Nov. 26, 1935. G. E. LOFGREN 2,022,249

VACUUM CLEANER

Filed Oct. 6, 1932 3 Sheets-Sheet 1

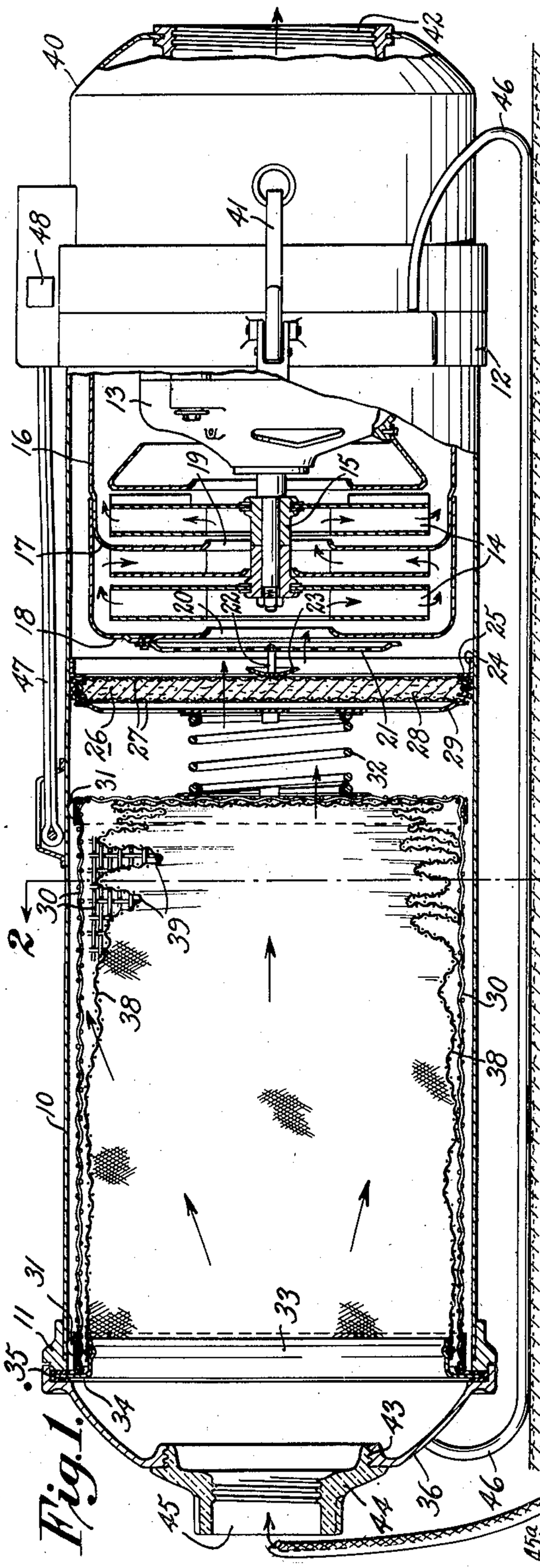

Fig. 1.

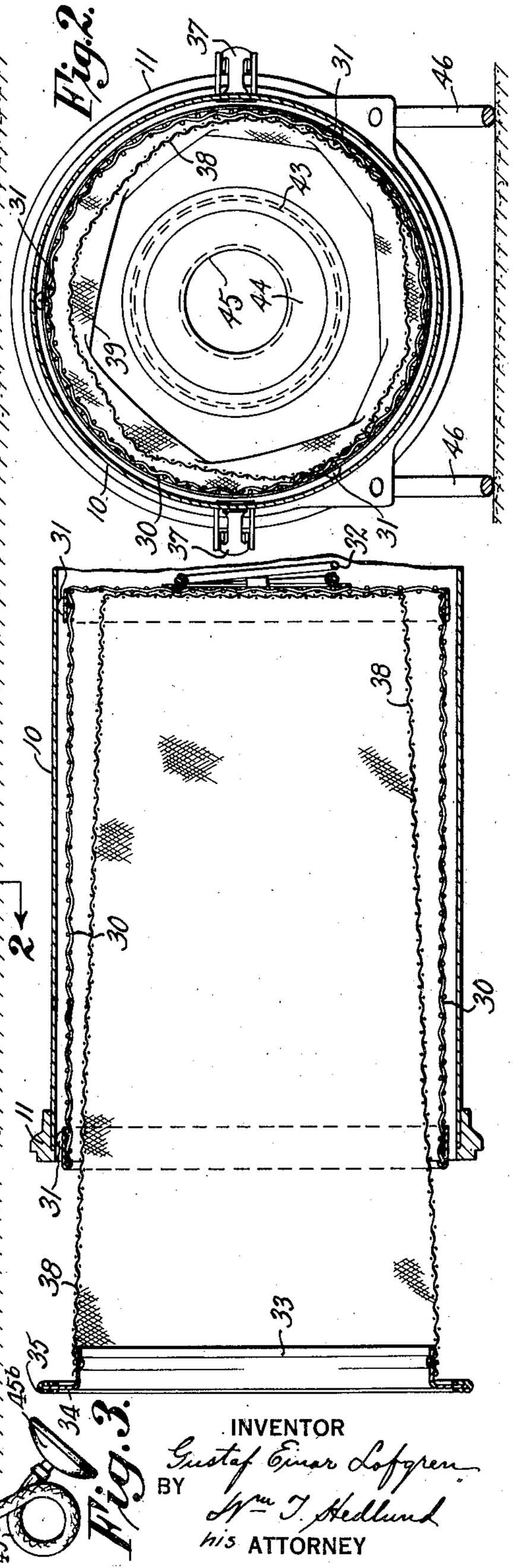

Fig. 2.

Fig. 3.

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VACUUM CLEANER

Filed Oct. 6, 1932 3 Sheets-Sheet 2

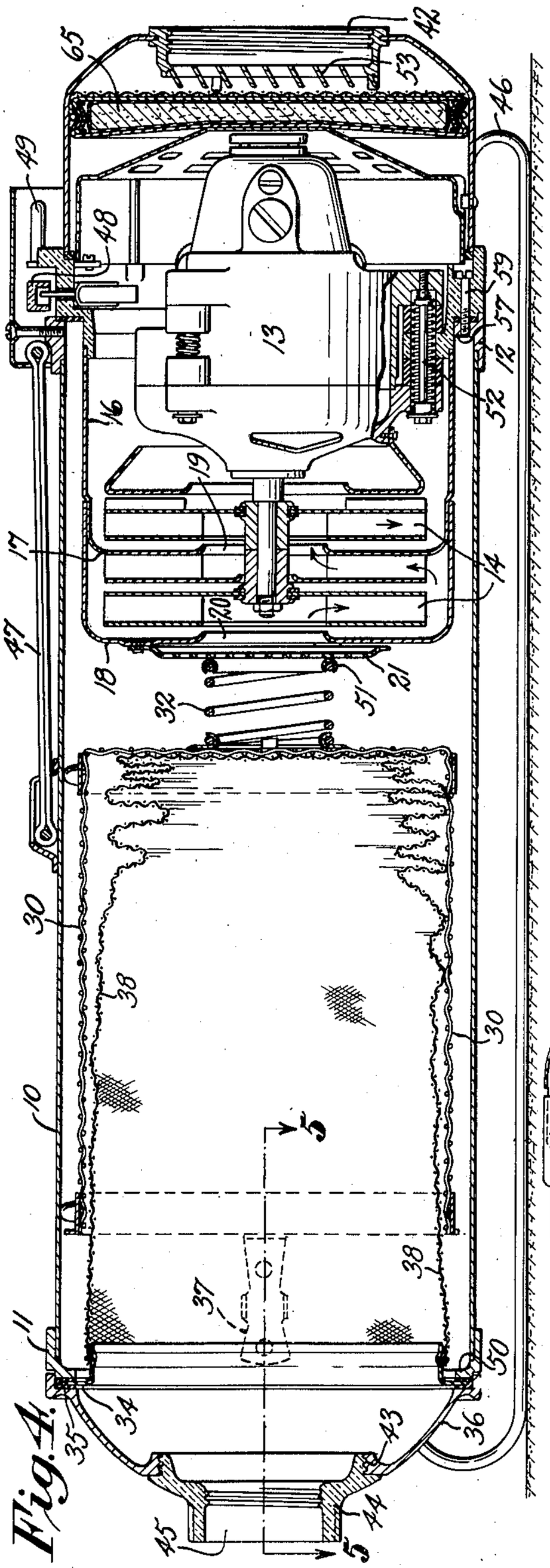

Fig. 4.

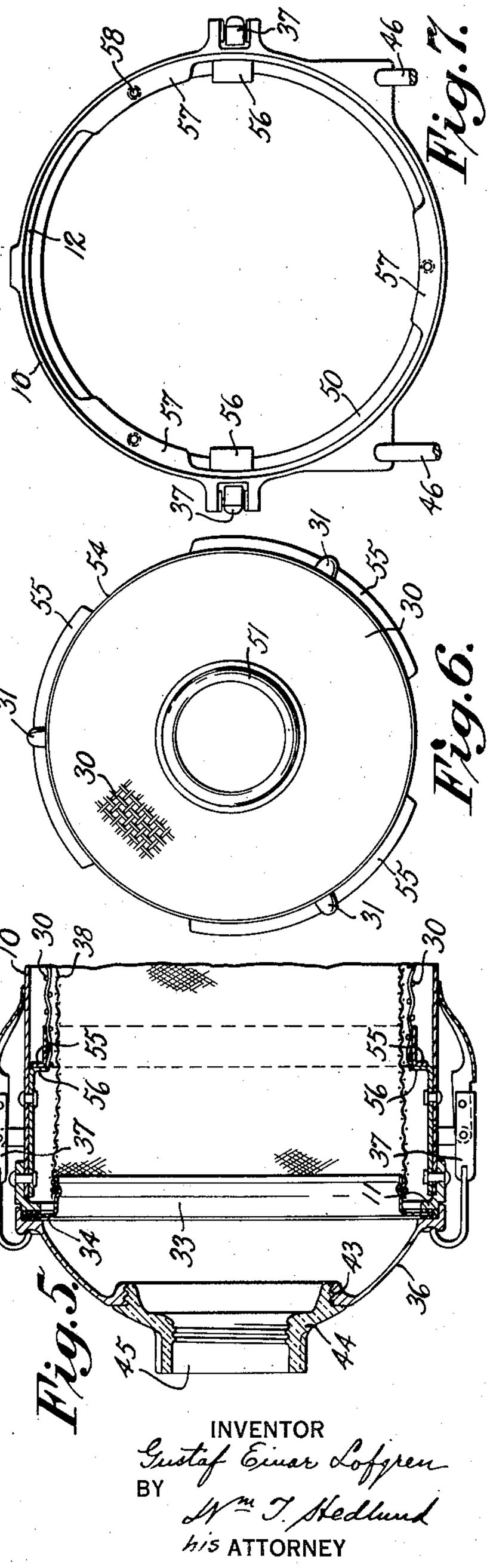

Fig. 7.

Fig. 6.

Fig. 5.

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VACUUM CLEANER

Filed Oct. 6, 1932 3 Sheets-Sheet 3

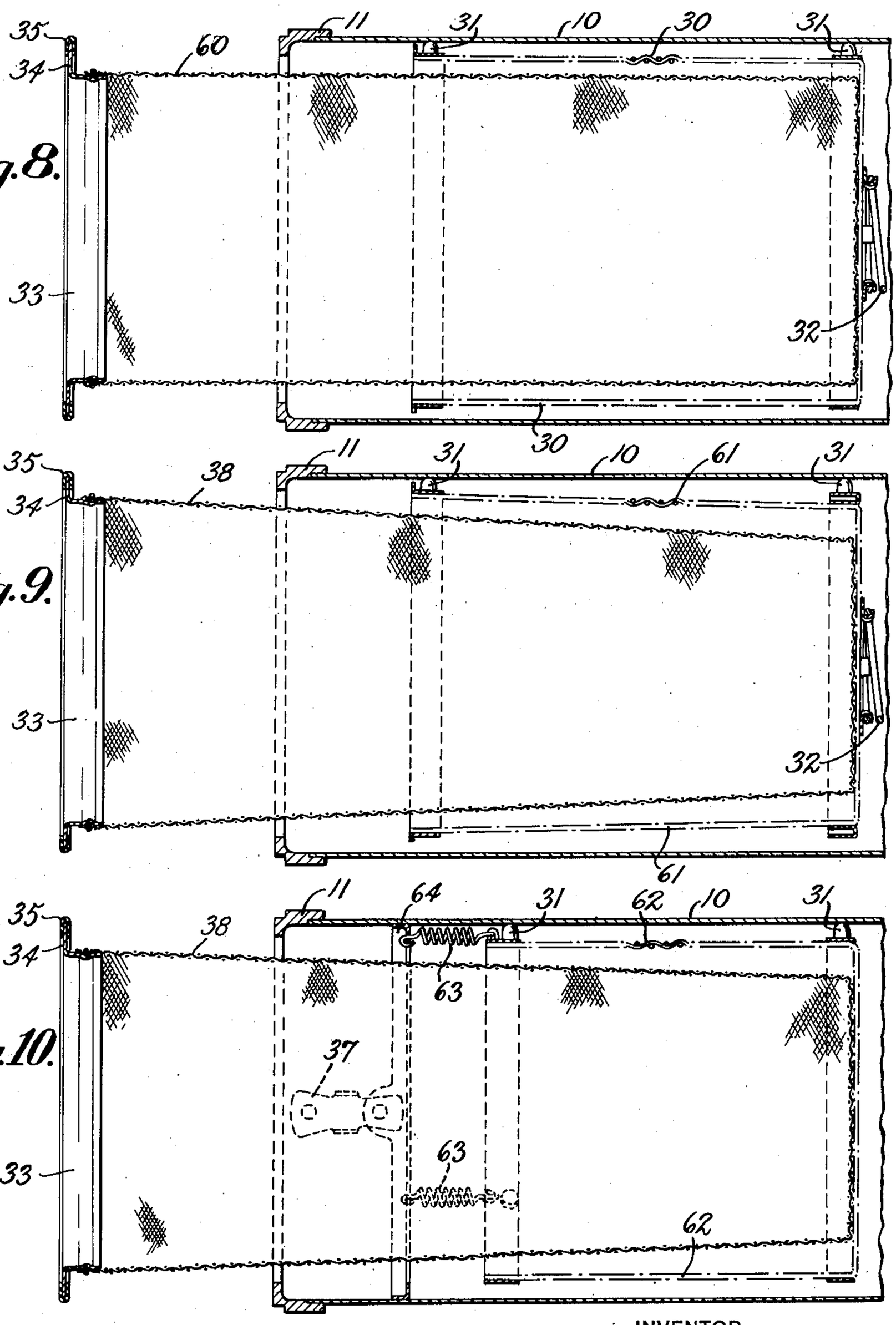

Fig. 8.

Fig. 9.

Fig. 10.

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UNITED STATES PATENT OFFICE

2,022,249

VACUUM CLEANER

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Application October 6, 1932, Serial No. 636,499

12 Claims. (Cl. 15—16)

My invention relates to vacuum cleaners and more particularly to the kind of vacuum cleaner employing a dust bag enclosed in an air-tight casing.

The primary object of my invention is to permit the advantageous use of a larger dust bag for a given size of casing than has heretofore been possible in this kind of cleaner by providing movement in an air-tight casing of a folded dust bag to adjust the dust bag to the work and obtain higher cleaning efficiency.

Further objects and advantages will be apparent from the following description considered in connection with the accompanying drawings, which form a part of the specification, and on which:

Fig. 1 is a side view, partially in cross-section, of a vacuum cleaner unit embodying my invention in preferred form;

Fig. 2 is a transverse cross-sectional view taken on the line 2—2 of Fig. 1;

Fig. 3 is a longitudinal cross-sectional view of a portion of the device shown in Fig. 1 with the dust bag fully extended;

Fig. 4 is a side view in cross-section of a vacuum cleaner unit embodying a somewhat modified form of my invention;

Fig. 5 is a cross-sectional view taken on the line 5—5 of Fig. 4;

Fig. 6 is an end view of a cage forming part of the structure of Fig. 4;

Fig. 7 is an end view of part of the casing of the unit shown in Fig. 4;

Fig. 8 is a horizontal cross-sectional view of a portion of a vacuum cleaner unit embodying my invention in still another form; and

Figs. 9 and 10 show further embodiments of the invention.

The vacuum cleaner unit, as shown in Fig. 1, comprises an outer air-tight casing including a barrel portion 10, preferably cylindrical in form and made of metal or other suitable stiff, impervious material. Barrel 10 is open at each end. At the inlet end barrel 10 is provided with a ring 11 suitably secured thereto, while at the outlet end a ring 12 is secured thereto. Suitably mounted within the casing adjacent to its outlet end is an electric motor 13, upon the shaft of which is mounted a centrifugal fan 14. Fan 14 comprises a pair of rotors mounted on a hub 15. The fan is surrounded by a housing 16 suitably supported in the casing and including a front wall 18 and an intermediate wall 17 between the two rotors of the fan. The walls 17 and 18 are provided with centrally located apertures 19 and 20 respectively. Aperture 20 is screened by a perforated plate 21 which permits the passage of air therethrough. Plate 21 carries a centrally located pin 22 to which is secured an abutment member 23.

Secured to the inside of barrel 10 of the casing in the plane of abutment member 23 is an annular ring 24 having a flange 25 in a vertical plane. A filter 26, which may comprise a ring carrying one or more pieces of cloth 27, between which may be located a filter material 28, fits snugly within barrel 10 and abuts against ring 24 and abutment 23. A perforated plate or frame 29 is disposed in front of the filter and may serve to hold the filter in place against the abutment 23 and the ring 24.

A cylindrical cage 30 having openwork wall structure, preferably made of wire mesh and suitably reinforced to be rigid, is located within the cleaner casing between the frame 29 and the inlet end of the casing. The cage is adapted to slide in the casing and is supported therein by means of rounded projections 31 secured at points around the circumference of the cage and adapted to slide on the inside smooth wall of the casing. The cage should be made of material having sufficient stiffness so that it will not collapse but will retain its original form. A helical spring 32 is located between the end or bottom of the cage and the frame 29 and is preferably secured to both of these members.

Within the casing and disposed within the cage is a dust separator comprising a ring 33 provided with an outwardly extending flange 34 to which is secured a suitable packing 35. A bell-shaped member 36, forming one end of the cleaner casing, is clamped to barrel 10 by means of suitable snap fasteners, such as those illustrated at 37 in Fig. 5, and clamps the packing 35 and flange 34 between it and the ring 11. Suitably secured to ring 33 is a dust bag 38 made of flexible material adapted to retain dust but pervious to air, such as cloth. In the embodiment shown in Figs. 1 through 3, the bag 38 has a tapered form, the larger end of the bag being secured to ring 33 while the smaller end of the bag is closed. The length of the bag 38 is greater than the length of cage 30, as is clearly shown in Fig. 3. Hence, when the bag is placed in the cage, the former becomes folded, as indicated at 39. The fact that the bag is tapered at its rear end provides space for these folds or wrinkles and it is preferable that the wrinkles be at the rear end of the bag rather than at the mouth of the bag. Furthermore, even though the wrinkles are at the

mouth of the bag when the former is first placed in cage **30**, they will soon work to the rear due to the passage of air through the bag and due to the movement of cage **30**, as will be later explained.

The outlet end of barrel **10** is closed by means of a cylindrical member **40** which is secured to ring **12** by means of snap fasteners **41**. The member **40** is provided with a centrally located outlet **42** which is threaded. Member **36** is provided with a centrally located threaded inlet **43**. A coupling **44** is adapted to be screwed into either inlet **43** or outlet **42**. Coupling **44** is provided with an opening **45** which is adapted to receive a hose **45***a* which may be connected to a cleaning implement **45***b*. A pair of runners **46** are secured at their front ends to ring **11** and at their rear ends to ring **12**. The runners serve to support the vacuum cleaner and permit of easily pulling it by means of the hose over the supporting surface. The cleaner is provided with a handle **47** located above the center of gravity of the device as a whole. A switch **48** controls the operation of the motor while contact members **49** are adapted to engage an electric plug for supplying current to the motor.

It will be noted that the opening in barrel **10** adjacent to ring **11** has a diameter as great as that of any part of the casing. It is therefore possible to withdraw cage **30** and with it the spring **32** and plate or frame **29** through the inlet end of the casing. When this has been done, filter **26** may be withdrawn and cleaned or replaced. When emptying dust bag **38**, it is not necessary to remove the cage, but simply to unclamp member **36** and withdraw the bag from the cage.

Various parts of the cleaner are so dimensioned that when assembled, but with the fan not operating, spring **32** holds the front of cage **30** lightly against the flange **34** of ring **33**. The flange hence acts as a stop for limiting the movement of the cage toward the inlet end of the cleaner.

In operation, the electric motor **13** drives the fan **14**, which causes a current of air to flow through the barrel **10** from the inlet to the outlet. If a hose is connected to coupling **44** and to a suitable cleaning implement which is moved over a dusty surface, dust-laden air will be drawn in through opening **45** in the coupling and into bag **38**. Here the dust will be deposited and the air will pass through the bag and through the openwork walls of cage **30**, through filter **26** and into the fan. From the fan the air will be discharged through and around the motor **13** to the outlet **42**.

The dust deposited within bag **38** has a tendency to clog the pores of the bag and to increase the resistance to flow of air through the bag. Obviously, the greater the surface of bag **38**, the greater will be the amount of dust required to clog the bag and the less will be the resistance to the flow of air for a given amount of dust. By making a bag longer than the space in which it is to be contained and then supporting such a bag in a wire cage or the like, whereby the bag becomes folded, I am enabled to use a dust bag having a much greater surface than would otherwise be the case. Therefore it is neccessary to clean the bag less frequently, and less power, on an average, is required to operate the fan.

The internal diameter of the cage **30** should be somewhat greater than the external diameter of the bag in order that the bag will not be pressed against the sides of the cage, as this would tend to prevent movement of the cage within the barrel due to the fact that the front of the bag is secured to the barrel. Also, I prefer to make the bag tapered toward its closed end. This facilitates insertion of the bag into the cage and provides space for the folds or wrinkles to be formed near the closed end of the bag where they will not interfere with the admission of dust into the bag.

When the fan is in operation and air is flowing through the bag, the resistance to flow of the air through the bag results in a pull on the bag. This pull is transmitted to the end of cage **30** and causes the cage to move within the casing by compressing spring **32** which opposes and limits the movement of the cage. When the motor is shut off, this pull disappears and the spring **32** moves the cage back toward the inlet. Likewise, when the cleaning implement is closed to some extent, as by being placed relatively tightly against an article to be cleaned, less air flows into and through the bag, and hence the pull on the bag is less. Consequently, the repeated placing of the implement on, and removing it from, the surface to be cleaned, as is done in the normal cleaning operation, can cause the cage to move back and forth. This movement of cage **32** helps to work folds in the bag which may have formed adjacent to the inlet thereof toward the back of the cage. It also causes the bag to fold more or less as the cage moves back and forth and thus dislodge a portion of the dirt which may have adhered to the upper part of the bag. This increases the effectiveness and efficiency of the apparatus.

I have found that a convenient way of inserting the bag is to first start the fan and then allow the bag to be drawn into the cage due to the suction. Unless the bag presses against the side of the cage the bag will be pulled into the cage by the suction so that substantially all the folding is at the bottom of the cage. To avoid having the bag press against the cage, the cleaner unit may be stood on end with the mouth of the cage upwards while the bag is allowed to be drawn downwardly by the suction.

In Figs. 4 through 7, there is shown a somewhat modified embodiment of my invention. This differs from the form shown in Figs. 1 through 3, chiefly in the fact that the filter **26** has been omitted. This makes it possible to insert the cage **30** from the outlet end of the barrel **10** before the motor and fan are installed. The cage, in this case, does not have to be removed in order to clean or renew the filter. Inasmuch as the cage does not have to be removed through the inlet end of the casing, the ring **11** may be made with an inwardly extending flange **50** against which the flange **34** and packing **35** may bear. This in turn reduces the outer diameter of the ring **11** and results in a neater appearance for the cleaner.

In this embodiment spring **32** abuts against perforated plate **21**, a ring of insulating material **51** being placed therebetween. For this purpose, the last turn of the spring may be enclosed in a piece of rubber tubing. The motor **13** is suitably supported within the casing and insulated therefrom by means of rubber and spring supports **52**. The provision of a ring **51** completely insulates the motor and fan housing from the other parts of the cleaner whereby, should a ground occur in the motor, the current will not be conducted through the casing of the vacuum cleaner.

A filter **65**, which may be similar to filter **26**

shown in Fig. 1, is located between the motor and the outlet opening 42. A series of vanes 53 may be located adjacent the outlet opening to deflect the air discharged from the cleaner upwardly away from the surface upon which the cleaner rests.

As shown in Fig. 6 the open end of cage 30 is provided with a ring 54 which has three outwardly extending flanges 55. A pair of abutments 56 are secured to the inside of barrel 10, preferably in conjunction with the means for securing fasteners 37 to the casing, and serve to limit the movement of cage 30 toward the inlet end of the casing by engaging flanges 55. The ring 12 is provided with three flanges 57, as is shown in Fig. 7. Flanges 57 are provided with threaded openings 58 which receive bolts 59 which secure the motor support 52 to the ring 12. Inasmuch as the cage 30 must be inserted into the barrel 10 from the outlet end thereof, it is necessary that the flanges 55 on the casing be so arranged that they will not be obstructed by the flanges 57 on ring 12 when the cage is inserted. As is apparent from Figs. 6 and 7, the respective flanges are so arranged that they do not interfere with each other.

The operation of this form of my invention is substantially the same as that described in connection with Figs. 1 through 3. The length of the bag is sufficiently greater than that of the cage so that the former will be folded when it is placed in the latter. The movement of the cage within casing 10 serves to work most of the wrinkles toward the rear of the cage, as described in connection with the first embodiment.

The embodiment shown in Fig. 8 is similar to that shown in Fig. 4, with the exception that the bag 60 is of cylindrical form instead of being tapered. In this case the movement of the cage within the casing 10 is relied upon to work the wrinkles to the rear of the cage.

In Fig. 9, both the bag 38 and the cage 61 are tapered, the former having a greater taper than the latter. This embodiment operates in substantially the same manner as that described in Fig. 1 or 4, the greater space between the rear of the bag and the rear of the cage allowing for folding of the bag at this point.

In Fig. 10, there is shown a device wherein the front end of the cage 62 is secured to the barrel 10 by means of tension springs 63. Preferably, three of these springs are located equidistant from each other around the circumference of the cage. A ring 64 is secured within the barrel 10 and serves as an anchorage for one end of spring 63. The other ends of the springs are secured to the front of cage 62. The operation of this modification is similar to that already described and need not be repeated.

While I have shown and described several embodiments of my invention, it is to be understood that they are for purposes of illustration only and that my invention is not to be limited except by the appended claims viewed in the light of the prior art.

What I claim is:

1. In a vacuum cleaner, a casing having an inlet for dust-laden air and an outlet for air from which dust has been removed, means to cause flow of air through said casing, a dust separator of flexible air-pervious material in said casing so positioned therein that the air which enters as dust-laden air passes therethrough, said dust separator being mounted in the casing so as to be distensible due to the flow of air, and movable means to retain said separator in partially distended condition, the last mentioned means being movable by increased distention of said separator in variable degree depending on the pressure drop through the dust separator.

2. In a vacuum cleaner, a casing having an inlet for dust-laden air and an outlet for air from which dust has been removed, means to cause flow of air through said casing, a dust bag of flexible air-pervious material in said casing having one end thereof fixed against movement and so positioned within the casing that all the air which enters as dust-laden air passes therethrough, said dust bag being distensible due to the flow of air, a movable member in said casing against which the dust bag is pressed due to pressure drop therethrough and which resists distention of the dust bag, and resilient means for yieldably pressing said member against the dust bag, whereby on increase in pressure drop said member is moved in one direction and on decrease in pressure drop the resilient means moves said member in the opposite direction.

3. In a vacuum cleaner, an air-tight casing provided with a dust-laden air inlet opening and an air outlet opening, means for causing flow of air therethrough, an openwork wall structure movably mounted in said casing, resilient means for opposing movement of said structure, and a dust bag of air-pervious flexible material disposed in said casing so that dust-laden air flows thereinto, said bag being of such size and so held in the casing as to press against and cause movement of said structure due to the flow of air therethrough.

4. In a vacuum cleaner, an air-tight casing provided with a dust-laden air inlet opening and an air outlet opening, means for causing flow of air therethrough, an openwork wall structure movably mounted in said casing and providing with said casing a space for reception of a dust bag, resilient means for opposing movement of said structure, and a dust bag of air-pervious flexible material in said space, the length of said bag being greater than the length of said space, whereby the bag is folded, one end of said dust bag being fixed against movement and said dust bag being so positioned within the casing that all the dust-laden air enters the bag, the bag when inflated bearing against said structure.

5. In a vacuum cleaner, an air-tight casing provided with a dust-laden air inlet opening and an air outlet opening, a fan in said casing for causing flow of air therethrough, a fixed member in said casing, means for driving said fan, an openwork wall structure movably mounted in said casing between said fan and said inlet, resilient means for opposing movement of said structure comprising a spring between said structure and said fixed member, and a dust bag of air-pervious flexible material in said casing having one end fixed to the casing, said bag being so large as to bear against said structure without being fully distended and so positioned as to receive all the dust-laden air passing through said inlet opening.

6. In a vacuum cleaner, an elongated casing, means for mounting said casing horizontally above a horizontal surface, a cage slidably mounted in said casing and substantially as wide as the inside of said casing, means for causing flow of air through said casing, a dust-bag disposed in said cage and narrower than said cage, said dust bag being positioned to receive all the dust-laden air passing through said inlet and

having one end fixed to the casing, said bag being of such length as to bear against the end of the cage in partially folded condition when air passes therethrough, said cage serving to hold said dust-bag away from the casing, and resilient means opposing movement of the cage under the influence of the bearing of the dust bag against the end thereof.

7. In a vacuum cleaner, an elongated casing, means for mounting said casing horizontally above a horizontal surface, a cage slidably mounted in said casing and substantially as wide as the inside of said casing and providing a space for a dust-bag, means for causing flow of air through said casing, resilient means opposing sliding movement of said cage, and a dust-bag disposed in said cage and narrower than said cage and longer than the length of said space, said cage serving to hold said dust-bag away from the casing and said dust bag having one end secured to the casing and positioned to receive all the dust-laden air entering through the inlet.

8. In a vacuum cleaner, a casing provided with an inlet opening and an outlet opening, means for causing flow of air therethrough, movable means to retain a dust bag therein in partially distended condition, and resilient means for governing movement of said retaining means due to variations in air pressure differential between opposite sides of the dust bag.

9. In a vacuum cleaner, a casing provided with a dust-laden air inlet opening and an air outlet opening, means for causing flow of air therethrough, a dust separator in said casing position to receive dust-laden air passing through said inlet, movable means to retain the dust separator therein in partially distended condition, a part of the dust separator being movable with respect to the remainder, and means responsive to variations in pressure drop through the dust separator to govern movement of the movable means so that the movable part of the dust separator moves progressively farther in one direction as dust accumulates therein.

10. In a vacuum cleaner, a casing provided with an inlet opening and an outlet opening, means for causing flow of air therethrough, a suction tool, a hose adapted to connect the suction tool with the casing, a dust separator in said casing positioned to receive dust-laden air passing through said inlet, movable means to retain the dust separator therein in partially distended condition, a part of the dust separator being movable with respect to the remainder, and means responsive to variations in application of the suction tool to an object to be cleaned to govern movement of the movable means.

11. In a vacuum cleaner, structure forming a dust bag chamber having a movable wall part, a dust bag mounted in said chamber, means to cause flow of air through said dust bag, part of said dust bag being fixed against movement and said dust bag being distensible to a size too large for accommodation in said chamber whereby on being distended in said chamber the dust bag presses against said movable wall part, and means whereby said wall part is movable in variable degree depending on variation in pressure drop through the dust bag.

12. In a vacuum cleaner, structure forming a dust bag chamber having a movable wall part, a dust bag mounted in said chamber, means to cause flow of air through said dust bag, part of said dust bag being fixed against movement and said dust bag being distensible to a size too large for accommodation in said chamber whereby on being distended in said chamber the dust bag presses against said movable wall part and said movable wall part resists distention of the dust bag, and resilient means for yieldably pressing said movable wall part against the dust bag, whereby on increase in pressure drop through the dust bag said movable wall part is moved in one direction and on decrease in pressure drop the resilient means moves said wall part in the opposite direction.

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