United States Patent

Davis

[15] **3,651,621**

[45] **Mar. 28, 1972**

[54] MACHINE FOR EXTRACTING DIRT FROM HOLES

[72] Inventor: **Henry J. Davis,** c/o Automation International Inc. 350 N. Edison St., Stockton, Calif. 95203

[22] Filed: **Nov. 17, 1969**

[21] Appl. No.: **877,292**

[52] **U.S. Cl.**.....**55/304,** 15/340, 55/319, 55/341, 415/206, 416/186

[51] **Int. Cl.**.....**B01d 46/04**

[58] **Field of Search**.....55/319, 300, 304, 305, 323, 55/325, 341; 15/340, 347; 415/206; 416/186

[56] **References Cited**

UNITED STATES PATENTS

1,507,243	9/1924	Myer	15/348
2,652,191	9/1953	Buchi	416/186
2,805,732	9/1957	Martinez	55/341
2,823,762	2/1958	Bunnell	55/341
3,272,429	9/1966	Wood	416/186
3,541,631	11/1970	Kluge et al.	15/352
729,492	5/1903	Hannay	55/305
1,743,934	1/1930	Ruemelin	55/319
2,790,509	4/1957	Share	55/305
3,363,405	1/1968	Baxendale	55/304
3,395,519	8/1968	Kleissler	55/304

FOREIGN PATENTS OR APPLICATIONS

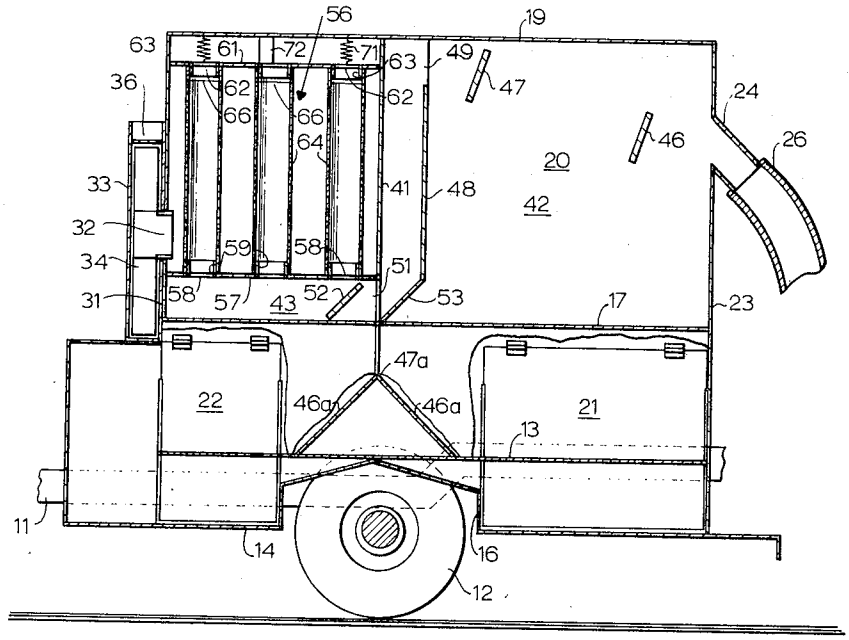
1,550,446	11/1968	France	15/340

Primary Examiner—Bernard Nozick
Attorney—Julian Caplan

[57] **ABSTRACT**

A portable machine used to raise dirt, rocks, and the like from holes, such as fence post and utility pole holes and similar purposes. Means is provided in a closed chamber to extract the heavy and the light dirt particles by gravity separation and then to extract the fine particles by cloth bag filtration. Means is provided to clean the fiber cloths by mechanical vibration. A blower draws a vacuum through the chamber and then through a hose which is lowered into the hole being cleaned.

2 Claims, 7 Drawing Figures



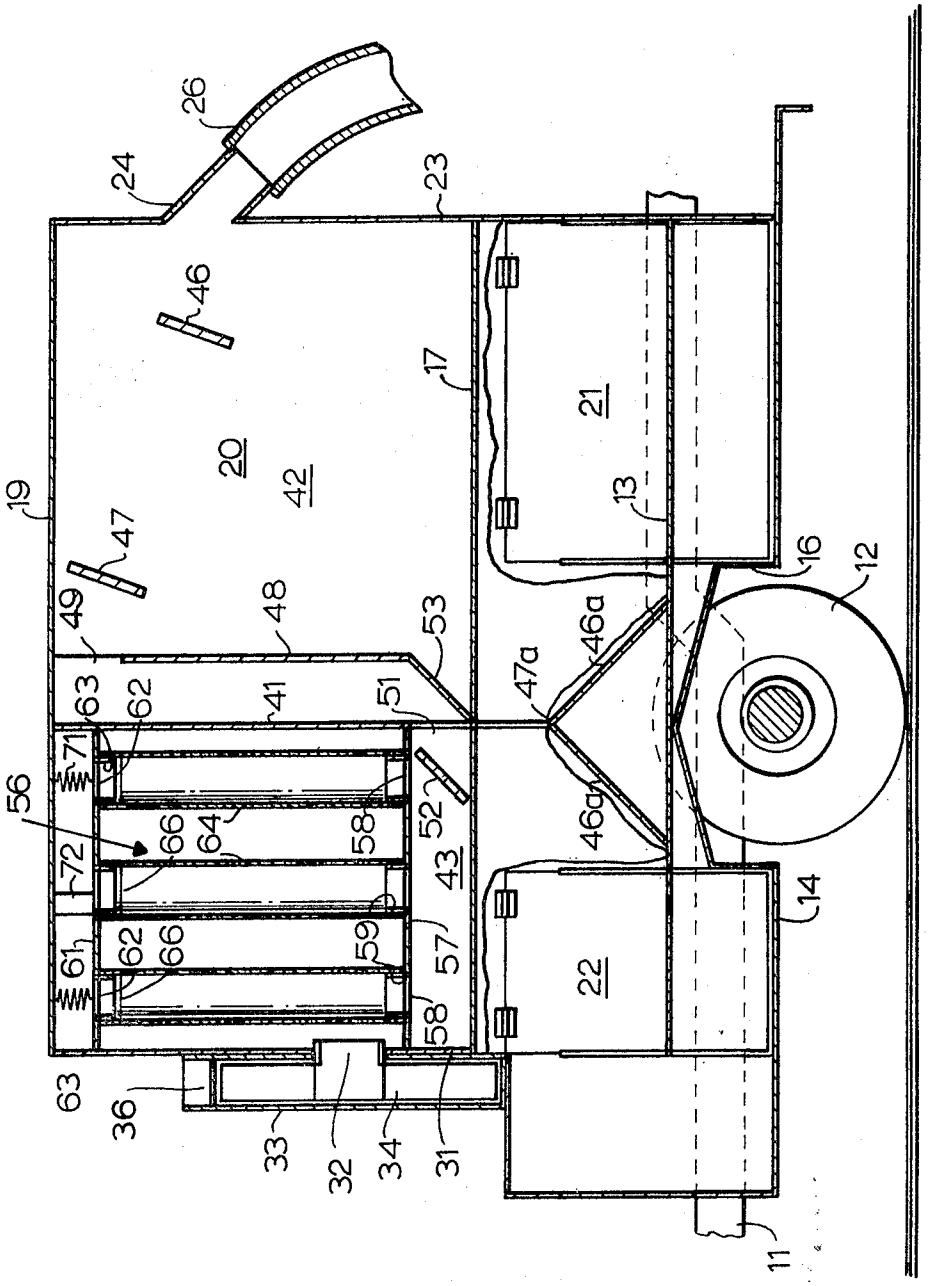


FIG. 1

INVENTOR.
HENRY J. DAVIS

BY

Julian Caplan
ATTORNEY

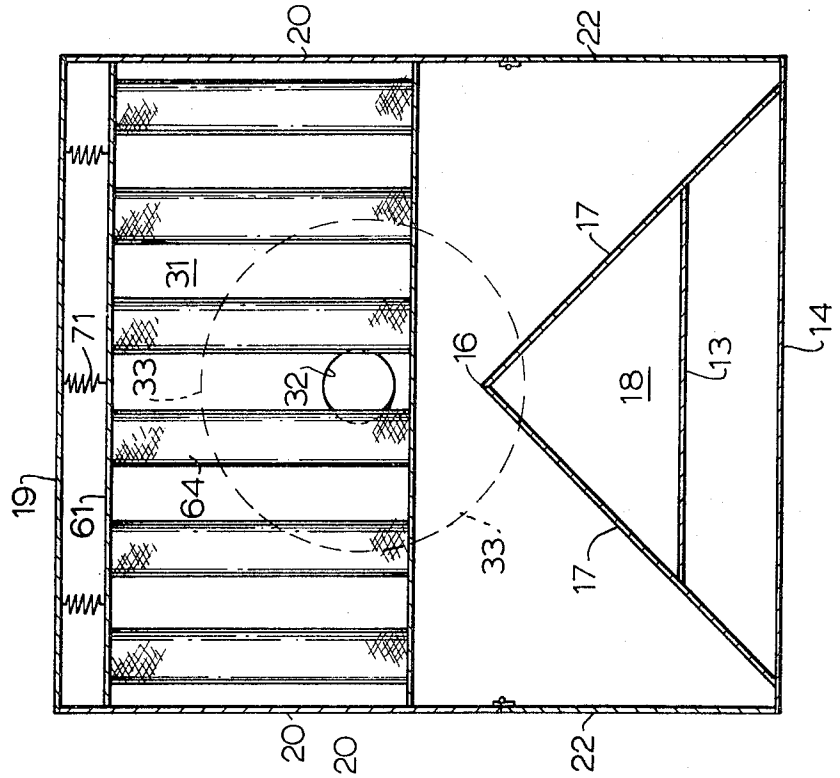


FIG. 3

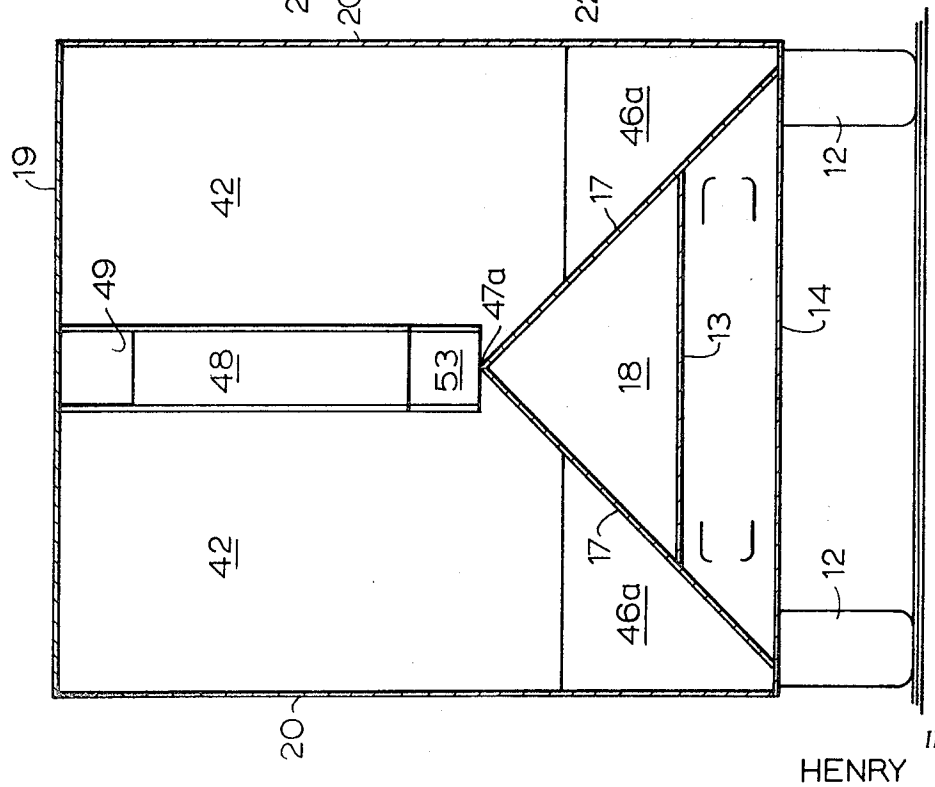


FIG. 2

INVENTOR.
HENRY J. DAVIS

BY

ATTORNEY

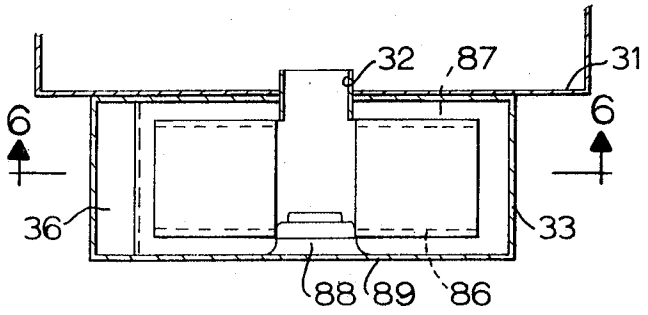


FIG. 5

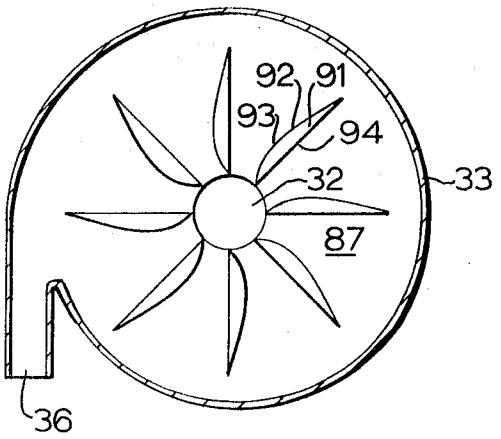


FIG. 6

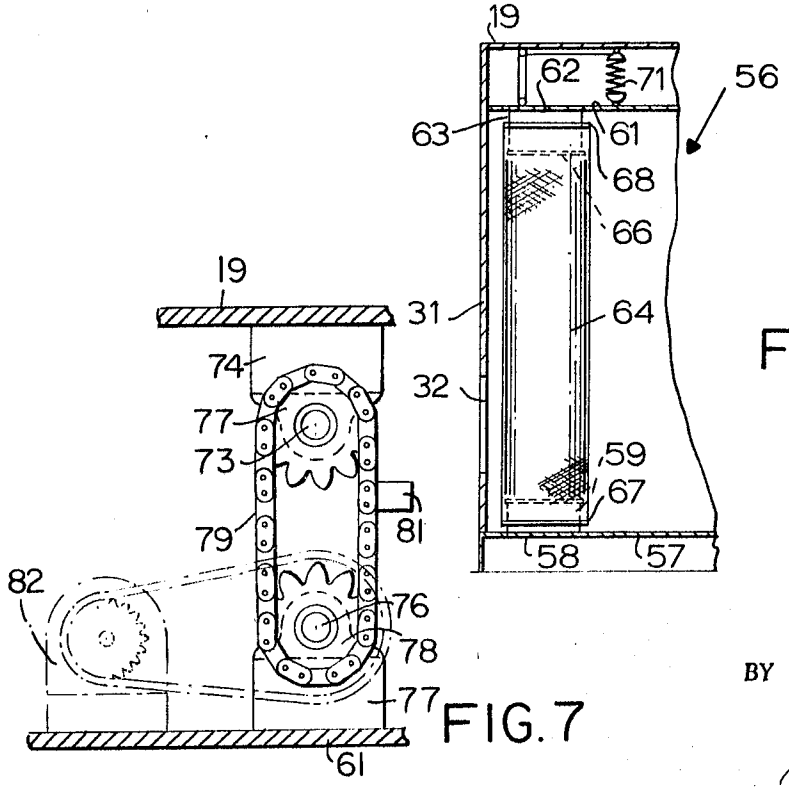


FIG. 4

FIG. 7

INVENTOR.
HENRY J. DAVIS

BY

Julian Caplan
ATTORNEY

MACHINE FOR EXTRACTING DIRT FROM HOLES

This invention relates to a new and improved machine for extracting dirt from holes. More particularly, the invention relates to a truck or trailer-mounted apparatus having a compartmented body for collection of dirt and rocks drawn through the hose from the bottom of a hole by means of a vacuum fan. Heavy and medium size dirt particles are separated from the air stream in the several compartments and finally the air is drawn through fabric filters to remove the remaining dust. The filters are preferably vibrated so as to be, for practical purposes, self-cleaning.

A principal object of the present invention is to draw dirt, rocks and the like out of holes which have been dug in the ground by other equipment. Earth augers of various types have been used for many years to dig holes for posts, utility poles, building foundation piles and the like. There is a tendency for dirt to drop into the holes when the auger is removed or sometime thereafter. Cleaning out the hole has been a difficult, labor-consuming operation. The present machine rapidly sucks the dirt from the hole with very little labor required.

In accordance with the present invention, a hose is lowered into the hole and a powerful vacuum is drawn through the hose to suck out the dirt. The apparatus separates the dirt from the air, greatly reducing discharge of dust into the atmosphere which would otherwise occur and hence eliminating a potential air pollution nuisance.

Another feature of the invention is the fact that the very heavy and the medium pieces of dirt are separated from the air stream by gravity classification. Hence when the air reaches the bag filters, much of the material which would otherwise tend to clog the filters has been removed and the cloth filters perform their function more effectively. Accordingly, the air is caused to whirl inside the casing so that the particles contact the sides of the casing, and thus are caused to drop from the air stream and fall to the bottom of the compartment where they may be removed at intervals through convenient doors formed in the sides of the body.

Another feature of the invention is the provision of a bank of bag filters which function to remove the fine dirt material and which are of a construction making their installation and removal convenient and rapid.

Another feature of the invention is the fact that the frame on which the bag filters are mounted is subjected either continuously or intermittently to vibration so that material tending to clog the filters is shaken off.

Another feature of the invention is the fact that access to the interior of the body through doors is convenient so that dirt may be removed at intervals when required.

A principal feature of the invention is that the equipment is compact and readily portable so that the apparatus may be moved up to the hole being cleaned even where the terrain is rugged.

Still another feature of the invention is the fact that the fan blade structure is so constructed as to improve the suction.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings in which similar characters of reference represent corresponding parts in each of the several views.

In the drawings:

FIG. **1** is a side elevational view of apparatus in accordance with the present invention partly broken away to reveal internal construction; and

FIGS. **2** and **3** are, respectively, front and rear elevational views likewise broken away in section to reveal internal construction; and

FIG. **4** is a fragmentary, enlarged sectional view of the filter bag mounting and adjacent elements.

FIG. **5** is an enlarged, horizontal, sectional view through the fan;

FIG. **6** is a sectional view substantially along the line **6—6** of FIG. **5**;

FIG. **7** is a schematic side elevational view of the vibrating means.

The apparatus hereinafter described in detail is presented in a preferred use for transportation to the site where holes have been excavated. For such purpose the equipment is installed on the chassis **11** of a trailer, truck or other suitable vehicle shown only partly in the accompanying drawings and supported above the ground by means of wheels **12**. The body is supported above the chassis **11** by means of a mounting plate **13** which is horizontally disposed and spaced upward from the bottom plate **14**. Plates **13**, **14** are suitably apertured to provide a well **16** for the wheels **12** on either side. Roof **19** is rectangular. The various outer walls and interior bulkheads of the body are reinforced at intervals by angle bars or other stiffeners so that they do not bend inward when the interior of the body is subjected to vacuum.

Extending longitudinally of the interior of the body is a triangular bottom having an apex **16** which has downwardly outwardly slanted sides **17** each disposed at an angle of about 45 degrees with respect to the horizontal. The space **18** below the slanted sides above the mounting plate **13** provides a compartment for storage of hose and the like, to which access is obtained from the rear. As hereinafter explained, dirt falling off the slanted sides **17** slides outwardly to either side **20** of the body so that access to rear and forward doors **21**, **22** on either side permits the accumulated dirt to be cleaned out.

Spaced downwardly from the top and disposed centrally of the rear **23** is the duct **24** which is preferably slanted downwardly rearwardly. Flexible hose **26** is installed over the duct **24**, the hose gradually diminishing in diameter as it extends outwardly so that it may conveniently be lowered into the bottom of holes in the earth (not shown).

Front panel **31** is formed with an aperture **32** centrally disposed relative thereto and the casing **33** of the blower is installed in registry with opening **32** to draw air out of the body and discharge the air through opening **36**.

Extending transversely of the body approximately midway of its length, is middle bulkhead **41** which divides the body into rear and front compartments **42**, **43** respectively. Center bulkhead **41** extends vertically approximately midway of the length of the compartment from side to side. Its bottom is closed off by slanted transverse bottom panels **46***a* which slope forwardly and rearwardly from a transverse horizontal apex **47***a* at the bottom of bulkhead **41**. Rearward of bulkhead **41** extending vertically at the center of the body is a rectangular box **48** having a square opening **49** at the top through which air enters from rear compartment **42** and having similar opening **51** at the bottom through which air is discharged into front compartment **43**. Transverse baffles **46**,**47** are installed in rear compartment **42** to ensure that air sucked in through duct **24** is caused to swirl within the compartment and to contact the side walls **20**, roof **19**, rear **23** and intermediate bulkhead **41**. The swirling of the dirt causes some of the heavier particles to separate out by centrifugal action and as the particles contact the walls of the compartment they are caused to drop to the bottom and then slide outwardly downwardly along sides **17** where they can be removed through doors **21**. Normally the very heavy dirt particles or rocks are separated out in compartment **42** and the remainder is drawn through the opening **51** in bulkhead **41** into compartment **43**.

Baffle **52**, forward of opening **51** causes air to swirl within compartment **43**. Most of the remaining particles of dirt drop out of air stream in box **48** and down into the forward compartment **43** along the slanted bottom **53** of the box **48**. Other medium sized particles which swirl around inside the compartment **43** contact the walls thereof and separate out from the air stream, falling onto the outward slanted bottom walls **17** and dropping to adjacent forward side doors **22** where the debris may be removed.

The upper portion of forward compartment **43** comprises a filter chamber **56** which is defined by front **31** and middle bulkhead **41** and filter compartment bottom **57** has a plurality of round holes formed therein and surrounding the holes **58** are upstanding cylindrical flanges **59**. The number and spacing of the holes **58** is a matter of choice but preferably they are staggered so that a major portion of the area of bottom **57** is

apertured and thus a maximum number of holes **58** is afforded. In a preferred form of the invention, there are 28 holes **58** in a pattern of five staggered longitudinal rows with six holes in the outer and center rows and five holes in the intervening rows. The top mounting plate **61** is located directly above plate **57** having similar holes **62** in alignment with holes **58** and likewise having flanges **63** around the holes. Extending between flanges **59** and **63** are filter bags **64** which are cylindrical sleeves open at the bottom and having closed tops **66**. The sleeves **64** are formed of filter cloth to trap remaining dirt in the air stream. The bottom edges of bags **64** fit around the flanges **69** and are held in place by clamps **67**. The tops **66** are spaced below the top edges of the bags **64** leaving an open cylindrical portion which fits around flanges **63** and held in place by hands **68**.

The top mounting plate **61** is suspended from roof **19** by means of springs **71** and a vibrating mechanism **72** is attached between roof **19** and plate **61**. Actuation of the vibrator **72** either continuously or intermittently shakes the bags **64** causing dirt trapped therein to fall down to the bottom of compartment **43** and thus reducing the tendency of the filter bags to clog. When it is necessary to remove the bags **64** for replacement or more thorough cleaning, the bands **67–68** are removed and bags **64** are easily displaced.

A satisfactory vibrator **72** is shown more or less schematically in FIG. **7**, it being understood that a variety of suitable vibrators is commercially available. Upper shaft is rotatably mounted on roof **19** by means of pillow blocks **74**. Lower shaft **76** is mounted on plate **61** by pillow blocks **77**. Sprockets **77,78** are fixed to shafts **73,76**, respectively, and interconnected by continuous roller-type chain **79**. One of the links of chain **79** carries a heavy weight **81**, which dynamically unbalances the system. One of the shafts, such as shaft **76**, is turned by motor **82** through any convenient means. Weight **81** causes severe vibration as chain **79** passes around its course.

Air in the filter compartment **56** is discharged through opening **32** in the forward wall **31** directly into blower **34** and thence through opening **36** into the atmosphere.

A preferred blower is shown in FIGS. **5** and **6**. Forward and rear annular disks **86,87** are supported by drive member **88** on front **89** of casing **33**. Casing **33** is of scroll shape, gradually increasing in radius in the counterclockwise direction of rotation of FIG. **6** and opens into discharge duct **36**. The central holes **91** of disks **86,87** register with opening **32** in front panel **31**.

Extending between parallel sides **86,87** are blades **91** here shown as seven in number and each generally shaped as an air foil. Each blade has a leading edge **92** which is curved outwardly forwardly to a maximum chordal width indicated by reference numeral **93** about one-fourth the radial length of the blade. The trailing edge **94** is substantially radial. The effect of the air foil shape is that the velocity of air movement is greater on the leading surface of the blade than on the trailing surface and this tends to pull air out from the center hole **32** more effectively than in blades of this general type.

In use of the device, the apparatus is transported to the site and the hose **26** inserted into the bottom of one of the holes in the earth. Fan **23** draws air out of the filter compartment **56**, forward compartment **43**, box **48**, and rear compartment **42** thus pulling air up through the duct **24**. Such air contains dirt, rocks and other debris which may have fallen into the hole. Baffles **46,47** cause the air to whirl in the rear compartment **42** and gravity, centrifugal force, and the friction of the particles along the walls of the compartment cause the heavy particles to drop out of the air stream to the bottom where they are periodically removed through rear side doors **21**. The middle sized and fine particles escape through the opening **49** into the box **48** and thence into the forward compartment **43**. Additional dirt falls out of the air stream into box **48** and compartment **43**. The remaining dirt is drawn through the opening **58** in the bottom **57** of the filter compartment **56** and the air is sucked through the filter sleeves **64**, causing the fine particles to remain on the inside of the filter bags. The air then flows out through opening **32** through the blower **33** into the atmosphere. The vibrators **72** cause the top plate **61** to vibrate and such operation is conducted either intermittently or continuously. The dirt in the pores of the bag **64** falls down through the openings in bottom plate **57** to the bottom of compartment **43**. Thus, all the remaining material in the air stream after the air leaves compartment **42** is discharged through doors **22**.

What is claimed is:

1. Apparatus for extracting dirt comprising a chassis, a housing mounted on said chassis, a transverse, vertical bulkhead in said housing dividing the interior of said housing into first and second compartments, first means forming an inlet into said first compartment for connection with a flexible intake hose opening into said first compartment adjacent the top thereof, a horizontal apertured bottom wall disposed substantially midway of the height of said second compartment dividing said second compartment into a lower housing section and an upper housing filter section, said wall having first flanges surrounding the apertures, filter mounting means in said filter section mounting a plurality of sleeve-type cloth filters, said mounting means comprising a top plate having annular flanges extending downwardly in said top plate receiving ends of said sleeves, respectively, a vibrator mounted on the top plate for vibrating said top plate to discharge dirt on said filters to the bottom of said second compartment, a vertical box mounted in said first compartment mounted to said bulkhead having an inlet at the top of said first compartment and an outlet opening into said lower housing section of said second compartment below said wall, baffles positioned in said first compartment and in said lower housing section to direct air in a tortuous path from said first means to said filter housing section, a fan mounted on said second compartment communicating with the filter section for evacuating air through said filter sleeves from the bottom, front portion of said filter housing section, each said compartment being formed with a floor which slants from the middle of said compartment outwardly-downwardly toward either side toward the sides of said body, and access doors for access to each of said compartments hinged to said sides about hinges having horizontal longitudinal axes for discharge of dirt, the lower edges of said doors coinciding with the outer ends of said slanted floors.

2. Apparatus according to claim **1** in which said fan comprises a casing which is scroll shaped in front elevation and has a central front opening, a drive member supported by said casing, a pair of annular disks on said drive member spaced apart and parallel to each other, the central holes of said disks in registry with said front opening, and a plurality of airfoil cross section shaped blades between said disks, each blade having a leading edge curved outwardly forwardly to a maximum chordal width about one-fourth of the radial length of the blade and a substantially radial trailing edge.

* * * * *