United States Patent

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[54] **MOBILE FURNACE CLEANING APPARATUS**
4 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **55/473,** 15/314, 55/487, 55/525
[51] **Int. Cl.** **F23j 1/02**
[50] **Field of Search** 15/340, 314, 347, 352, 313; 55/486, 487, 372, 525, 473

[56] **References Cited**

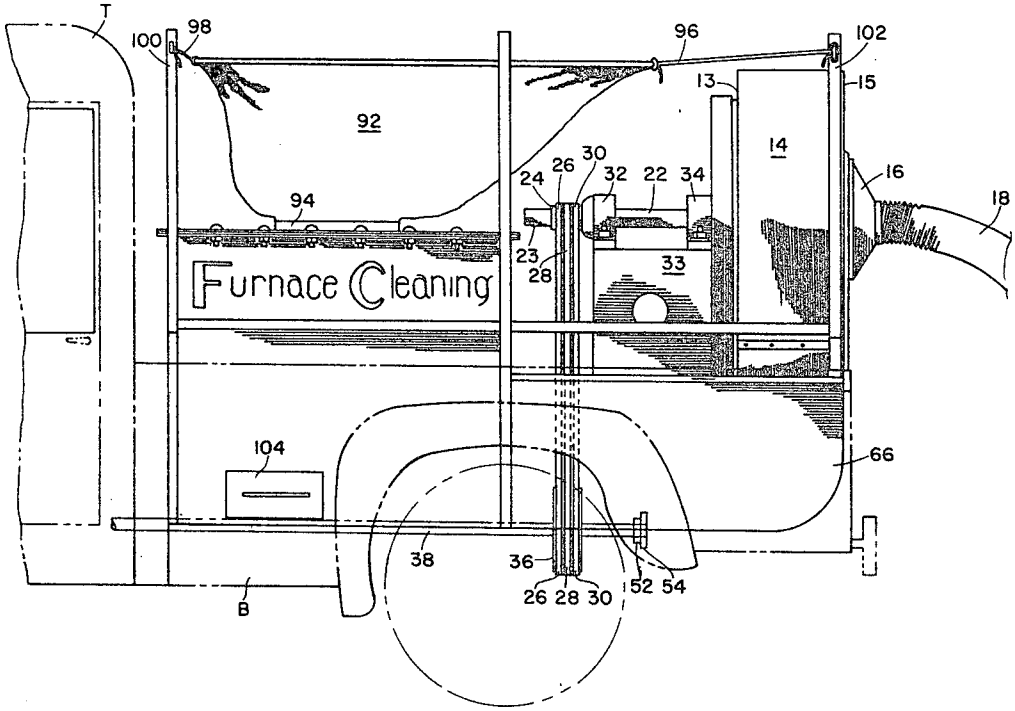
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ABSTRACT: This invention is directed to a mobile apparatus employing a vacuum for cleaning furnaces immediately after they are shut off, eliminating the usual waiting period for the furnace to cool. The device includes a source of suction communicating with the interior of a furnace creating an enclosed airflow path from the furnace outwardly, carrying with it smoke, pieces of hot coals, and debris pulled from the furnace walls. A series of fire resistant filters interrupts the airflow path and removes the hot cinders, pieces of carbon, and other soot and debris from the airflow path. A final filter comprises a cloth billow through which the clean air is expelled to the atmosphere.

Furnace cleaning, according to present devices employed, is a slow and tedious process, and requires the furnace to be shut down and cooled completely before cleaning. Present methods include either manually scraping the inside of the furnace or applying suction to the furnace after it has completely cooled. Such devices obviously result in the furnace being shut down for a considerable amount of time, and therefore cleaning is usually accomplished only during the summer months.



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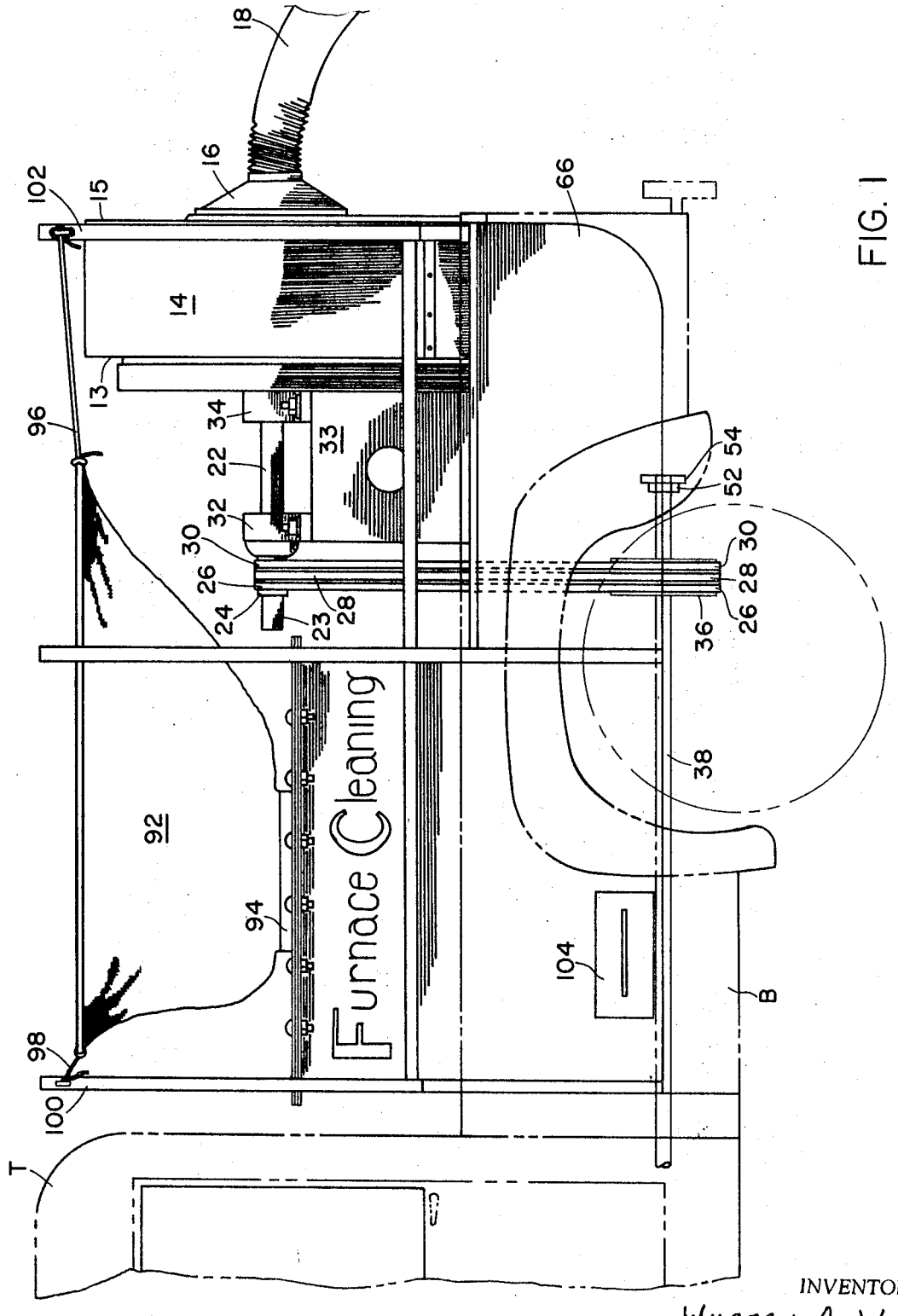


FIG. 1

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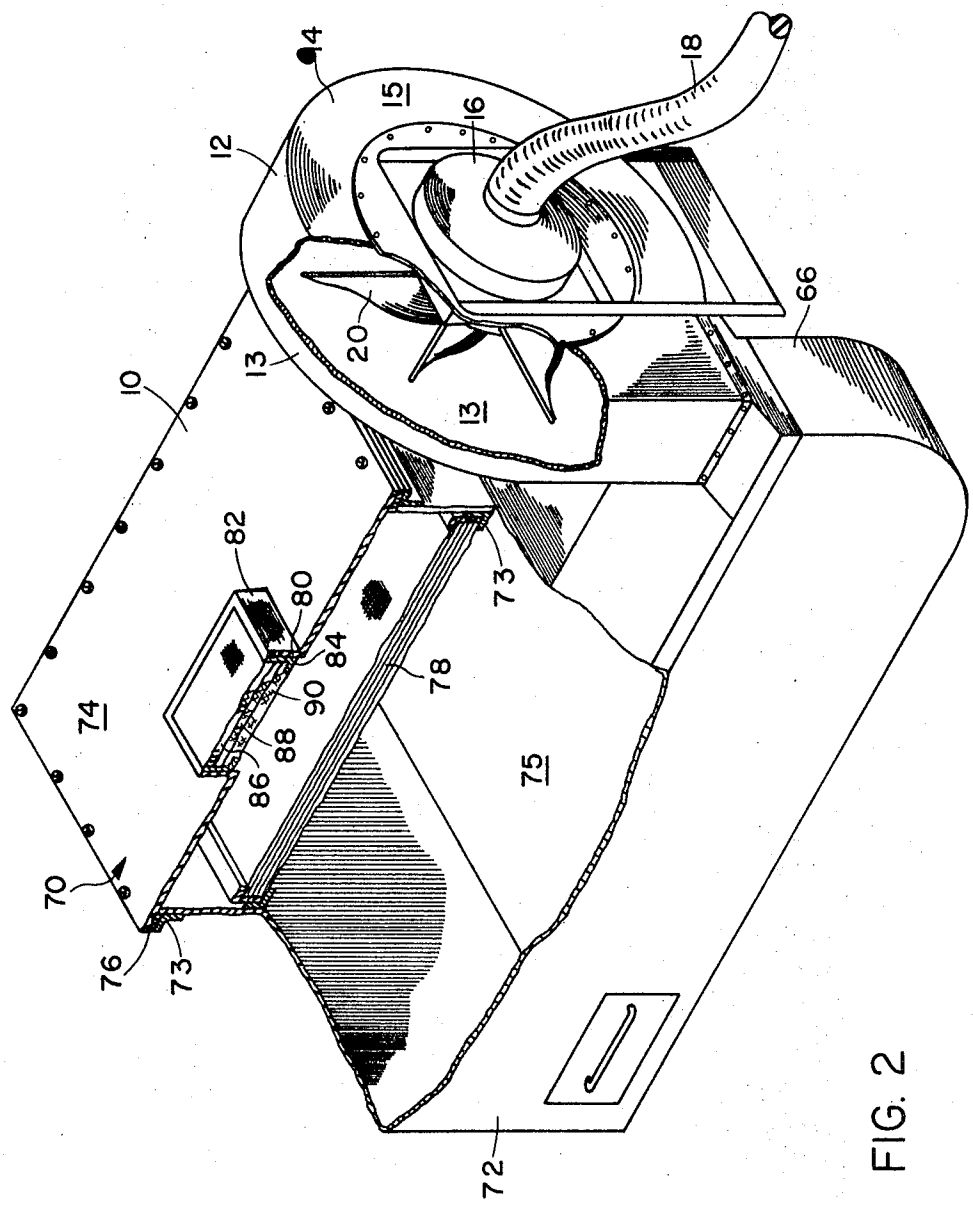


FIG. 2

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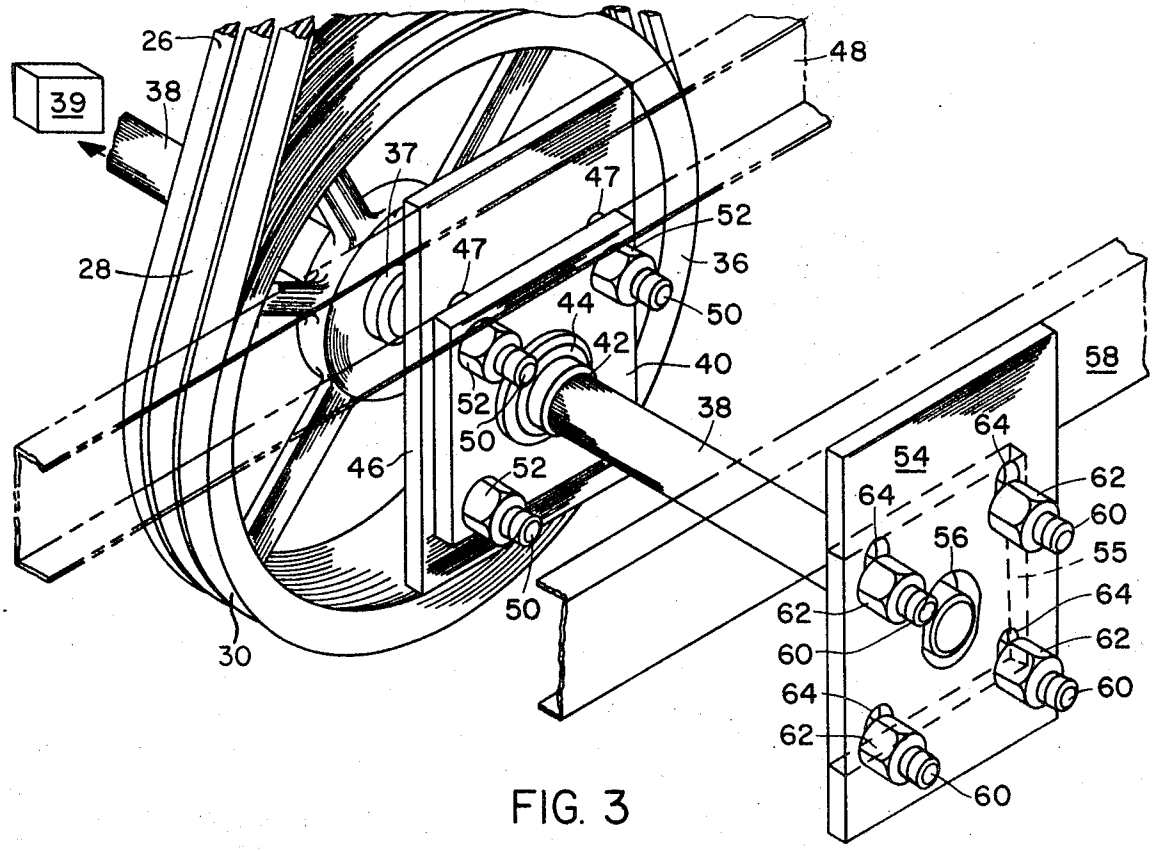


FIG. 3

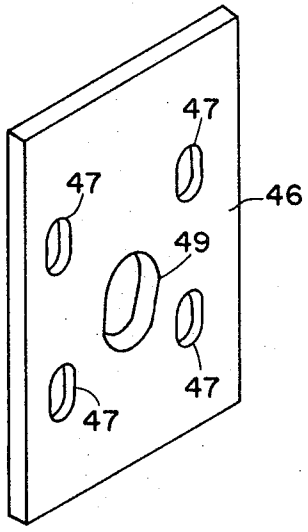


FIG. 4

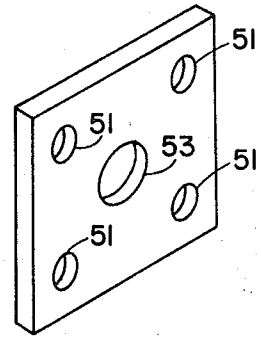


FIG. 5

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MOBILE FURNACE CLEANING APPARATUS

The apparatus which is the subject of the present invention, on the other hand, is capable of cleaning a furnace immediately upon shutting off the furnace and eliminates the usual cooling period, because the initial filters of the present apparatus are fire resistant. Therefore, a furnace can easily be cleaned in a matter of 30 to 40 minutes, and operation of the furnace then resumed without loss of heat for a significant amount of time.

It is therefore an object of this invention to provide an improved cleaning apparatus whereby furnaces may be cleaned immediately upon shutdown and before they have cooled.

It is another object of this invention to provide a mobile cleaning apparatus which communicates with the interior of a furnace and may be employed while the furnace is still hot.

Another and more specific object of the invention is to provide a mobile cleaning apparatus for furnaces which may be employed immediately upon shutting down of the furnace and which induces an airflow path for removing the debris from the interior of the furnace. A series of fire resistant filters remove the hot coals, large carbon pieces, sparks and smaller particles without danger of catching on fire.

Briefly, the invention comprises a source of suction and nonflammable filter system mounted on the bed of an appropriate vehicle such as a pickup truck. The source of suction comprises a large fan operated by the power takeoff system of the vehicle which communicates with the interior of a furnace and removes carbon and debris from the inside walls of the furnace through a flexible pipe. The debris laden air is subsequently forced through a filtering system comprising a large, relatively coarse mesh, metal filter which removes the big carbon, rust, and other similar pieces, and three smaller, fine mesh, metal filters which remove the fire, sparks and smaller particles. The air exits through a fabric filter such as a canvas billow which removes any remaining solids such as soot.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which

FIG. 1 is a side view, with parts broken away, of a vehicle having the furnace cleaning apparatus according to the present invention mounted thereon;

FIG. 2 is a perspective view, with parts broken away, showing the cleaning apparatus removed from the vehicle;

FIG. 3 is a perspective view, with parts broken away, showing the large adjustable pulley beneath the vehicle which connects the power takeoff system of the vehicle to the source of suction for the apparatus through the V-belts;

FIG. 4 is a perspective view of one of the mounting plates removed from the apparatus; and

FIG. 5 is a perspective view of one of the adjustable plates removed from the apparatus.

Referring now tO the drawings and more particularly to FIG. 1, the cleaning apparatus **10** according to the present invention is mounted on the rear of bed B of a suitable vehicle, such as a pickup truck or the like. A source of suction **12** comprises a generally cylindrical housing **14** having an axial opening in the rear plate **15** thereof. An adapted **16** is connected to flexible hose **18** and covers the opening in rear plate **15**, providing a means for attaching hose **18** to housing **14**. A fan **20** is mounted inside the cylindrical housing **14** and creates an airflow path by providing a source of suction communicatIng with the furnace through flexible hose **18**. The airflow path induced by fan **20** is of sufficient strength to remove the debris inside the furnace and that caked on its interior walls.

Suction fan **20** is axially mounted on a shaft **22** which extends through the front wall **13** of housing **14** and toward the front of the truck T a distance of approximately 3 to 4 feet. The shaft **22** is journaled for rotational movement between brackets **32** and **34** which in turn are securely attached to a stationary portion **33** of the truck itself. A small grooved pulley **24**, approximately 4 inches in diameter, is secured to the forward end **23** of shaft **22** and comprises the upper bearing member for three V-belts **26**, **28**, and **30**. Large grooved pulley **36** comprises the lower bearing member for the belts approximately 17 inches in diameter.

As shown in FIG. 3, large pulley **36** comprises the means for transmitting power from the power takeoff device of the vehicle and the suction fan **20**. Pulley **36** is secured to the rear portion of shaft **38** which in turn connects the pulley with the power takeoff apparatus **39** mounted near the transmission at the front of the truck and selectively operable by the driver. Shaft **38** extends through an opening in hub **37** of pulley **36** a short distance and is attached to adjustable plates **40** and **55** to provide a means for vertically adjustIng the large pulley **36** to tighten or loosen the tension on the three belts **26**, **28**, and **30**.

Mounting plate **46** is suitably attached, as by welding, to the framework **48** of truck T at a position interrupting the path of shaft **38**, and includes several elongated slots **47** and a central vertically elongated opening **49** (FIG. 4) through which shaft **38** is loosely received for adjusting pulley **36**. Adjustable plate **40** includes circular openings **51** and a central circular opening **53** through which shaft **38** extends. Collar **44** is attached to adjustable plate **40** and includes an opening **42** aligned with opening **53** for journaling shaft **38**. Plate **40** is attached for vertical adjustment to mounting plate **46** by means of bolts **50** and nuts **52** which extend through the elongated slots **47** in mounting plate **46** and through the aligned openings **51** in plate **40**. Vertical adjustment of adjustable plate **40** causes a corresponding shift in the position of shaft **38**, which in turn raises or lowers pulley **36**.

Adjustable plate **55** is identical to plate **40** in the way it receives shaft **38** and the function it performs. Mounting plate **54** is identical to mounting plate **46** and is attached to another portion **58** of the framework of the truck. As in mounting plate **46**, mounting plate **54** includes an elongated slot **56** for receiving shaft **38** and a series of four elongated slots **64** through which screws **60** extend and are held by nuts **62** to adjustably mount plate **55** thereto. To increase or decrease the tension on belts **26**, **28**, and **30**, bolts **52** and **62** are loosened, plates **40** and **55** moved to the desired position, and the bolts tightened.

As shown in FIG. 2 one side of the cylindrical housing **14** has an opening therein and has connected thereto a conduit **66** which provides communication between the fan **20** and the filter system **70**. The debris laden air currents are drawn from the furnace through flexible hose **18** and forced from housing **14** through conduit **66** into the filter housing **70**. Conduit **66** opens into the filter housing near the bottom beneath the filter layers as hereinafter described.

Filter housing **70** comprises an enclosed rectangular housing with walls **72**, cover **74** and a floor **75**. Cover **74** is suitably attached to a peripheral horizontal flange **73** formed integrally with the upper edges of walls **72**. An asbestos or other nonflammable gasket **76** between cover **74** and flange **73** prevents escape of any debris laden air to the atmosphere other than through opening **80** in cover **74**.

Within the enclosure formed by walls **72** and cover **74** and above the point where the debris laden air currents enter housing **70** from conduit **66**, a primary, relatively coarse mesh, metal filter **78** completely spans the area between the walls **72**, so that all of the air must pass therethrough. Filter **78** is supported by flanges **73** extending inwardly from walls **74** and is formed as a series of offset stainless steel screens. There are approximately 10 layers of screens, each screen having approximately one-quarter inch openings, and the layers be so positioned that the openings are offset in adjacent layers. The stainless steel filter **78** removes the large carbon, hot coals, rust, and other large particles, larger pieces to drop to the bottom of the housing **70**. The remaining air laden with smaller pieces of debris passes through to be further filtered as hereinafter described.

A smaller opening 80 is provided in cover 74 and includes an upstanding wall 82 around the periphery thereof. A ledge 84 extends inwardly from wall 82 at a point spaced approximately 3 inches below the upper edge thereof and supports three secondary metal filters 86, 88, and 90 in superposed relation. These are standard, commercial metal filters approximately 1 inch thick, and span opening 80 completely, so that all the air must pass therethrough on its way out of filter housing 70. The three secondary filters 86, 88 and 90 have a relatively fine mesh which removes the fire, sparks, and smaller particles remaining in the air currents after passing through filter 78, whereupon these particles sift down through filter 78 to the floor of housing 70.

The remaining air comprises smoke and soot which are eliminated by a waterproof canvas billow-type filter 92 having an opening in the bottom thereof approximately the same size as opening 80 and having the canvas portion surrounding said bottom opening attached to the upstanding wall 82 by means of a metal band 94 which clamps billow 92 to flange 82. A pair of vertical support posts 100 are secured to each front corner of the truck bed, and a similar pair of support posts 102 are secured to the rear corners. A horizontal rod (not shown) extends between front posts 100 and a second horizontal rod extends between rear posts 102. The upper portion of canvas billow 92 is attached to one end of ropes 96 and 98, and the other end of ropes 96 and 98 are fastened to the horizontal rods, whereupon the billow 92 is retained in an erected position. As the smoke and soot laden air are forced out the opening 80 in filter box 70, the canvas billow 92 provides a final filter for the air on its way to the atmosphere.

In operation, the operator of the furnace cleaning apparatus attaches the flexible hose 18 to the flue of a furnace desired to be cleaned, and shifts the power takeoff apparatus of the vehicle into engagement with the output of the motor. As the motor runs, shaft 38 is caused to rotate, in turn transmitting rotational motion to the large pulley 36. The rotational motion is then transferred to small pulley 24 through belts 26, 28, and 30 and because of the difference in diameter between the two pulleys, shaft 22 is caused to rotate at high speeds, operating fan 20.

Debris is pulled from the inside of the furnace through the flexible hose 18 and is delivered into conduit 66 from which it is blown into the filter housing 70 beneath the primary filter 78. The air then flows through primary filter 78, through smaller secondary filters 86, 88, and 90, and finally escapes to the atmosphere through final canvas filter 92.

After the furnace is thoroughly cleaned, the vacuum system is shut down, the hose 18 removed, and the truck is ready to move to the next job. During movement from job to job, the vibrations and wind blowing through canvas billow 92 cleans it, so that the particles deposited on the inner surface thereof fall back through the other filters onto the floor of the housing 70, from whence they may be removed periodically through access door 104.

It is to be recognized that although the embodiments shown in FIGS. 1 through 3 and described above disclose a specific filter arrangement and a specific connection between the fan and power takeoff of the truck, various changes may be made while remaining within the scope of the invention. For example, there might be a different number of metal filters used, or they might be arranged in a different pattern. Other embodiments will occur to those skilled in the art and are within the scope of the following claims:

What I claim is:

1. A mobile vacuum system for cleaning the interior of a furnace comprising:

a. a first means mounted on a movable vehicle for inducing an airflow path outwardly from said furnace;

b. a second means enclosing said airflow path and connecting the interior of said furnace with a first and second filter;

c. said first filter mounted on said vehicle comprising a fire resistant material and interrupting said airflow path whereby hot coals and other waste particles entrained in said airflow path are removed, and further wherein said fire resistant material includes a primary, relatively coarse mesh, metallic filter for removing the large carbon, rust and hot coals entrained in said airpath, and a secondary, relatively fine mesh, metal filter for removing fire, sparks, and smaller particles, wherein said primary filter comprises a plurality of adjacent layers of stainless steel screen, each layer having the openings thereof slightly offset from the adjacent layers, and said secondary filter comprises a plurality of separate metal filters in superposed relation; and

d. a second filter comprising a fabric material and interrupting said air flow path at a point subsequent to said first filter for filtering smoke and fine particles, whereby the air passing through to the atmosphere is relatively free of contamination.

2. The mobile vacuum system according to claim 1 wherein said first means comprises a source of suction, and said second means comprises:

a. a flexible hose connecting said furnace and the inlet side of said source of suction; and

b. a conduit connectlng the outlet side of said source of suction and said first filter.

3. The mobile vacuum system according to claim 2 and further including a collection housing having a cover, sidewalls and a floor enclosing said primary filter, said housing having a first opening in the lower portion of one sidewall for receiving one end of said conduit at a position below said primary filter, said collection housing further having a second opening in the cover thereof, said primary filter spanning substantially the entire cross-sectional area of said collection box at a a point above said first opening, and said secondary filter covering said second opening, said second fabric filter comprising a billow covering said second opening and extending upwardly therefrom.

4. The mobile vacuum system according to claim 3 wherein said collecting housing further includes an access opening in one of said sidewalls adjacent the floor for withdrawing solid waste particles which fall from said filters thereon.