, or the like. Additionally, other cleaning compounds may also be used in combination

with the chlorinated hydrocarbon solvent. For example,

5

ammonia may be released into the duct to be cleaned simultaneously with the generation of the chlorinated hydrocarbon solvent vapor, to assist in removing flammable materials from the interior surfaces of the duct.

After the interior surfaces of the duct have been cleaned, the heating element is turned off and the major amount of the chlorinated hydrocarbon solvent vapors remaining in the duct are permitted to condense and flow into the trough. The temperature of the interior surfaces of the duct under ambient conditions is generally below the boiling or condensation temperature of the chlorinated hydrocarbon solvent and is, thus, sufficient to cause condensation of a major portion of the solvent vapors passing through the duct. If desired, however, auxiliary cooling means, such as cooling coils, may be employed to aid in this condensation. When the condensation is sufficiently complete, the cover 22 is removed and the liquid chlorinated hydrocarbon solvent in the trough, either with or without added silicone, is removed through the discharge line 20 by opening valve 21. The solvent is collected in a suitable container and stored until it is needed for the next cleaning operation. Where the water layer is present on top of the silicone and chlorinated hydrocarbon solvent, the valve 20 will be closed after removing substantially all of the hydrocarbon solvent from the trough. The water layer will then be removed through the discharge line and discarded. The fan, E, in the duct, may be utilized to remove any remaining chlorinated hydrocarbon solvent vapors from the duct, after which normal baking, cooking or other operations can be resumed.

By using the cleaning apparatus of the present invention, the cleaning of flammable deposits from the interior of ducts and the like is accomplished much more easily and quickly than has been possible using prior art cleaning techniques, which techniques have largely involved manual cleaning operations. By thus eliminating much of the hand or manual labor previously required in such cleaning operations and also greatly reducing the down time of the cooking, baking or other equipment, there is realized considerable savings both in labor costs and in increased operating time of the equipment.

While, as has been described hereinabove, an important function of the present apparatus is in cleaning flammable material from ducts, the apparatus may also be employed to extinguish fires which may start in ducts containing flammable materials. In the event of a fire in the duct, the chlorinated hydrocarbon solvent is added to the trough of the apparatus, the heating element is activated and the resulting chlorinated hydrocarbon vapors pass into the duct and quickly extinguish the flames,

6

thereby eliminating or at least minimizing a serious fire hazard.

While there have been described various embodiments of the invention, the structures and methods described are not intended to be understood as limiting the scope of the invention, as it is realized that changes therewithin are possible, and it is intended that each element recited in the following claim is to be understood as referring to all equivalent elements for accomplishing substantially the same results in substantially the same or equivalent manner, it being intended to cover the invention broadly in whatever form its principles may be utilized.

What is claimed is:

A portable gas-generating apparatus useful in removing flammable materials from the interior surfaces of a stationary duct, which apparatus comprises a horizontally disposed trough having endless inner and outer substantially vertically disposed wall sections and an endless substantially horizontally disposed base section, said endless inner wall defining an opening of sufficient cross-sectional area to permit passage of gas therethrough and said inner, outer and base sections defining an endless open-topped channel adapted to contain a fire-resistant solvent liquid which is to be converted to the gaseous state, an electrical heating element positioned in the lower portion of the trough and located in a generally parallel relationship with the base section, said heating element, upon activation, effecting controlled generation of solvent gas from the fire-resistant solvent liquid contained in the open-topped channel, a releasable flexible duct secured at its upper portion to the lower peripheral edge of the stationary duct and at its lower portion to the outer wall section of the trough, and means provided on the trough to allow rolling movement thereof.

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