Jan. 3, 1956 K. D. McMAHAN 2,729,303

VACUUM CLEANER

Filed Feb. 3, 1951

2 Sheets-Sheet 1

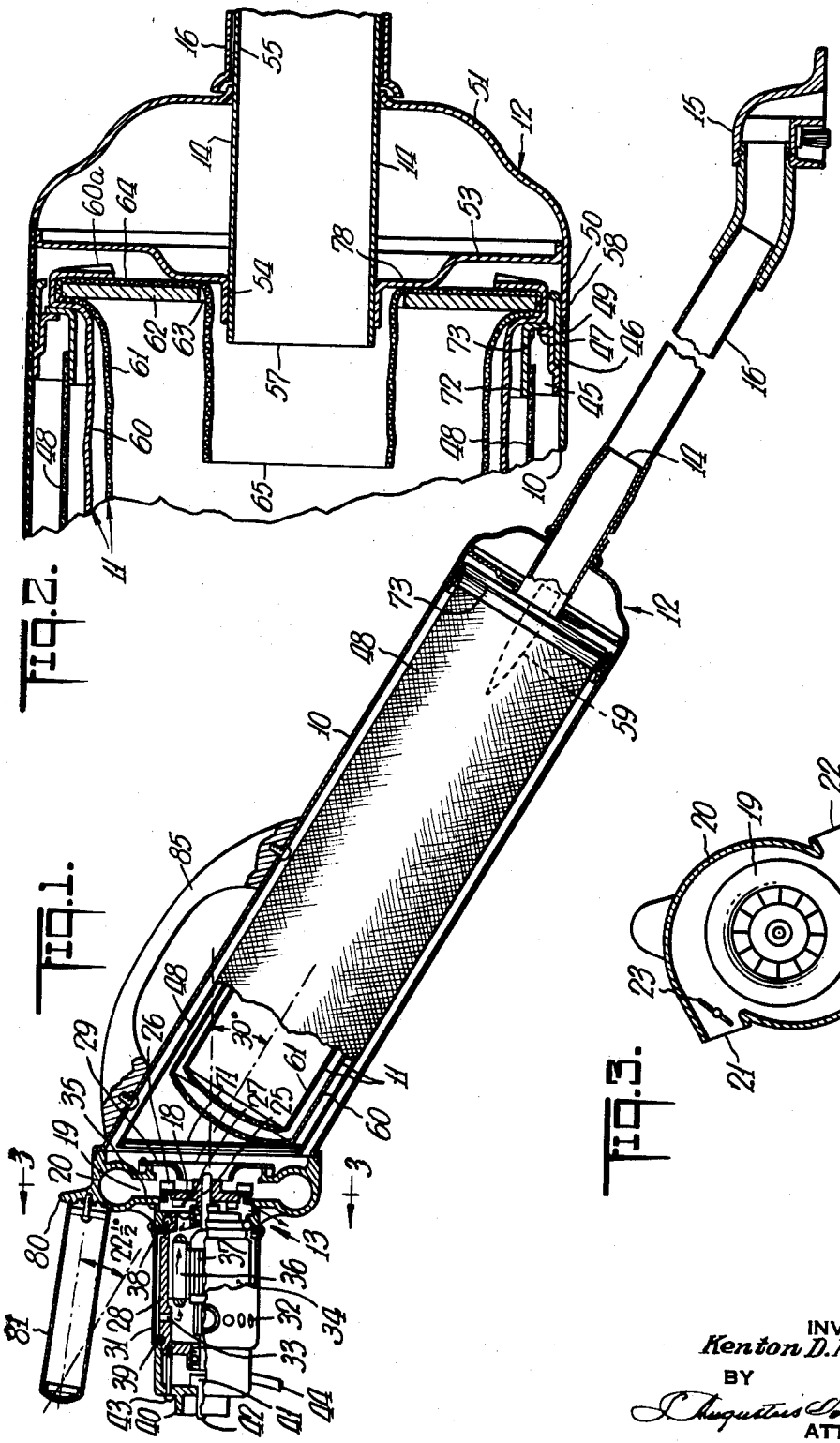


Fig. 1.

Fig. 2.

Fig. 3.

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FIG. 4.

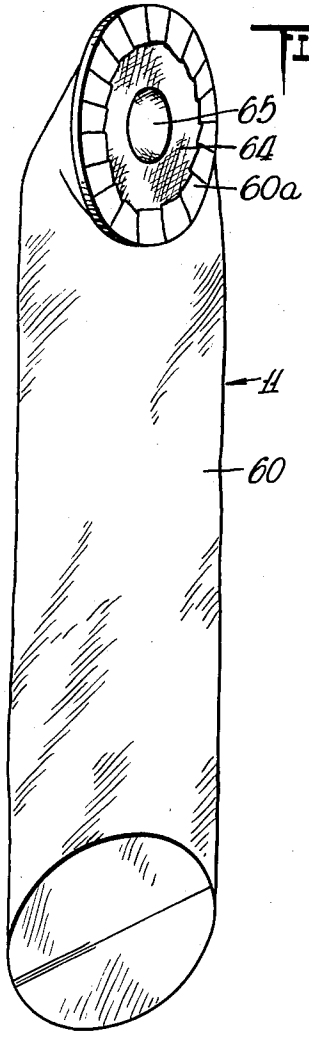


FIG. 5.

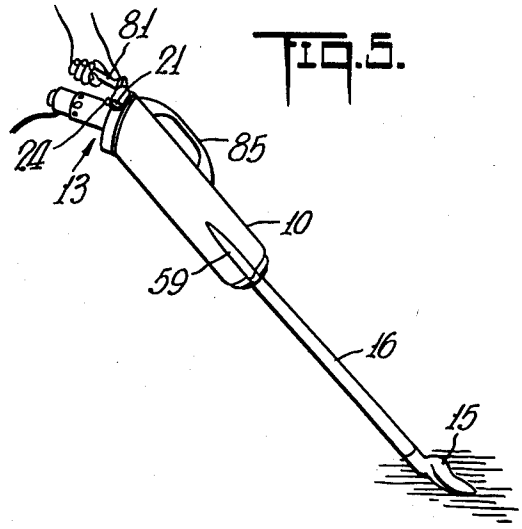


FIG. 6.

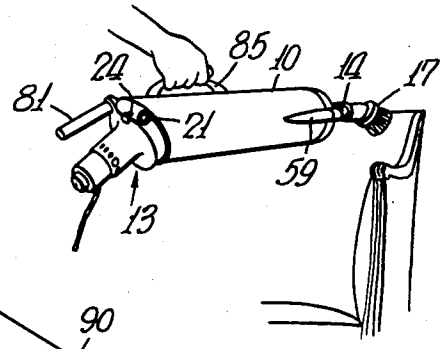
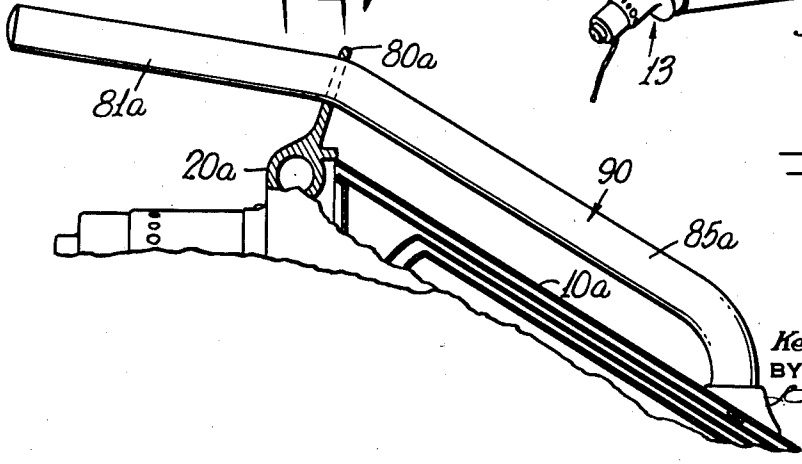


FIG. 7.



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VACUUM CLEANER

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5 Claims. (Cl. 183—37)

The present invention relates to a vacuum cleaner and to a dust bag therefor.

The conventional type of floor or tank type cleaner with its heavy floor unit and long flexible cumbersome hose attached thereto is awkward to manipulate, heavy and burdensome to carry and difficult to store. Moreover, these vacuum cleaners, because of their design and because of the corrugations and/or irregularities in their flexible hose, suffer from heavy pressure losses therethrough, requiring thereby comparatively large motors and fans.

One object of the present invention is to provide a vacuum cleaner with its parts designed, arranged and balanced to permit its easy and convenient manipulation selectively either as a floor or rug cleaner or as an easily portable hand device for cleaning upholstered furniture, draperies or the like.

Another object is to provide a new and improved disposable dust bag construction for a vacuum cleaner which is inexpensive to make, which is efficient in filtering out the finest dust particles but which at the same time cannot be clogged by lint accumulations, and which is designed to trap the dust collected therein when the cleaner is not in use.

Various other objects of the invention are apparent from the following particular description and from an inspection of the accompanying drawings, in which

Figure 1 is a longitudinal section through a form of vacuum cleaner embodying the present invention and shown set for floor cleaning;

Figure 2 is a detail portion of Figure 1 shown on a larger scale;

Figure 3 is a schematic section of the fan including its housing taken on lines 3—3 of Figure 1;

Figure 4 is a side elevational perspective of the dust bag employed in the vacuum cleaner but shown in flat condition for storage and/or transportation;

Figure 5 shows the vacuum cleaner set up to clean a rug or floor;

Figure 6 shows the vacuum cleaner set up as a portable hand device to clean the upholstery on a chair or to clean any area above the floor level; and

Figure 7 is a detail section of another form of vacuum cleaner embodying the present invention.

Referring to Figures 1–6 of the drawings, the vacuum cleaner comprises generally a rigid cylindrical casing **10** for a dust bag **11**, a cap **12** removably attached to the forward end of the casing on the inlet end of the dust bag and a fan and motor unit **13** secured to the rear end of the casing on the outlet end of said bag. The end cap **12** is adapted to mount a short rigid suction tube **14** in communication with the inlet end of the dust bag **11** and in position to support a floor cleaning nozzle or tool **15** through a long rigid tube extension **16** when the cleaner is set to clean a floor, rug or the like, as shown in Figs. 1 and 5 or in position to support directly a cleaning brush or tool **17** when the cleaner is set as a portable hand device for cleaning above the floor level, as shown in Fig. 6.

The fan and motor unit **13** comprise a small high speed motor-driven single stage centrifugal suction fan **18** on the outlet end of the dust bag **11** having a radial diffuser **19** and a housing **20** comprising two separate similar involutes with two diametrically opposite tangential discharge openings **21** and **22** respectively at the ends of the involutes. One of the openings **21** has a control damper **23** which is mounted on a shaft terminating outside the fan housing **20** in a suitable turning handle or knob **24** and which serves to control the suction pressure through the cleaner. One of the discharge openings **21** or **22**, with or without the control damper **23**, serves as a connection for the attachment of accessories such as tubes and nozzles by which blowing operations may be effected and for the attachment of such devices as paint spray units and demothing units.

The centrifugal fan **18** has an impeller web **25**, one side of which carries suction blades **26** for drawing the dust laden air through the dust bag **11**, the other side carrying blades **27** for a ventilating fan drawing air through a motor **28** forming part of the unit **13** for driving the fans. A plate **29** secured at its outer periphery to the fan housing **20** has its central portion annularly flanged to form a suction inlet or orifice for the fan **18**.

The motor **28** is enclosed in a thin housing **31** secured at one end to an axial extension of the fan housing **20** and having near its other end a series of inlet air holes **32** communicating with corresponding inlet air holes **33** in the motor casing **34**. Openings **35** in the axial extension of the fan housing **20** serve as outlets for the ventilating air induced by the fan blades **27** through inlet holes **32** and **33** and along the stator **36** and the rotor **37**.

The motor **28** is elastically mounted by circular section rings **38** and **39** which serve to support the motor resiliently. The ring **38** is located between one end of the motor casing **34** and the axial extension of the fan housing **20** and the other ring **39** is located between the thin motor housing **31** and the motor casing **34**.

A cap **40** containing a switch **41** with a snap finger plunger **42** projecting axially therefrom is removably connected to the end wall of the motor casing **34** by screws **43**. A conductor cord **44** secured to the switch **41** extends from the cap **40** for connection to a wall outlet.

The forward end of the casing **10** is constructed for the attachment of the end cap **12** thereto. Towards that end, there is secured to the end of the casing **10** on its inner peripheral side, as for example by welding, a cap mounting ring **45** offset to form an annular recess **46** with the inner periphery of the casing and an annular radial flange **47** serving as an abutment for one end of a rigid bag container **48** to be described. This annular recess **46** is adapted to receive a lip **49** on a ring **50** likewise secured to the peripheral inner side of casing **10**, as for example by welding.

The end cap **12** comprises a dished section **51** desirably constituting a metal stamping, tapering generally towards its forward end and axially secured at this end to the suction tube **14**. For reinforcing the end cap **12** and for further supporting the suction tube **14**, said cap has inside its rear end a wall plate **53** secured at its outer periphery to said end cap, as for example by welding, and provided with an axial cylindrical flange **54** embracing the suction tube **14**. This suction tube **14** is welded to the forward end of the cap section **51** or to the wall plate flange **54** or to both and has a forward part **55** projecting axially outwardly from the forward end of the cap **12** for the direct frictional attachment thereto of the cleaning nozzle **17** (Fig. 6) or of the tube extension **16** (Figs. 1 and 5) and a rear part **57** projecting axially inwardly from the wall cap plate **54** for ex-

tension into the inlet or suction end of the dust bag **11**, as will be more fully described.

The lip ring **50** secured to the end of the casing **10** serves to align the rear end **58** of the dished cap section **51** with said casing, so that said cap can be slipped on or off the casing **10** for bag replacement purposes. Lip ring **50** also serves as a snap ring retainer for the bag **11**, as will be more fully described.

To insure retention of the cap onto the casing **10**, there is provided between said cap and said casing on diametrically opposite sides thereof releaasable spring clamps **59** of any suitable well-known construction.

The dust bag **11** is completely disposable and comprises an inexpensive sack **60** made of a layer or layers of paper fibrous filter material pervious to air and impervious to dust and an inner flexible sack lining **61** of cotton mesh or gauze-like fabric arranged to catch metallic objects, such as hair pins, nails, etc. which might otherwise puncture the paper filter sack. The mouth of the composite bag **11** is held in expanded position and sealed against leakage by a disk ring **62** having form sustaining rigidity and desirably made of inexpensive material such as paper to permit it to be discarded with the bag. This ring **62** has a central hole **63**, and is positioned with a snug fit within the mouth of both the paper sack **60** and the lining **61**.

To prevent the mouth of the paper sack **60** from slipping over the ring **62**, the end mouth section of the sack beyond the ring is folded radially inwardly over the ring and is provided with darts **60***a* in the form of tapering folds which reduce the diameter of the mouth opening of the sack beyond the ring in cylindrical condition of the sack but still allows the ring to enter the sack elgewise when the sack is in flat condition.

The end section **64** of the cotton lining **61** extends beyond the end of the paper sack **60**, is wrapped around the ring **62** and is tucked through the ring hole **63** to form a suction nozzle **65** for the dust bag **11** in operation as shown in Fig. 2 and a dust and lint trap for the bag **12** when operation ceases. The rear part **57** of the suction tube **14** extends through this bag nozzle **65** and during cleaning operation the suction created through said nozzle causes it to be inflated axially as shown in Fig. 2. When operation ceases, the part of the flexible cotton lining **61** defining the bag nozzle **65** collapses around the rear part **57** of the suction tube **14** projecting therein and forms a trap for the lint and the dust.

For transportation or storage, the ring **62** is laid against the assembled paper sack **60** and lining **61** and the closed end of the dust bag folded such as shown in Fig. 4 to form a flat easily packable unit or the ring **62** might be left completely inside sack **60** and lining **61** in a flat position or as a component of a rolled unit. The end section **64** of the lining **61** tucked into the hole **63** of the ring **62** prevents said ring from slipping out of the bag unit **11**. For insertion into the casing **10**, the ring **62** of the dust bag unit **11** is shifted into position at right angles to the longitudinal axis of said unit.

To contain the dust bag **11** in the casing **10** and to protect said casing and the fan **18** from hard foreign objects should the bag be inadvertently left out, there is provided the rigid cylindrical container **48** of metal wire or plastic mesh such as 16 mesh closed at its rear end by a mesh wall **71** and supported at its forward open end on the forward end of said casing. For supporting the bag container **48** in position in the casing **10**, said container has connected to its forward end, as by welding or soldering, a ring **72** with a radially outwardly extending flange **73** adapted to axially abut and be attached to the radial inwardly extending flange **47** on the cap mounting ring **45**. With this arrangement, when the end cap **12** is removed from the casing **10**, the dust bag **11** is free to be slipped out of the casing.

The bag ring **62** is larger in outside diameter than the inside diameter of the flange **73** on the bag container

ring **72** and when the dust bag **11** is set up inside the casing **10**, it is pressed into position against said flange and forms therewith an effective seal against dust leakage.

For clamping the dust bag **11** in this position in the casing **10**, and offset **78** in the wall cap plate **53** abuts the central portion of the cloth covering bag ring **62** with a pressure applied by spring clamps **59**, and presses the outer peripheral section of said bag ring against the flange **73** on the bag container ring **72**.

When the vacuum cleaner is set up for cleaning rugs, floors, etc. with the rigid extension tube **16** attached, the cleaner is manipulated with the casing **10** raised at one end, so that this casing extends at an angle with the floor, as shown in Figs. 1 and 5. In this position of the cleaner, it is convenient to have a handle near the rear end of the casing **10** extend substantially horizontal for manipulation of the cleaner. In order to accommodate a handle so conveniently mounted, the axis of the fan and motor unit **13** is desirably about 30° with and below the longitudinal axis of the casing, so that this axis is substantially horizontal in floor operating position of the cleaner. Secured to a bracket extension **80** of the fan housing above the fan motor **28** just rearwardly of the center of gravity of the entire unit is a straight primary handle **81** extending generally along the fan and motor unit **13** and desirably at an angle of about 22½° with the longitudinal axis of the casing **10**. This feature materially contributes to the balance and ease of handling of the vacuum cleaner and permits the primary handle **81** to be placed near the center of gravity of the fan and motor unit **13** which is the heaviest part of the cleaner.

The primary handle **81** is ordinarily employed for manipulation of the cleaner for floors and carpet operations in the manner shown in Figs. 1 and 5. For use in connection with such operations the long straight rigid tube extension **16** is telescoped over the short suction tube **14** and is removably retained thereon by friction, as already described. At its forward end, the tube extension **16** has frictionally fitted thereon the floor nozzle or similar cleaning tool **15**.

In addition to the primary handle **81**, there is provided a secondary arched handle **85** secured to the top of the casing **10** at its rear end near and above the center of gravity of the entire unit exclusive of the rigid tube extension **16** and nozzle **15**. This secondary handle **85** is intended for manipulation of the unit when used for cleaning upholstery, draperies or the like above the floor, as shown in Fig. 6. For that purpose, an appropriate brush or small cleaning nozzle **17** is attached by frictional embracement directly to the short suction tube **14**.

Since the secondary handle **85** is mounted directly about the center of gravity of the cleaner when rigged up as shown in Fig. 6 for cleaning above the floor, the cleaner will not have a turning tendency about the holding hand of the operator. The unit can therefore be easily carried and manipulated from place to place by hand with ease and comfort.

It should be noted that the fan **18** and dust bag **11** are arranged with the fan on the outlet side of the bag. The air drawn into the cleaner unit is therefore filtered before being admitted into the field of action of the fan **18**. The fan **18** is thereby protected against the destructive and soiling action of foreign matter carried by the drawn air.

No flexible hose is carried by the cleaner unit of the present invention, so that high pressure drops attending the use of such hose is avoided. In accordance with the present invention, straight rigid tubes are employed between the cleaning nozzle or tool and the inlet end of the dust bag **11**. The pressure drop through this part of the unit is therefore low, permitting thereby the use of a small fan **18** and a motor **28** of minimum size and weight.

The fan **18** with its radial diffuser **19** and involute housing **20** is very efficient in connection with a vacuum cleaner unit, and practically eliminates air heating in the unit, thereby reducing offensive dust odors. The frequency of

fan operation is high and desirably above the audible range of human ears, so that the intensity of the fan noise is a minimum.

In Figure 7 is shown a modified form of handle construction for the cleaner unit, in which the two handles are combined and in which the secondary portion of the handle is made long enough to allow the operator to hold it in any selected part therealong to afford her the balance she desires. In this modified construction, there is provided a single handle member **90** in the form of a round rod, affixed at its forward end to the top of the casing **10***a*, as for example by riveting, and having a forward part spaced from the casing to form a secondary handle **85***a* and extending substantially parallel to the casing wall to permit it to be conveniently grasped. The handle member **90** extends snugly through a hole in the bracket extension **80***a* of the fan housing **20***a* and has a rear part extending straight and offset at a desirable angle of 22½° with the longitudinal axis of the casing **10***a* to form a primary handle **81***a*. The secondary handle **85***a* is longer than the width of an ordinary grasping hand to permit an operator to select her own grasping section of said handle.

As another alternative, the bracket extension **80***a* may be eliminated entirely and the handle member **90** may be supported as a cantilever at is forward end, so that this member is unobstructed along its entire length. With this continuous construction, the primary and secondary handle parts may be joined by a section of wider radius than is shown in Fig. 7, so that any part of the full length of the handle member **90** can be utilized as a handle.

While the invention has been described with particular reference to specific embodiments, it is to be understood that it is not to be limited thereto but is to be construed broadly and restricted solely by the scope of the appended claims.

What is claimed is:

1. A vacuum cleaner comprising a rigid casing for a dirt separator adapted to extend at an angle to the floor when said cleaner is employed for cleaning near the floor level, means for securing a tubular connection for a cleaning tool to the forward inlet end of said casing, a coaxial fan and motor unit mounted at the rear outlet end of said casing with its axis extending at an acute angle to the casing axis, at least a portion of the axis of the fan and motor unit along said unit being located below said casing axis, and said angle being such as to cause the axis of said unit to extend substantially horizontal in floor cleaning position of said cleaner, the heaviest part of the cleaner exclusive of tubular connections and of cleaning tools at the forward end of said casing being the fan and motor unit, and the center of gravity of the cleaner exclusive of tubular connections and of cleaning tools at the forward end of said casing being in the region of the casing near its rear outlet end, said cleaner being light enough to permit its operation conveniently as a portable hand device above the floor level, and handle means for said cleaner comprising a primary part located above the fan and motor unit and extending in a direction substantially parallel to the axis of the motor and fan unit and at an acute angle to the casing axis to permit convenient manipulation of the cleaner as a floor cleaner and a secondary part on the top of said casing approximately over said center of gravity to permit convenient manipulation of the cleaner as a portable hand device.

2. A vacuum cleaner having a rigid casing, a composite dust bag in said casing having an outer paper sack, a flexible, mesh, non-metallic, fabric sack on the inside of said paper sack, and a non-metallic disc ring at the open end of said paper sack, said composite bag forming a disposable unit adapted to be inserted into said casing or taken out therefrom as a unit, and a suction tube connected to one end of said casing and extending into the hole in said ring for communication with the interior of said dust bag, said mesh fabric sack being wrapped at one end over said ring and tucked into said ring hole around said suction tube to form a dust and lint trap for the dust bag.

3. A vacuum cleaner having a rigid casing, a composite disposable dust bag in said casing having an outer paper sack, a flexible mesh fabric sack on the inside of said paper sack, and a rigid paper disc ring at the open end of said paper sack, the end of said mesh sack extending beyond the end of said paper sack and being wrapped over said ring and tucked into the hole in said ring, whereby the component parts of the composite dust bag are retained as a unit, and a suction tube connected to one end of said casing and extending into said ring hole for communication with the interior of said dust bag.

4. A composite disposable dust bag comprising an outer paper sack, a flexible mesh non-metallic fabric sack on the inside of said paper sack, and a rigid non-metallic disc ring at the open end of said paper sack, the end of said mesh sack extending over said ring and being tucked into the hole in said ring, whereby the component parts of the composite dust bag are retained as a unit.

5. A composite disposable dust bag comprising an outer paper sack, a flexible cotton mesh fabric sack on the inside of said paper sack, and a rigid paper disc ring inside the open end of said paper sack, the end mouth section of said paper sack being darted to reduce the end opening of said paper sack, the end of said mesh fabric extending beyond the end of said paper fabric and being tucked into the hole in said ring to retain the component parts of the dust bag together as a unit and to form a dust and lint trap for the end of said dust bag in use.

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