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Christensen et al.

[11] **3,892,008**

[45] **July 1, 1975**

[54] **VENTED DOUBLE SKIRT SYSTEM**

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[73] Assignee: **Tennant Company,** Minneapolis, Minn.

[22] Filed: **Mar. 16, 1973**

[21] Appl. No.: **341,975**

[52] **U.S. Cl.** **15/368;** 15/340; 15/347

[51] **Int. Cl.** **A47l 9/06**

[58] **Field of Search** 15/347, 340, 368

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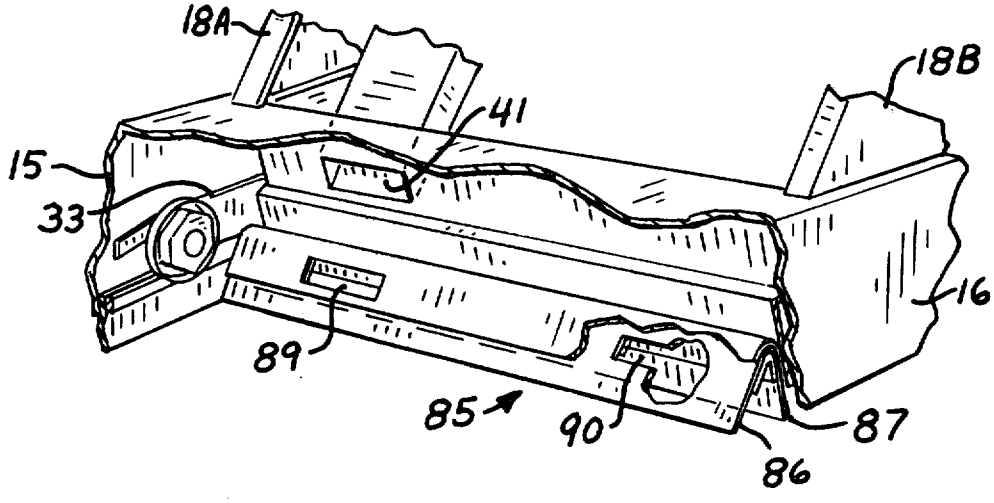
Primary Examiner—Harvey C. Hornsby

Assistant Examiner—C. K. Moore

[57] **ABSTRACT**

An improved sealing arrangement for isolating the enclosure which is exposed to a source of reduced pressure to establish air flow, and which houses a floor treating means such as an axially rotatable brush from ambience. The improved seal means includes a plurality of generally parallelly disposed spaced apart sealing elements cooperatively arranged to define a seal chamber therebetween, and a vent opening is formed in one of the sealing elements to provide gaseous fluid communication between the seal chamber and the enclosure housing the floor treating means.

11 Claims, 8 Drawing Figures



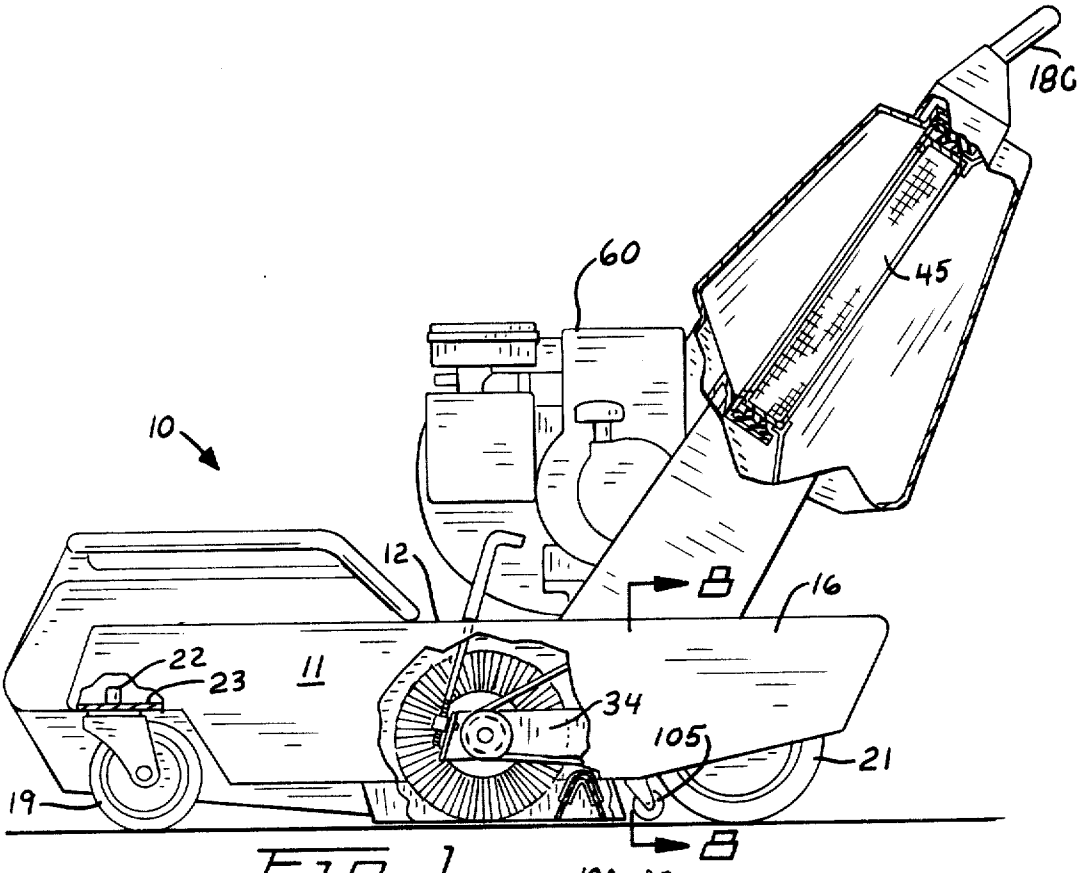


Fig. 1

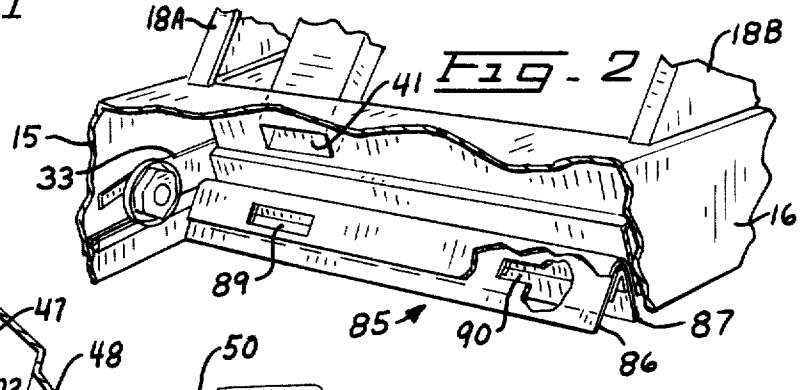


Fig. 2

Fig. 3

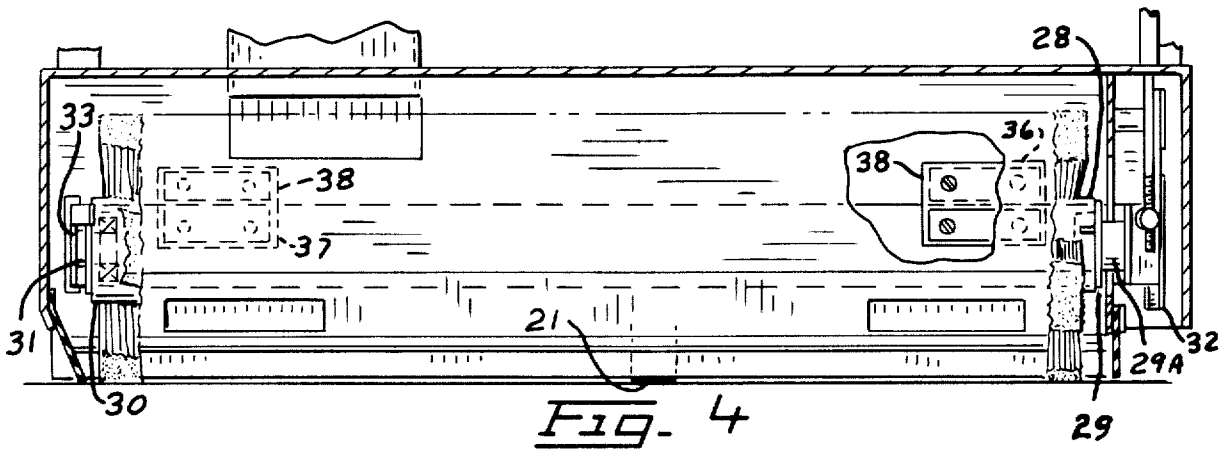


Fig. 4

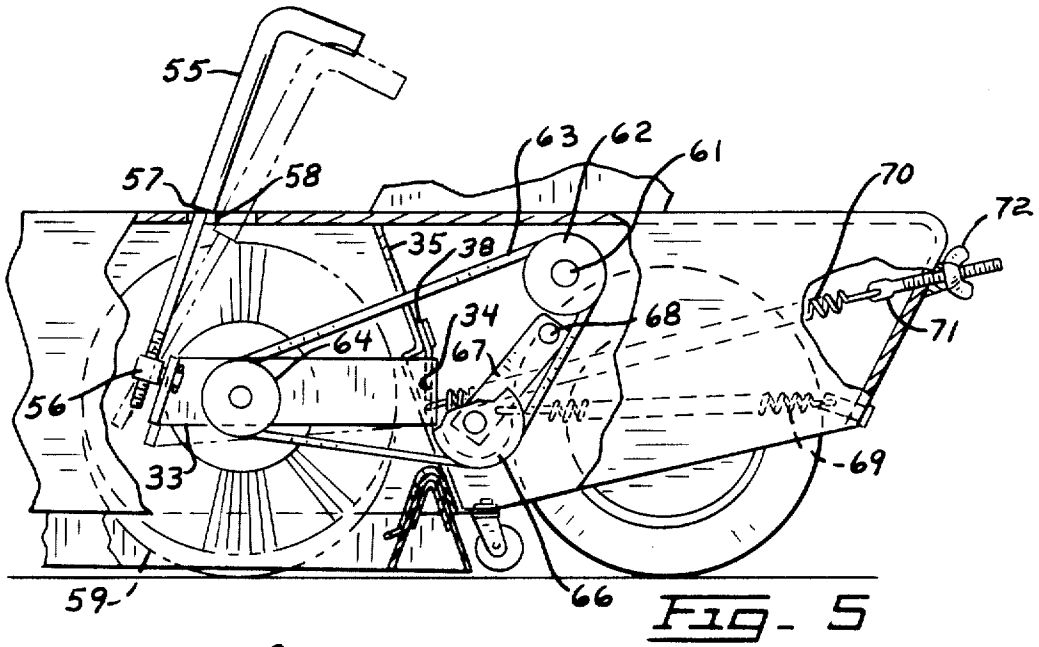


Fig. 5

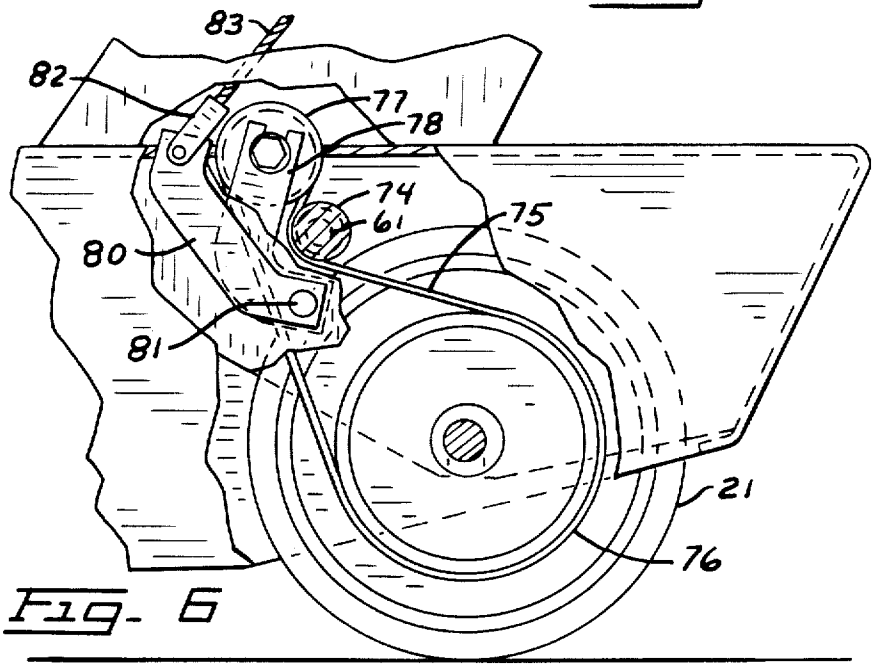


Fig. 6

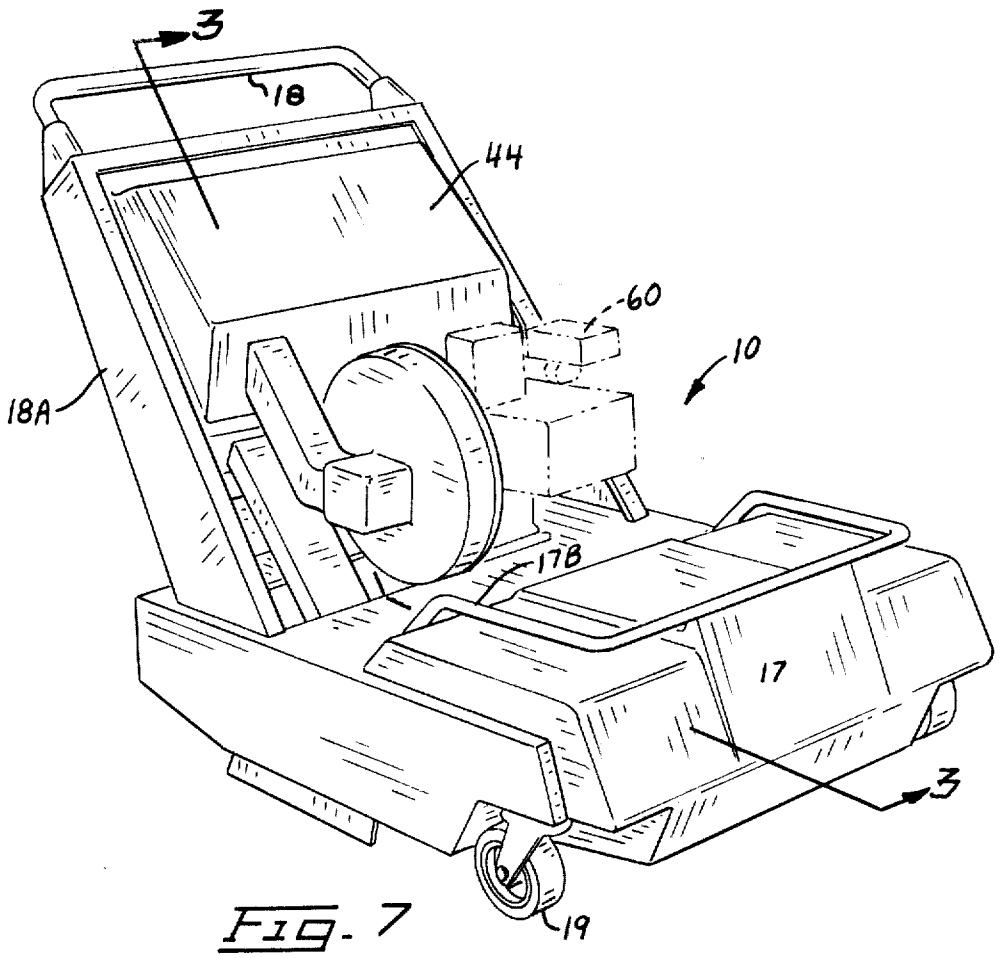

3
18
44
60
10
18A
17B
17
3
19

Fig. 7

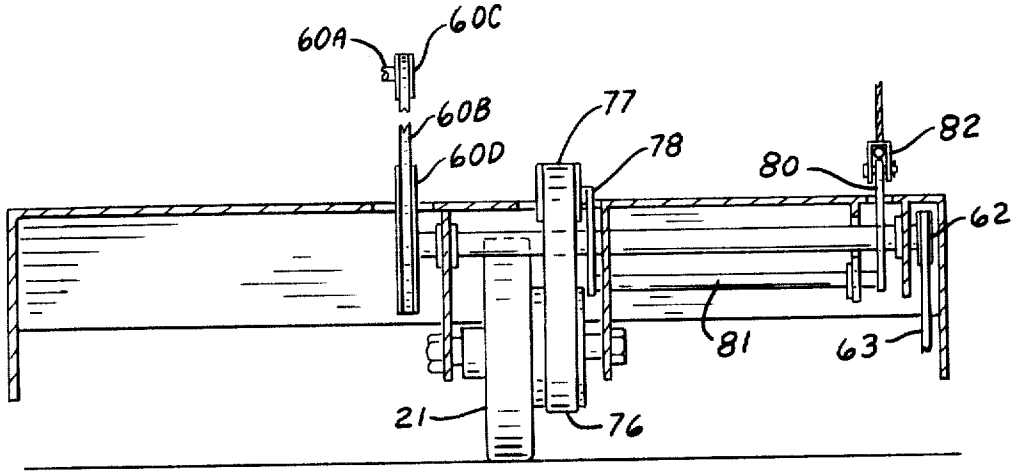

60A
60C
60B
60D
77
78
80
82
62
81
63
21
76

Fig. 8

VENTED DOUBLE SKIRT SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

The present skirt seal system may be employed in the apparatus disclosed in the co-pending application of Ralph C. Peabody, Ser. No. **341,975,** filed Mar. **16, 1973** and entitled "POWER FLOOR TREATING APPARATUS".

BACKGROUND OF THE INVENTION

The present invention relates generally to an improved floor sweeping apparatus, and more specifically to an improved sealing arrangement for isolating the floor treating means of a floor sweeper from ambience, the floor treating means being exposed to a source of reduced pressure, commonly referred to as "vacuum", to establish air flow. The seal provides improved dust control for floor sweeping apparatus, with a significant reduction in dust generation being experienced with the improved seal means of the present invention.

Power driven floor sweeping devices are in wide use, and particularly in commercial establishments such as factories, office buildings, parking ramps, and the like. These sweeping devices are employed for removal of dust, dirt, as well as other debris from floor surfaces. Typically, these devices provide for the controlled flow of gaseous fluid from an area or enclosure exposed to the surface being treated into a dust or other solid particle removal or separation chamber which is at a reduced pressure. The separation chamber is held at a reduced pressure, with a dust removing filter being interposed within the chamber and rigidly held therewithin. For removal of larger or heavier particles of debris, a rotating brush is employed to make brushing contact with the floor surface and move the debris from the surface into a hopper. The airsuspension of dust or solid particles generated from this operation is carried through an evacuation port for ultimate transfer to a filter mounted in the separation chamber.

While brush rotation is necessary for raising debris from a floor surface, this motion frequently contributes to the raising of quantities of dust in the ambunce. In order to reduce the quantity of dust being raised, a reduced pressure is provided in the brush chamber and seals are employed between the structure and the floor surface for isolating the brush chamber or enclosure from ambience. Again, typically, these seals are in the form of a resilient skirt or the like which extends generally between the lower edges of opposed walls of the brush enclosure and normally reach approximately to the surface of the floor being treated.

SUMMARY OF THE INVENTION

In accordance with the present invention, an improved sealing skirt is provided which has been found extremely effective in the reduction in the quantity of dust-laden air generated by the brush and discharged into the area being treated. Briefly, the improved skirt means of the present invention includes a plurality of generally parallelly disposed and spaced apart sealing elements which form a seal chamber or sealing chamber therebetween. Normally, a pair of such sealing elements are employed in the brush housing, and the elements extend between opposed walls such as, for example, between opposed side walls. In such an arrangement, the skirt means are tandemly arranged and, in effect, form a seal pair. A vent opening is formed in one

of the sealing elements to provide gaseous fluid communication between the brush enclosure and the chamber formed by the sealing elements. This venting is believed to contribute to the reduction in pressure drop which will normally exist between the brush surface and ambience, and thus provide a zone free of turbulence which enables dust particles which may otherwise be discharged into ambience to be either permitted to settle, or re-introduced into the brush enclosure, and ultimately discharged into the solid-air separation or debris receiving chamber.

Therefore, it is a primary object of the present invention to provide an improved skirt seal means for a floor sweeping apparatus which contributes significantly to a reduction in the discharge of dust into ambience.

It is a further object of the present invention to provide an improved floor sweeping apparatus which employs a sealing arrangement having a plurality of generally parallelly disposed and spaced apart sealing elements which form and define a seal chamber or sealing chamber therebetween, with at least one vent opening being formed in one of the sealing elements to provide gaseous fluid communication between the brush enclosure and the seal chamber.

It is yet a further object of the present invention to provide an improved floor sweeping apparatus utilizing an axially rotating brush, with skirt means being provided in the brush enclosure for forming first and second parallelly disposed spaced apart sealing elements cooperatively arranged to form a seal pair, and providing means for improving the ability of the apparatus to maintain dirt and other debris in suspension for ultimate discharge into the debris receiving chamber.

Other and further objects of the present invention will become apparent to those skilled in the art upon a study of the following specification, appended claims, and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevational view of the improved floor sweeping apparatus of the present invention, with portions of the housing being cut away so as to illustrate details of the brush enclosure and debris receiving chamber;

FIG. **2** is a detail perspective view, partially broken away, and illustrating the improved seal means of the present invention as disposed within the apparatus;

FIG. **3** is a vertical sectional view of the floor sweeping apparatus as illustrated in FIG. **1,** and showing the debris receiving chamber in open dosposition in solid lines, and in closed disposition in phantom, with this view being taken generally along the line and in the direction of the arrows **3—3** of FIG. **7**;

FIG. **4** is a detail vertical sectional view of the brush receiving enclosure, with the central portion of the brush being shown in phantom to better illustrate other features of the apparatus;

FIG. **5** is a fragmentary side elevational view, partially broken away, illustrating details of the brush suspension and drive system;

FIG. **6** is a fragmentary side elevational view, partially in section, and illustrating the drive means for delivering power to the drive wheel;

FIG. **7** is a perspective view of the improved floor sweeping apparatus of the present invention; and

FIG. 8 is a fragmentary vertical sectional view taken along the line and in the direction of the arrows 8—8 of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In accordance with the preferred embodiment of the present invention, the floor sweeping apparatus generally designated **10** includes a frame means **11** in the form of a structural housing including a top panel **12**, a front panel **13**, a rear panel **14**, and a pair of laterally opposed side panels **15** and **16**. The housing further is arranged to receive a removable debris hopper or receiver **17**, as is illustrated in FIG. **3**. The hopper is appropriately sealed into contact with the remaining portions of the structure, as is apparent from the showing in FIG. **3**. A control handle **18** is provided, with handle **18** having a pair of laterally disposed arms **18A** and **18B** secured to top panel **12** of the frame means **11**, and with a gripping section being provided as at **18C**. The support wheels include a pair of forwardly disposed casters **19** and **20**, and a rearwardly disposed drive wheel **21**. The forwardly disposed casters are adapted for rotation, as is conventional, by means of mounting plate or post as at **22**, the casters being secured to a main support plate **23**, as indicated in FIG. **1**. Rear drive wheel **21** is mounted for rotation on axle shaft **25**, with power being delivered to drive wheel **21** by means of a drive assembly to be described in further detail hereinafter.

As is apparent from the drawings, the apparatus includes a floor treating means in the form of a cylindrical brush **27** which is journaled for axial rotation within the frame means. The details of the mounting of the cylindrical brush **27** are best illustrated in FIG. **4**, it being noted that the cylindrical brush **27** includes a core **28** which is arranged to receive the hubs **29** and **30** therewithin. As is apparent in the illustrations of FIGS. **5** and **6**, hubs **29** and **30** are arranged along a common axis and provide a convenient means for supporting cylindrical brush **27**. The core **28** of brush **27** is positively engaged with hub **29** to provide for a proper drive coupling. A key or a radially extending rib may be employed if desired with a matching receiving slot being formed in the brush core. For reduction of friction upon mounting the brush in the system, the core engaging portion of boss **30** is preferably hexagonal. In order to provide for freedom of rotation of hubs **29** and **30**, suitable journal bearings are provided in the mounts as at **31**. Also, as is apparent in FIGS. **5** and **6**, hubs **29** and **30** are supported on laterally disposed mounting bracket **32** and arm **33**. Support for bracket **32** and arm **33** is obtained from plate **34** which is hingedly secured to frame plate extension **35** as at **36** and **37**, plate **34** thus being a transverse support member for bracket **32** and arm **33**. Hinge elements **36** and **37** utilize a flexible coupling web such as a web of polypropylene as is illustrated at **38**, this web providing hinged support or coupling between plates **34** and **35** and thus permitting free-floating or brush **27** while in use. This suspension system has been found to reduce the amount of vibratory energy which is transferred from the rotating cylindrical brush **27** to the remaining portions of the frame.

As is apparent in the drawings, the brush enclosure includes a forward wall such as wall **13**, a rear wall at **40**, and opposed side walls **15** and **16**. A receiving post for air suspended dust or debris is formed in wall **40** as at **41**, and a conduit **42** extends from the brush receiving enclosure **43** to the air suspended dust or debris receiving enclosure generally designated **44**. Chamber **44** acts as a solid-air separating chamber with filter **45** being employed to separate the incoming portion of the chamber as at **46** from the discharge portion of the chamber as at **47**. Exhaust conduit **48** extends from chamber segment **47** to exhaust port **49** which communicates with ambience. Impeller **50** housed within casing **51** is utilized to generate fluid flow from the enclosure **43** to the chamber **44**. Impeller **50** is mounted on shaft **52**, with rotational energy being delivered to the impeller by means of belt **53**, belt **53** being driven from shaft **61** which is coupled to the drive shaft **60A** of motor **60** along plural spans including belt span **60B**, with the spans covering pulleys **60C**, **60D** and others. Suitable journal bearings are provided as illustrated in FIG. **8** of the drawings.

Attention is now directed to FIG. **5** of the drawings for a discussion of the suspension and support system for the rotating brush assembly. As is apparent in this view, arm **33** supports hub **30** which, in turn, is received within the core of cylindrical brush **27**. The axial height of brush **27** when raised for transport or other reasons is adjustably controlled by means of threaded control shaft **55** which engages internally threaded coupling **56**, and which is provided with a support step or collar as at **57** for engaging a key-hole opening in frame or housing top panel **12**. Key-hole bore is formed in top panel **12** as at **58** for receiving the shank of member **55**. The phantom view of lever **55** is provided to illustrate the free-floating lower or running disposition of cylindrical brush **27**, as is illustrated in phantom at **59**.

Motor **60** is provided in order to deliver power for imparting axial rotation to the cylindrical brush **27**. The drive shaft **60A** of motor **60** drives output or countershaft **61** (FIG. **5**) through a belt with brush drive pulley **62** being fast on shaft **61**. Belt **63** is utilized to deliver power to pulley **64** which is, in turn, fast on shaft **29A** of hub **29**. Idler pulley **66** is provided for maintaining desired tension in belt **63**, with idler **66** being mounted on link **67** which is pivotally secured to the frame on shaft **68**. Adjustable spring member **69** has one end coupled to link **67**, with its other end being secured to the frame. A second spring is shown at **70** for maintaining or regulating the amount of down-pressure on brush **27**. Spring **70** has its forward end secured to support plate **34**, with its rearward end being adjustably coupled to the frame through eye-bolt **71**. The position of eye-bolt **71** is determined by wing nut **72**.

Attention is now directed to FIG. **6** of the drawings for an illustration of the drive means. Drive wheel **21** is driven from shaft **61** by means of pulley **74**, pulley **74** being fast on shaft **61**, with belt **75** engaging pulleys **74** and **76**. Adjustable idler pulley **77** is mounted for rotation on a shaft secured to crank arm **78**, arm **78** being secured to bracket **80**. Bifurcated coupling **82** is provided at the end of cable **83** for controlling the disposition of idler **77** and the ultimate tension in belt **75**. In the position illustrated in FIG. **6**, the arrangement is in "drive" disposition, and counter-clockwise motion of arm **80** about pivot pin **81** will reduce tension in drive belt **75**, thus permitting the unit to rest with the engine at idle.

Attention is now directed to the details of the seal means illustrated in FIGS. **2** and **3**. Skirt means generally designated **85** are provided, and are coupled to the

wall means at the rear of chamber **43**. Skirt means **85**, which isolate enclosure **43** from ambience, include first and second tandemly arranged spaced apart sealing elements **86** and **87**. These sealing elements **86** and **87** are cooperatively arranged to form a seal pair and define a seal chamber **88** therebetween. A pair of vents are provided as at **89** and **90** for providing gaseous fluid communication between the chamber **43** and the seal chamber **88**. The combined area of vents **89** and **90** is preferably substantially equal to the area of port **41**. As is apparent in the drawings, vents **89** and **90** are preferably spaced apart and disposed generally adjacent the opposed side walls **15** and **16** of chamber **43**. Also, these vents are formed in the skirt which is adjacent that portion of the brush which, in its normal running disposition, forces debris thereagainst.

In addition to the seal means **86** and **87**, a further seal is provided as at **93** for providing further isolation of the chamber **43** from ambience, seal means **93** also providing a gasket for debris receiving hopper **17**. An upper forward seal is shown at **93A**, this seal performing a similar gasketing function. Lateral seals are also provided.

As illustrated in this embodiment, the seals which are utilized to form the seal chamber extend between opposed side walls at the rear of the brush housing. As will be appreciated, such seal arrangements may extend between any opposed walls, and in certain instances, may be designed to extend around and circumscribe the entire brush housing to form an annular seal chamber thereabout. A suitable bent or plurality of vents would be established to provide communication between the seal chamber and brush housing.

While the embodiment illustrated herein employs a pair of spaced apart vents establishing communication between the seal chamber and the brush housing, it will be appreciated that adequate venting may be achieved by utilizing a single such vent opening, or by employing a larger number of such openings. It will be appreciated, therefore, that alternate venting arrangements may be established to achieve the performance and results of the present invention.

Particular attention is now directed to FIG. **4** of the drawings for a detailed discussion of the manner in which brush **27** may be removed from the assembly. As has been previously indicated, brush **27** is provided with a core **28** which is received on hubs **29** and **30** of the opposed bosses. Arm **33** is resilient and is inwardly biased so as to firmly engage and retain brush **27** in operating disposition. For removal of brush **27**, the operator will press arm **33** outwardly so as to disengage the surface of hub or boss **30** from the core **28** of brush **27**, thereby permitting the brush to be dropped.

While the structure has been illustrated as being provided with a gasoline engine **60**, it will be appreciated that alternate forms of power may be provided such as by electrical motor means or the like.

In the air suspended dust-receiving chamber **44**, hinge means are provided as at **97** for enabling the operator to open the chamber and remove accumulated debris therefrom. A lock is provided as at **98** to ensure closure of chamber wall **99** when the unit is in operation. As is apparent in the drawings, filter **45** is received within the confines of a gasketed perimeter as at **100**, with the gasket employing a pair of generally parallelly disposed lips **101** and **102** for making contact with the outer periphery **103** of filter **45**. It has been found that the positioning of filter **45** within the confines of arms **18A** and **18B** of handle **18** enhances the delivery of vibratory energy from the engine to the filter, and thus tends to render it self-cleaning while the unit is in operation.

Hopper **17** is also removable from the assembly, as is conventional in power sweeper devices of this type. Large items of debris which are collected in hopper **17** by rotation of brush **27** are thus conveniently transported to a suitable place of disposal.

For purposes of operating stability, while the three support wheels including castors **19** and **20** and drive wheel **21** are generally sufficient, additional support may be made available to the structure by means of elevated castors or support wheels **105** and **106**. These units may assist in preventing the unit from tipping sufficiently far from its normal running disposition so as to protect the integrity of seals **86** and **87**.

The materials of construction to be utilized for the device are conventional. Seals **86** and **87** are preferably that of reinforced rubber or the like. Such seal material is, of course, commercially available and any of a variety of resilient flexible materials may be employed for this purpose.

We claim:

1. In a floor sweeping apparatus having a frame, mounting means within said frame for journably supporting floor treating means for axial rotation therewithin, wall means including a forward wall, a rear wall, and opposed side walls coupled to said frame means forming an enclosure about said floor treating means, said wall means having a debris receiving port formed therein, power means for imparting axial rotation to said floor treating means; a debris receiving chamber, conduit means coupled to said debris receiving port and providing fluid communication between said floor treating means enclosure and said debris receiving chamber, and fluid impeller means for providing gaseous fluid flow from said floor treating means enclosure to said debris receiving chamber;

a. skirt means coupled to said wall means and extending generally between at least one pair of opposed walls for isolating a portion of said enclosure from the ambience, said skirt means including a plurality of spaced apart generally parallelly disposed flexible sealing elements each having a lower free edge surface and being cooperatively arranged to define at least one enclosed seal chamber therebetween, and at least one vent opening formed in the innermost one of said sealing elements to provide gaseous fluid communication between said floor treating means enclosure and said seal chamber.

2. The floor sweeping apparatus as defined in claim **1** being particularly characterized in that said skirt means extend between opposed side lateral walls.

3. The floor sweeping apparatus as defined in claim **1** being particularly characterized in that first and second sealing elements are cooperatively arranged to form a seal pair.

4. The floor sweeping apparatus as defined in claim **3** being particularly characterized in that said seal pair is disposed at the rear wall of said floor treating means enclosure.

5. The floor sweeping apparatus as defined in claim **1** being particularly characterized in that a plurality of spaced apart vent openings are formed in said sealing

element at a location spaced upwardly from the lower free edge surface of said sealing element.

6. The floor sweeping apparatus as defined in claim **1** being particularly characterized in that the area of said vent opening is approximately equal to the area of said debris receiving port.

7. The floor sweeping apparatus as defined in claim **1** being particularly characterized in that said floor treating means is a cylindrical brush.

8. The floor sweeping apparatus as defined in claim **7** being particularly characterized in that said spaced apart sealing elements include first and second tandemly arranged sealing elements forming a seal pair.

9. The floor sweeping apparatus as defined in claim **8** being particularly characterized in that said skirt means is disposed along said rear wall.

10. The floor sweeping apparatus as defined in claim **1** being particularly characterized in that means are provided for adjustably supporting the elevation of said cylindrical brush.

11. The floor sweeping apparatus as defined in claim **1** being particularly characterized in that said debris receiving chamber is provided with filter means for separating solids from air and for trapping debris moving to said debris receiving chamber from said floor treating means enclosure.

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