(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 056 176**
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **81300153.4**

(22) Date of filing: **14.01.81**

(51) Int. Cl.³: **B 24 C 3/06**

(43) Date of publication of application: **21.07.82**
Bulletin 82/29

(84) Designated Contracting States: **DE FR GB NL SE**

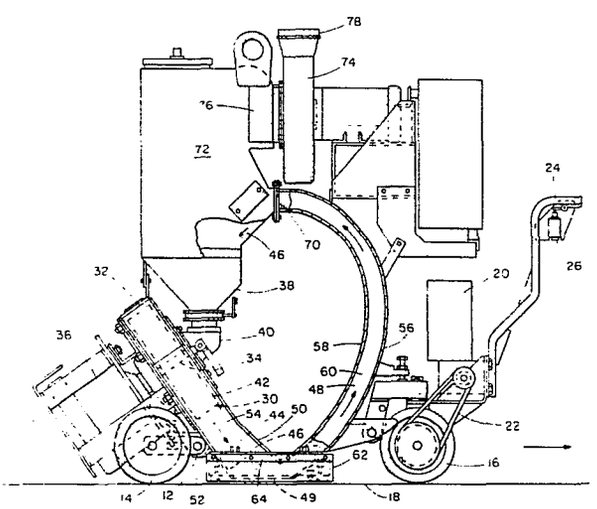
(71) Applicant: **WHEELABRATOR-FRYE INC., Liberty Lane, Hampton New Hampshire (US)**

(72) Inventor: **Bergh, John C., 1831 Juanita Drive Eastwood Estates, Elkhart Indiana 46514 (US)**

(74) Representative: **George, Roger David et al, Raworth, Moss & Cook 36 Sydenham Road, Croydon Surrey CR0 2EF (GB)**

(54) Portable apparatus for treating surfaces.

(57) A portable apparatus for treatment of surfaces (18), preferably horizontal, comprising a centrifugal wheel (30) for projecting abrasive particles (44) onto the surface (18) at an angle within the range of 30° to 80° with the surface (18), a feed hopper (38) for supplying abrasive particles (44) to the wheel (30, a rebound corridor (48) of constant cross-section extending angularly upwardly preferably curvilinearly and into which the abrasive particles (44) rebound upon striking the surface (18) and means (72, 74) for returning abrasive particles rebounding through the corridor (48) to the hopper (38).



EP 0 056 176 A1

S P E C I F I C A T I O N

This invention relates to a device for treatment of surfaces with particulate material thrown at high velocity onto the surface and it relates more particularly to a portable device which makes use of one or more airless wheels having radially extending blades for throwing, by centrifugal force, particulate material such as steel shot, grit, or abrasive particles against the surface for cleaning, abrading, or other surface treatment.

Recovery for re-use of abrasive or other particulate material is essential to the economical operation of the device, otherwise the cost of particulate material or abrasive becomes excessive, the means for supplying of the large volumes of abrasive material imposes a similar problem of size and weight, and the means for disposal of spent abrasive material increases the problem of size and weight.

Recovery of the particulate material and abrasive entails the problems of removal of the particulate material and abrasive from the surface after they have served their purpose, separating re-usable particulate material and abrasive from the dust, dirt and fines picked up from the surface, and returning the cleaned particulate material or abrasive for recycle to the centrifugal blasting wheel for re-use in surface treatment.

Such recovery, cleaning and recycle of cleaned particulate material and abrasive should be embodied as a unit with the centrifugal wheel or wheels and housing for confinement of the thrown abrasive particles if the unit is intended for use as a portable surface cleaning or treating device.

Present surface treatment devices of the type described, especially for the treatment of horizontal surfaces, such as floors, ships' decks, roads, runways and the like, are very large and difficult to maneuver in relatively small areas. A great deal of the length and weight is taken up by the recovery, cleaning and recycle system for the used particulate material or abrasive.

It is an object of this invention to provide a portable surface treating device of the type described which is of a size and weight to be easily maneuverable over the surface to be cleaned or otherwise treated, in which means are provided for recovery of the re-usable abrasive or other particulate material, in which the recovered abrasive or particulate material is cleaned and recycled in a simple and efficient manner which requires a minimum of space and additional equipment, and in which the abrasive or other particulate material is substantially completely removed from the cleaned or treated surfaces thereby to minimize the loss of material, and the amount of additional cleaning required to remove the dust and residue from the cleaned or treated surfaces.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, an embodiment of the invention is shown in the accompanying drawings, in which:

Figure 1 is a schematic sectional elevational view showing the essential elements of a portable apparatus embodying the features of this invention for cleaning a floor, ship's deck, or other horizontally disposed surface;

Figure 2 is a front elevational view of the apparatus shown in figure 1; and

Figure 3 is a front elevational view of the rebound chamber shown in figures 1 and 2.

The invention will be described with reference to an apparatus for cleaning a horizontally disposed, relatively flat surface, such as a floor 18, ship's deck, airport runway, street and the like, but it will be understood that the

apparatus to be described has application also for the treatment of surfaces other than flat and other than horizontal, such for example as a rolling surface, inclined surface and even a vertical surface.

While the invention will hereinafter be described with reference to the use of hard abrasive particles for cleaning such surfaces, it will be understood that the apparatus of this invention has application for the treatment of surfaces with other particulate material for use in cleaning surfaces, removal of surface finishes, hardening surfaces as by peening or impacting, and for providing certain finishes to a metal, plastic, wooden and the like surface. The type of surface treatment or finish depends somewhat upon the type of particulate material projected onto the surface such as steel shot, steel grit, metal abrasive, sand for surface cleaning, or softer materials such as particulate organic materials in the form of nut shells, nut seeds, wooden or plastic particles and the like for surface finishing, hereinafter collectively referred to as abrasive particles.

Referring now to the drawings, illustration is made of an apparatus which includes a rigid frame 12 mounted on wheels 14, one of which is in the form of a caster wheel 16 for enabling movement of the apparatus in various directions over the surface 18 to be treated. The apparatus may be adapted for movement by hand, in which event handle bars are provided to extend rearwardly from the frame, or, as illustrated in the drawing, the apparatus may be powered for movement over the surface, as by means of a motor drive 21, with steering means 24 for maneuvering the apparatus over the surface to be treated. The driving motor 21 carried on the frame 12, is interconnected to the caster wheel 16 by an endless belt 22, with controls 26 on the handle 24 for operation thereof.

The apparatus is provided with one or more centrifugal wheels 30 enclosed within a protective housing 32. The wheel 30 is generally referred to as a centrifugal

blasting wheel, of the type well known to the trade, and marketed by Wheelabrator-Frye Inc., of Mishawaka, Indiana, under the name WHEELABRATOR. The wheel is rotated at high speed on an axle 34 driven by an electrical motor 36. Instead of a direct motor drive, rotational movement at high speed can be imparted to the wheel by means of a belt drive which interconnects a pulley on the end of the axle with a motor driven sheave offset from the wheel axis.

Abrasive particles are fed from a supply hopper 38 through a feed spout 40 to a cage in the center of the wheel. The cage dispenses the abrasive particles onto the inner end portion of the blades 42 which extend radially outwardly in circumferentially spaced relation from the hub whereby, in response to rotational movement of the wheel, the abrasive particles 44 are displaced radially outwardly over the surfaces of the blades and thrown with high centrifugal force from the ends of the blades in a direction controlled by the cage. The rate of flow of particulate material is controlled by a control valve in the feed system.

As illustrated in figure 1, the wheel axle is inclined so that the abrasive particles will be thrown from the blades angularly downwardly through a similarly inclined blast corridor 46 onto the surface 18. The cleaning efficiency and rebound of the abrasive particles, for best recovery, is somewhat dependent upon the angle of inclination at which the abrasive particles strike the surface which angle corresponds to 90° minus the angle of inclination that the wheel axle makes with the horizontal. The angle of inclination that the wheel axle makes with the horizontal should be less than 60° and not less than 10° so that the angle at which the abrasive particles strike the surface will not be less than 30° nor greater than 80° and preferably within the range of 45° to 65°.

When the abrasive particles are thrown at high velocity angularly onto the surface, they tend to rebound from the surface at a reflective angle. For recovery of the spent abrasive particles, there is provided a rebound corridor 48

which extends upwardly from the surface, initially at an angle between the reflective angle and 10° to 15° less than the reflective angle.

Thus the blast corridor 46 and the rebound corridor 48 merge at their lower end portions to provide a downwardly facing opening 49 therebetween, which defines the blast area through which the abrasive particles are thrown onto the surface and from which they rebound for return through the rebound corridor 48.

The blast corridor is defined by front and back walls 50 and 52 and side walls 54 while the rebound corridor is defined by front and back walls 56 and 58 and side walls 60. The lower edges of the walls 50, 58, 54 and 60, which define the opening 48, terminate a short distance above the surface 18. The area is enclosed by resilient skirts 62 which depend from brackets 64 fixed to the lower edge portions of the surrounding walls. The skirt 62 is intended to enclose the area to confine the blast and to prevent ricocheting of abrasive particles to the region outside of the housing. The skirt is characterized by sufficient flexibility to permit abrasive particles, collected on a surface 18, to pass beneath the skirt and to permit air to be drawn about the underside of the skirt from the outside atmosphere into the blast area, as will hereinafter be described. For this purpose, the skirt is formed of a rubber-like material dimensioned to engage the surface or preferably to terminate a short distance above the surface to permit the inflow of air from the surrounding atmosphere into the blast area.

Advantage is taken of the energy imparted to the abrasive particles by the throwing wheel whereby they rebound from the surface at a reflective angle and with sufficient kinetic energy for transport through the rebound corridor to a height sufficient for return to the feed hopper 38.

This eliminates the need for collectors and conveyors otherwise required to recover the abrasive particles and to recycle the re-usable abrasive to the blast wheel. It also

eliminates the need to incorporate means for otherwise dissipating the kinetic energy imparted to the abrasive particles by the wheel and it minimizes the excessive wear of surfaces by abrasive whereby frequent repair or replacement is required.

In a copending application filed in this country, use is made of a rebound corridor of curvilinear contour in the lengthwise direction, in which the rebound corridor diminishes in cross section from the entrance at the lower end toward the outlet at the upper end. Such gradual decrease in cross section was intended to increase the rate of flow of induced air through the corridor by an amount which corresponds substantially inversely to the square of the cross section, whereby the increasing velocity supplements the kinetic energy of the rebounding particles for substantially complete traverse of the rebound corridor without external assists.

It has been found that the advantages sought to be obtained with a rebound corridor of decreasing cross section have not completely materialized, due perhaps to the adverse effect of increasing density of the elements in relation to the decrease in cross section. In addition, the cost of manufacture of a rebound corridor of diminishing cross section is relatively high and the capacity of the machine is somewhat diminished.

It has been found that efficient and effective recovery of abrasive particles can be achieved by rebound when use is made of a rebound corridor, perferably of curvilinear contour from the entrance end portion at the bottom to the exit end portion at the top, wherein the cross sectional area of the rebound corridor remains substantially constant throughout its length. The kinetic energy of rebound upon striking the surface is sufficient to enable the particles completely to traverse the rebound corridor, especially when formed of curvilinear shape for smooth and uninterrupted flow from the struck surface 18 to the outlet end of the rebound corridor and with normal air flow induced by the rapidly rotating wheel and/or the flow of air into the blast area from the surrounding

atmosphere as induced by the exhaust fan of the dust separator communicating with the exhaust end portion of the rebound corridor, as will hereinafter be described.

While the rebound corridor is of constant cross section substantially throughout its length, the width corresponds with the width of the blast opening, as shown in figure 3, to enable entry of the abrasive or other particles striking the surface 18.

By construction of the rebound corridor of constant cross section substantially throughout its length, the cost of the machine is reduced while the rebounding particles tend to flow with less turbulence during traverse of the rebound corridor for return to the hopper feeding the wheel.

In the modification shown in the drawings, the upper outlet end 70 of the rebound corridor 48 empties into an expansion chamber 72. Separation of the abrasive particles 46 from the dust and dirt is effected in the expansion chamber by means of an air stream drawn by an exhaust fan 74 having its inlet duct 76 in communication with the upper end portion of the expansion chamber 72, and its outlet duct 76 connected to a conventional dust collector (not shown) for removal of dust and dirt before exhaust into the atmosphere.

As the stream of rebounding particles, dust, dirt and air exit from the rebound corridor into the expansion chamber 72, the heavier abrasive particles 46 settle gravitationally for return to the hopper 38 while the entrained dust and dirt rises with the air stream for exhaust from the machine.

The relatively small amount of abrasive particles, which do not traverse the rebound corridor, fall back onto the surface and pass under the skirt 62 about the blast area. These particles can be picked up by a trailing auxiliary pickup unit, such as a vacuum cleaner, magnetic drum, rotating brush or the like. It will be understood that the power requirement for operating such auxiliary unit to pick up the small amount of abrasive particles remaining on the surface

18 is materially less than the power that would otherwise be required fully to recover the abrasive particles within the blast unit itself.

Since the great majority of the abrasive particles, entrained dust and fines, rebound with sufficient kinetic energy to pass through the rebound corridor for cleaning and for return of the re-usable abrasive particles to the supply hopper, it is possible markedly to increase the recovery capabilities of the device without the need to utilize much space or energy for substantially complete recovery of the abrasive particles.

When adapted to operate on horizontally disposed surfaces, it is preferred that the rebound corridor extend curvilinearly upwardly through an angle of about 180° and preferably through an angle of 180-210° to the horizontal so that it will terminate in an end portion which extends horizontally into the expansion chamber or angularly downwardly in the direction of the hopper 38, as illustrated in figure 1.

Instead of forming the rebound corridor with a continuous curvature throughout its length, the rebound corridor can be formed with an initially relatively straight portion extending at the desired reflective angle, but terminating at its upper end either in a return curvilinear portion for smoothly guiding the rebounding particles into the expansion chamber or in an angled deflector plate for deflecting the abrasive particles inwardly into the expansion chamber.

The flow of air into the blast area is induced, in part, by the fan of the dust collector and by the rotation of the blast wheel as well as the abrasive particles traveling at high velocity through the blast chamber whereby subatmospheric conditions exist within the blast chamber. This causes air to be drawn into the blast area from the outside atmosphere about the underside of the skirt to sweep residual particles from the surface into the main stream and to induce the particles to rise into the main stream and join the line of travel of the rebounding particles into and through the rebound corridor

Thus the kinetic energy of the particles plus the induced air flow is employed to collect the spent abrasive particles and to carry them with the dust, dirt and other fines from the surface, through the rebound chamber, to a cleaning section and return to the feed hopper for re-use.

This eliminates the need for collectors and conveyors otherwise required to recover the abrasive particles and to recycle the re-usable abrasive to the blast wheel. It also eliminates the need to incorporate means for otherwise dissipating the kinetic energy imparted to the abrasive particles by the wheel and it minimizes the excessive wear of surfaces by abrasive whereby frequent repair or replacement is required.

Effective surface treatment is derived, at least in part, by the beat of the abrasive particles thrown sequentially by the radially spaced blades of the wheel, while the latter is rotating at high speed.

Instead of making use of gravity feed from the hopper to the wheel, use can be made of other systems for feeding particulate material to the wheel such as a pneumatic feed, screw feed, or other means for positive displacement of abrasive particles in the desired amounts. Under such circumstances, it is not essential to have the rebound corridor rise to a certain level, although it is preferred that the rebound corridor terminate at a downward incline so as to be able to take advantage of gravitational forces for continued processing of the recovered particles.

Instead of handle bars being mounted on the rear of the apparatus, it will be understood that such control means can be provided on the opposite end or both ends of the apparatus for enabling movement in either direction.

It will also be understood that the machine can be used for treatment of surfaces which are moved at a steady pace after the blast zone for treatment whereby the machine can be stationary or otherwise manipulated over such moving surface.

From the foregoing, it will be apparent that an

apparatus is provided for the treatment of surfaces in which utilization is made of kinetic energy resident in the abrasive particles to enable recovery of the abrasive particles in an efficient and economical manner whereby size, weight and cost of the unit can be greatly reduced, while providing greater maneuverability, by hand or by power operated means, over the surface to be treated.

It will be understood that changes may be made in the details of construction, arrangement, and operation without departing from the spirit of the invention, especially as defined in the following claims.

I CLAIM:

1. A portable surface treating apparatus comprising a housing having a horizontally disposed blast opening, a blast corridor extending at an incline downwardly into the opening, means for projecting particles for surface treatment through the blast corridor and through the opening onto the surface, a rebound corridor extending at an upward incline from the blast opening at about a mirror angle to the blast corridor whereby the particles rebound upon impact with the surface into and through the rebound corridor for return to said projecting means, said rebound corridor having a width corresponding to the width of said blast opening and cross section which is constant substantially throughout its length.

2. A portable surface treating apparatus as claimed in Claim 1 in which the blast corridor and the rebound corridor are disposed at acute angles to the horizontal.

3. A portable surface treating apparatus as claimed in Claim 1 in which the blast corridor extends at an angle within the range of 30-80° with the horizontal.

4. A portable surface treating apparatus as claimed in Claim 1 in which the rebound corridor extends curvilinearly from the blast opening to the exit end portion thereof.

5. A portable surface treating apparatus as claimed in Claim 4 in which the rebound corridor has an exit end portion at a level above the level of the projecting means for return of spent particles to the projecting means by gravitational force.

6. A portable surface treating apparatus as claimed in Claim 1 in which the rebound corridor defines a substantially continuous and unobstructed chamber within the housing for continuous, unobstructed flow of particles through the rebound chamber.

7. A portable surface treating apparatus as claimed in Claim 1 which includes an expansion chamber in communication with the outlet from the rebound corridor, a hopper communicating with the base of the expansion chamber, and means for causing a stream of air to flow upwardly through the expansion chamber whereby particles issuing from the rebound corridor into the expansion chamber separate gravitationally for separation from the dust and dirt entrained in the air flow.

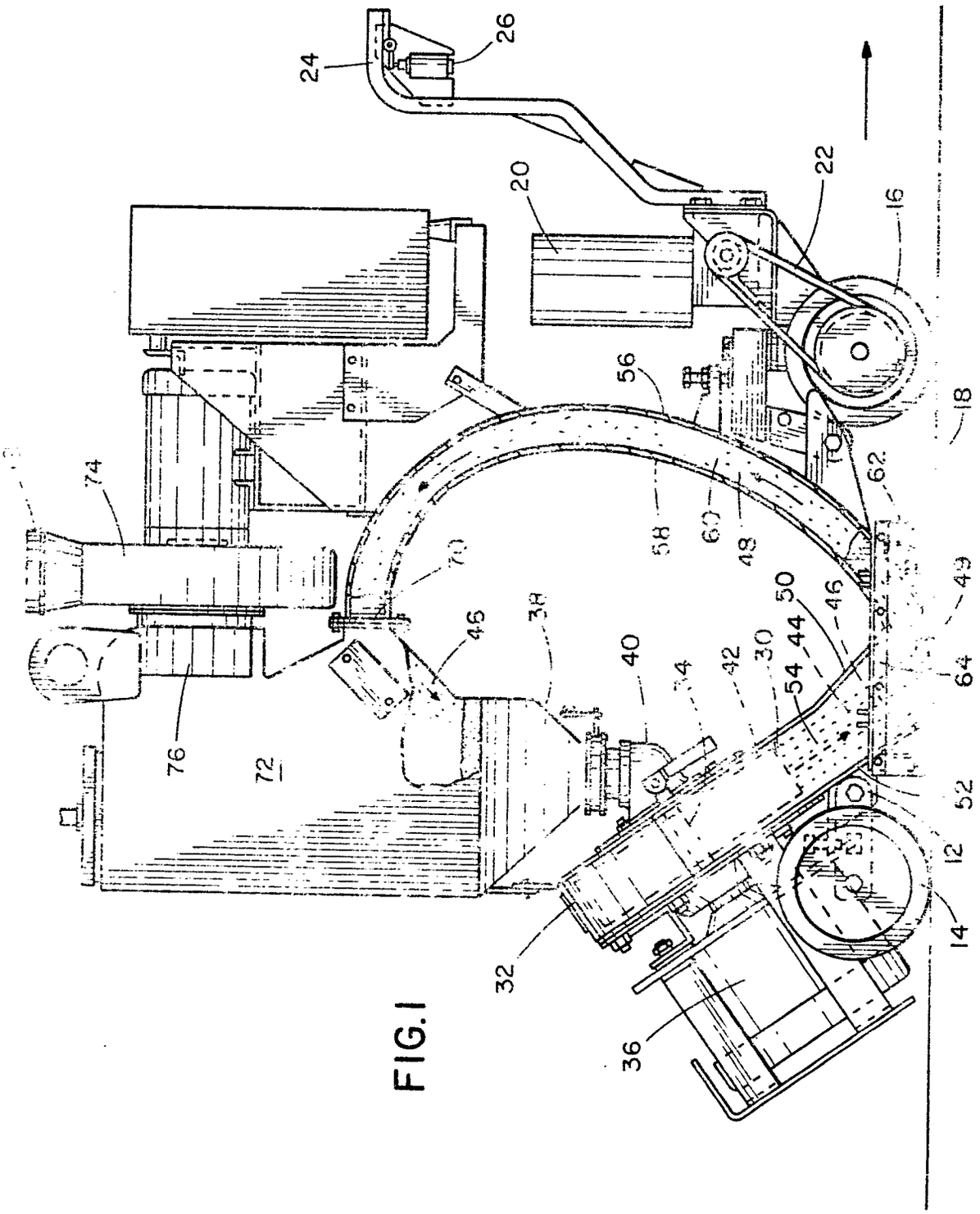

24
26
20
22
16
18
56
58
60
48
62
74
70
46
38
40
42
30
54
44
50
46
49
64
76
72
52
12
14
32
36

FIG.1

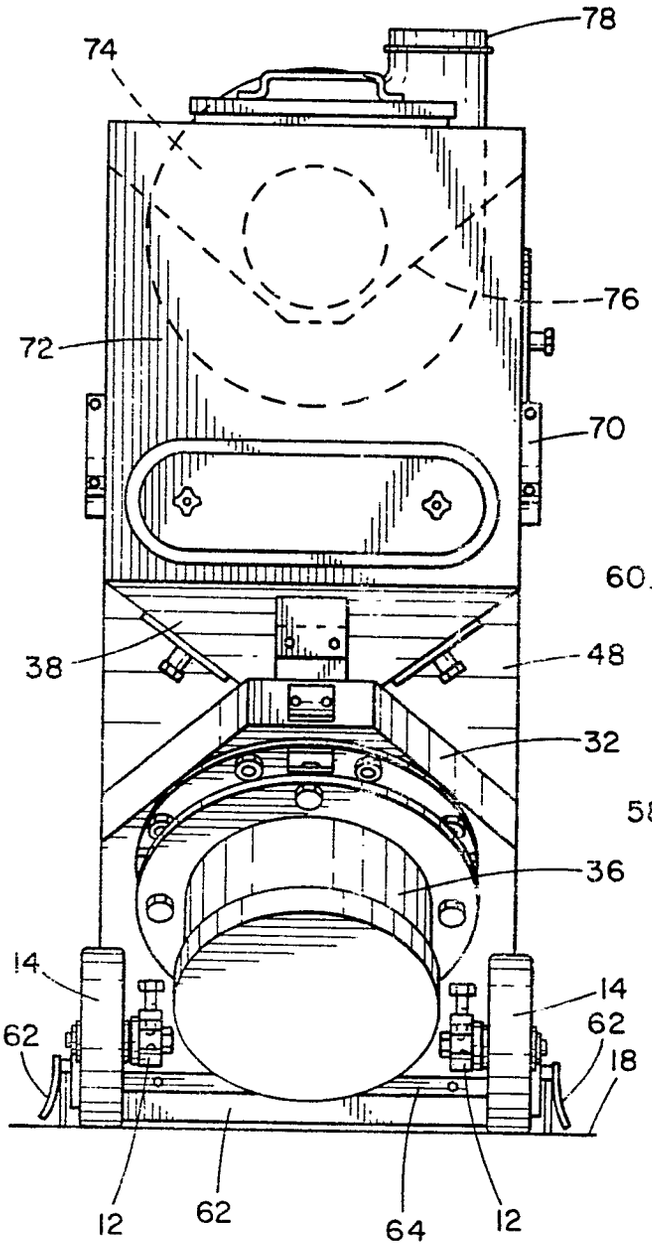


FIG. 2

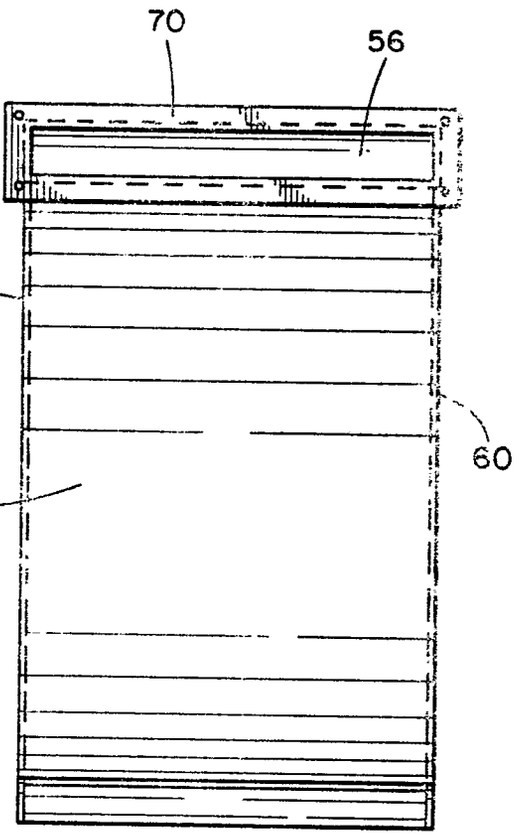


FIG. 3

0056176
Application number

European Patent Office

EUROPEAN SEARCH REPORT

EP 81 30 0153.4

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
	GB - A - 1 575 477 (WHEELABRATOR-FRYE INC.) * claims 1, 2, 5; page 1, lines 59 to 78; page 3, lines 95 to 126; fig. 1 to 3 * & DE - A1 - 2 708 528	1-7
	US - A - 4 202 142 (H.G.VAN FOSSEN) * column 2, line 24 to column 3, line 57; fig. 1 *	1-7
	US - A - 4 080 760 (R.M. LELIAERT) * claims 1 to 5; column 2, lines 23 to 50; fig. 1 *	1-4,6
	US - A - 4 052 820 (J.C. BERGH) * claims 1 to 4; column 2, line 23 to column 3, line 44; fig. 1 *	1-5
	US - A - 3 034 262 (E.T. PAWLSON) * claim 1; fig. 2 *	1-3
A	US - A - 3 900 969 (P.H. DIEHN)	

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

B 24 C 3/06

TECHNICAL FIELDS SEARCHED (Int. Cl.³)

B 24 C 3/06
B 24 C 9/00

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	27-08-1981	MARTIN