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[33] **Switzerland**
[31] **6496/68**

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[54] **APPARATUS FOR SEPARATING FIBERS FROM A CONVEYING AIR STREAM**
16 Claims, 4 Drawing Figs.

[52] U.S. Cl. ..... **55/295,** 53/124 B, 55/315, 55/350, 55/351, 55/374, 55/378, 55/381, 55/430, 55/466, 55/529, 100/90, 141/67, 141/73
[51] **Int. Cl.** **B01d 46/00**
[50] **Field of Search** ..... 53/124 B; 100/90; 139/1 C; 141/67, 71, 73, 80, 313–317; 55/282, 283, 295, 296, 301, 375, 374, 378, 381, 430, 466, 529, 315, 350, 351

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ABSTRACT: Separating fibers from a conveying air stream which conducts said fibers through a stationary inlet into a separating apparatus. The apparatus contains a filter and the separated material is ejected into a container or the like. According to an important aspect of the invention, an axially displaceable plunger mechanism is operably connected with a drive arrangement, this plunger mechanism possessing an opening which communicates via a telescopic or flexible member, defining the aforementioned filter, with the stationary inlet means.

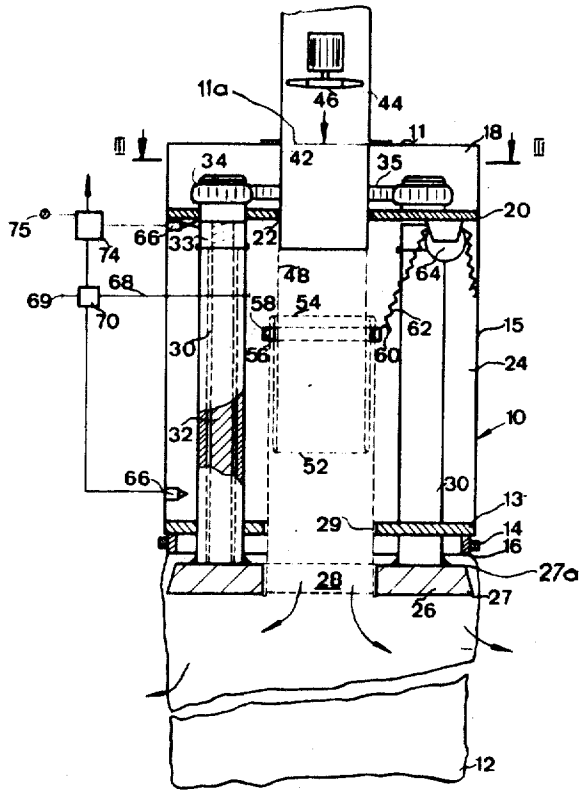

Fig. 1

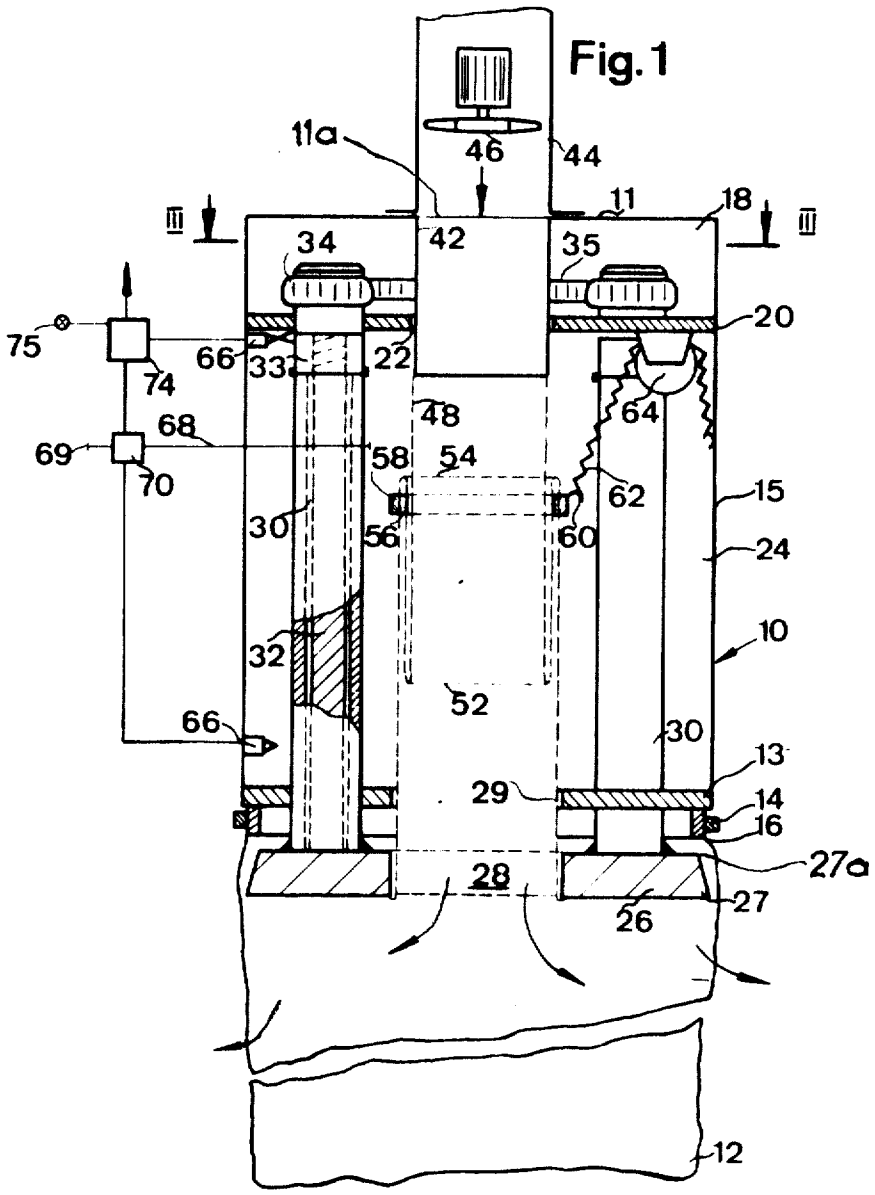

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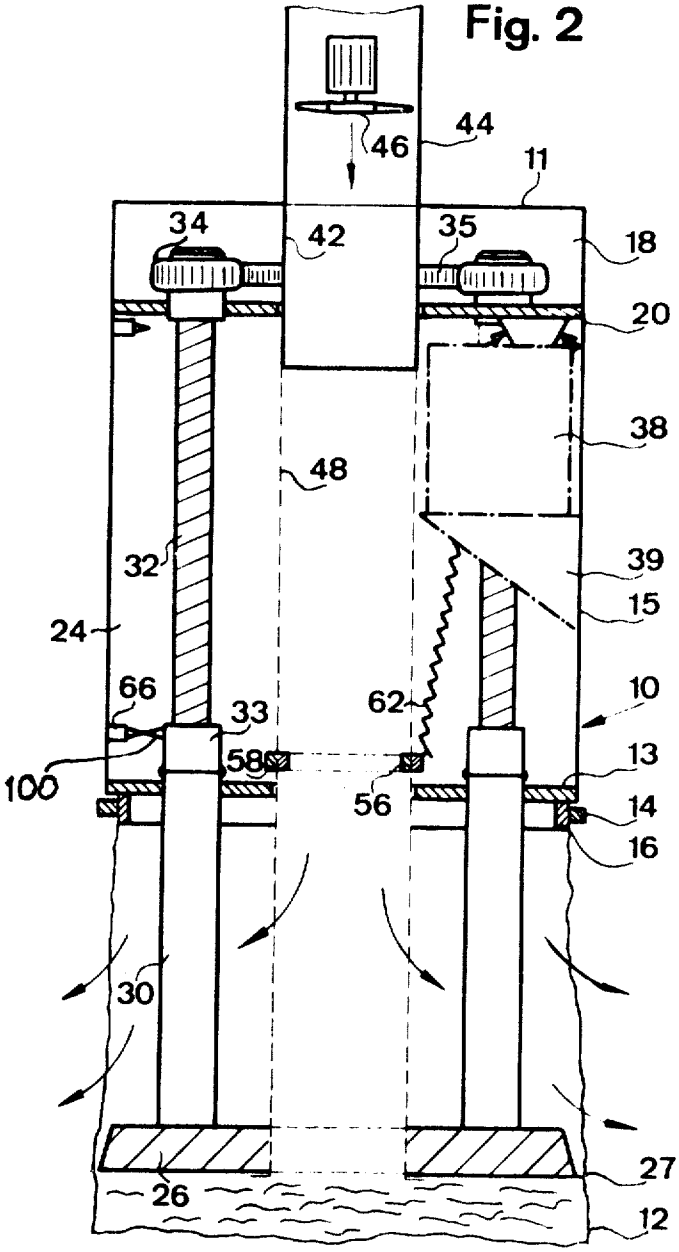
Fig. 2



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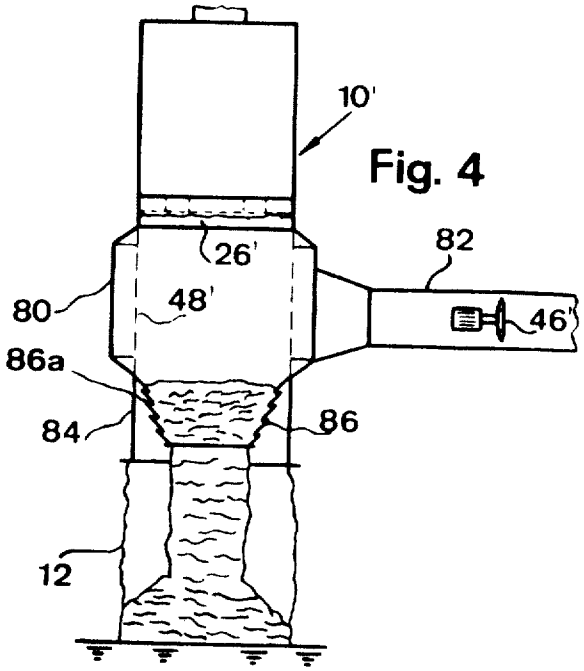

Fig. 4

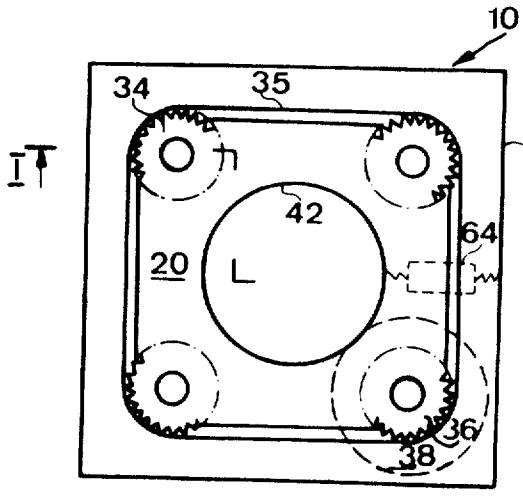

Fig. 3

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APPARATUS FOR SEPARATING FIBERS FROM A CONVEYING AIR STREAM

BACKGROUND OF THE INVENTION

The present invention relates to a new and improved apparatus for separating fibers or the like from a conveying air stream which is guided via an inlet connecting piece or opening into the apparatus proper, the latter containing a filter, and wherein the separated material is ejected into a suitable container.

One such type apparatus known to the prior art is especially used for the separation and filling of textile fibers into sacks, or equivalent structures.

Also, apparatuses are known to the art for separating textile fibers from an air current, by means of which the fibers should be separated by an approximately planar or flat filter member. In order to ensure for a constant pressure drop across the filter, such must be manually cleaned at certain regular time intervals. However, this cleaning operation is one of the most unpleasant, time-consuming and expensive procedures encountered in a spinning mill.

Attempts have already also been made to conduct the conveying air current through an air permeable or foraminous filter bag or sack and to collect the retained fibers in this sack. However, the degree of filling of the sack which is obtainable with textile fibers is relatively small and requires a frequent replacement of the filter sack or bag.

According to a further known apparatus, the air charged with fibers is conducted into a filling device, whereby the air escapes or passes through a filter and is conducted away in a transport or conveying air channel, whereas the fibers separated by the filter drop into a bag or sack. A suitable flap or valve member is arranged in the air conveying or transport channel and serves to periodically interrupt the conveying air current. Consequently, an air blast or shock occurs within the apparatus which is employed for compacting the fibers within the sack. The drawback of this arrangement resides in the fact that the air blast acts upon the entire pneumatic system. Consequently, it must be dimensioned and designed to be much stronger than otherwise necessary, resulting in an increase in the cost for the entire system, apart from the fact that the air shock wave or blast results in considerable noise.

SUMMARY OF THE INVENTION

Consequently, it is a primary object of the present invention to provide an improved apparatus for separating fibers from a conveying airstream which effectively overcomes the aforementioned drawbacks of the prior art constructions. Another, more specific object of the present invention relates to an improved apparatus for separating fibers from a conveying stream of fluid medium, typically air, in an extremely efficient, rapid and reliable manner, through the use of mechanism which is not readily subject to breakdown, requires very little servicing and maintenance, operates relatively noise-free, and provides for an increased filling capacity of the containers, such as bags or sacks, receiving the fibers separated from the conveying airstream.

Yet a further, equally significant object of the present invention relates to an improved apparatus for separating fibers from a conveying airstream and loading the thus-separated fibers into suitable containers, such as bags or sacks, in such a way that these containers receive an increased amount of the fibrous material, resulting in less frequent exchange of the container, and wherein the separation and filling operation is achieved in a manner not subjecting the components of the apparatus to increased wear, thereby providing for improved longevity of the entire system.

Yet a further significant object of the present invention relates to an improved apparatus for separating fibers from a conveying airstream which operates at a reduced noise level, thereby rendering it capable of being comfortably installed in a room where other workers are present without disturbing the latter.

Now, in order to implement these and still further objects of the invention, which will become more readily apparent as the description proceeds, it will be understood that the apparatus for separation of fibers from a conveying or transport air current, as contemplated by the invention, is equipped with an inlet means or opening for leading the conveying air current charged with the fibers into the apparatus. The apparatus, in turn, contains a filter and the separated material is ejected into a container of suitable construction. According to an important aspect of the invention, an axially displaceable or moveable plunger mechanism is operably associated with a suitable drive means. The plunger mechanism possesses an opening which communicates with the stationary inlet means or opening via a telescopic or flexible permeable member defining the aforementioned filter.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood, and objects other than those set forth above, will become apparent, when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings, wherein:

FIG. 1 is a longitudinal sectional view, taken substantially along the line I—I of FIG. 3, through a first embodiment of inventive apparatus, depicting the compacting element in its normal position;

FIG. 2 is a similar longitudinal sectional view to that shown in FIG. 1 and through the apparatus depicted therein, however illustrating the position of the various components during the compacting operation;

FIG. 3 is a cross-sectional view of the apparatus structure depicted in FIG. 1, taken substantially along the lines III—III thereof; and,

FIG. 4 is a schematic longitudinal sectional view through a second embodiment of inventive apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Describing now the drawings, in FIGS. 1 to 3, inclusive, there is shown a first embodiment of inventive apparatus for separating fibers from a conveying or transport air current. It will be recognized that the apparatus embodies a housing **10** possessing an essentially square or quadrangular cross-sectional configuration, although other shapes are contemplated, and is equipped with a cover member **11** and a base or bottom **13**. Extending between the cover member **11** and the floor or bottom **13** are sidewalls **15** of the housing **10**. Additionally, it will be seen that the cover member **11** is provided with a substantially central opening **11***a* and the bottom or floor **13** with a likewise substantially central opening **29**.

The lowermost region or portion of the housing **10**, namely, the connecting portion **16**, is of substantially framelike configuration and possesses a conventional, and therefore schematically illustrated quick connecting or closure device **14**, by means of which the container, here shown as a bag or sack **12**, which is to be filled, can be detachably secured to the connection portion **16**. This air permeable of foraminous sack or bag **12** hangs freely downwards under the influence of the force of gravity.

Continuing, it will be seen that the housing **10** is divided by means of a horizontally-extending partition wall **20** into two portions or compartments, that is, an upper drive portion or compartment **18** and a lower portion or compartment **24**. Just as in the case of the cover member **11** and the floor or bottom **13**, here also this partition wall **20** possesses a substantially centrally disposed opening **22**. The lower portion **24** of the housing **10** is delimited at its lower end by the base or floor **13**, which, as mentioned above, possesses the central opening **29**.

Furthermore, it will be seen that a displaceable plunger member, here shown in the form of a flat plate or disk **26**, is arranged beneath the connecting portion **16** secured to the floor **13**. This plunger member **26** also possesses a central opening **28**. The largest diameter of the plate **26** is smaller than the diameter of the connecting portion **16**, so that the bag

or sack 12 surrounds this plate 26. As will be seen by referring to either FIGS. 1 or 2, the edge of the plate 26 possesses a substantially conical construction. More precisely, the portion 27 of the plate 26 which is furthest from the housing 10 protrudes further than the portion 27*a* neighboring the housing 10. Also, it will be seen that the marginal edge 27 extends up to the region of the wall of the bag or sack 12.

Additionally, it will be seen that at the substantially platelike plunger member 26 there are secured three sleeve members 30 which are displaceably mounted at the base 13. Each sleeve member 30 surrounds an associated threaded spindle 32 located therein. The threaded spindles 32 and sleeve members 30 extend from the plate member 26 towards the cover member 11, as shown. Although the sleeve members 30 terminate at a spacing from the partition wall 20, the threaded spindles 32, which are rotatably mounted in the partition wall 20, will be seen to extend upwardly into the drive portion or compartment 18 of the housing 10, at which location they are rigidly connected for rotation with a respective associated sprocket wheel or gear 34. The uppermost region of each sleeve member 30 is coupled with a threaded spindle 33 which meshes with the associated threaded spindle 32.

The sprocket gears or wheels 34 associated with the three threaded spindles 32 mesh with a sprocket chain 35. The latter is trained about all three of the sprocket gears or wheels 34 as well as a further sprocket gear 36. Sprocket gear 36 is operatively associated with a suitable drive motor 38. This drive motor 38 is supported in the housing 10 upon a platform or support member 39, as best shown by referring to FIG. 2.

The cover member 11 carries an air impervious inlet means or connecting piece 42 which extends through the driving portion or compartment 18 and into the lower portion 24 of the housing 10. The inlet connecting piece 42, during installation of the apparatus in a spinning mill, for instance, is coupled with an air infeed conduit 44 in which there is arranged a delivery ventilator or fan 46, as best seen by referring to FIG. 1.

In the arrangement shown in FIGS. 1 to 3, it will be recognized that an air permeable or foraminous hoselike filter member 48, which may be formed of flexible material and/or possess a telescopic construction, as will be explained shortly hereinafter, is secured to the lower end of the inlet connecting piece or spout 42. This filter hose member 48 extends downwardly through the entire length of the housing 10, through the opening 29 of the floor or base 13, and is secured to the plate member 26. As best seen by referring to FIG. 1, within the housing portion 24 the filter hose member 48 is flexed or bent through a first undulation 52 towards the outside and upwardly and in a second undulation or flexure 54 towards the outside and downwardly. In so doing, the spacing of both flexed portions 52, 54 from one another approximately corresponds to half of the stroke of the threaded spindles 32. At the upper flexure or bend 54 the filter hose member 48 is clamped between two suitable ring members 56 and 58, which are appropriately connected with one another by fastening means, such as rivets or equivalent structure. The outer ring member 48 possesses a hook member 60 at which there is suspended a spring member 62. This spring member 62 is guided over a roller 64 secured to the partition wall 20 and such spring member is also connected at its opposite end, as shown in FIG. 1, to the inside wall 15 of the housing 10. By virtue of the aforegoing arrangement, it will be seen that the filter member 48 provides an extensible telescopic construction. By the same token, filter member 48 can be formed of flexible material so that it is inherently extensible, for the reasons to be explained shortly hereinafter.

Continuing now, as best seen by referring to FIGS. 1 and 2, within the housing portion 24 of the housing 10 terminal switches 66 are arranged at the region of the extremities or ends of a sleeve member 30. These terminal switches 66 cooperate with appropriate cam means 100 provided at the associated sleeve member 30. The interior of the housing 10 and the walls of the hoselike filter member 48, as well as the exterior of the housing 10, are operatively coupled via suitable pressure probes 68 and 69 with a pressure-sensitive device 70. This pressure-sensitive device 70, the terminal switches 66 and the drive motor 38, are all electrically connected with an evaluation device 74. In order to preserve clarity in illustration, these control devices have been conveniently depicted externally of the housing 10.

Before proceeding with a description of the operation of the heretofore described illustrative embodiment of inventive apparatus for separating fibers from a conveying air current, reference is initially made to the modified version of equipment depicted in FIG. 4. In this arrangement, it will be seen that the ventilator or fan 46' for generating the conveying air current is arranged at the clean air side of the equipment. The hoselike filter member 48', which, in this case, need not possess a telescopic extensible construction, will be seen to be surrounded by an annulus or ring-shaped compartment 80 which communicates with a delivery or air transport channel 82. In this case, the ventilator 46' is arranged in the air transport channel 82. A plate member 26', defining the plunger means and corresponding to the plate member 26 of the previous embodiment, is disposed in its normal position above the filter member 48'. It will be understood that the mechanism for displacing the plate member 26' can be the same as that shown in the arrangement of FIG. 1, and therefore has not been illustrated in this embodiment in order to preserve clarity in the drawings. Continuing, it will be seen that the sack or bag 12 which is to be filled is arranged below the annular compartment 80 in detachable fashion at a cylindrical piece or skirt 84. A conical member 86 is arranged in the substantially cylindrical piece 84. It will be seen that the cross section of this conical member 86 reduces in the impact direction of the plate member 26'. Furthermore, the inside of the cone portion 86 is equipped with upwardly directed teeth 86*a*, so that the compacted material cannot slide back against its direction of discharge or ejection.

When using air permeable sacks or bags 12 which are to be filled, there can be advantageously placed in each sack 12 a suitable holddown weight or the like. With an appropriate construction of the discharge cone portion 86, that is, for instance by tapering same, it is possible to dispense with the mounting of the sack directly at the cylindrical piece 84, since the tapered or cone discharge portion serves to compact the fibers and the thus compressed material acts as a seal as far as the conveying air is concerned which is withdrawn by the fan 46'. Hence, the compacted fibers can also be filled into a container which is not directly connected with the apparatus since no appreciable amount of air is present to blow the fibers around and the fibers themselves appear as a somewhat compacted and coherent mass.

During operation of the apparatus, the ventilator 46 conveys air and the material contained therein which is to be separated, for instance, fibers, which are delivered from a cleaning installation of a textile machine, into the sack or bag 12. While the fibers will be retained by the sack 12, the air will pass through the wall of the sack into the space surrounding the apparatus.

The pressure-sensitive device 70 continuously measures the pressure drop across the sack 12. When the pressure drop has exceeded a predetermined value, then, the drive motor 38 is switched on by means of the evaluation device 74. The drive motor 38 then, in turn, through the agency of the chain 35, the chain wheels 34, the spindles 32, the threaded sleeves 33 and the sleeve members 30, causes the platelike plunger member 26 to be displaced downwards. As a result, the hoselike filter member 48 slowly extends against the action of the spring member 62. The downwardly moving plate member 26 wipes away material adhering to the wall of the sack 12 and presses the separated material together which is within this sack. The air now passes through the extended filter member 48 and through the sack 12. When the plate member 26 has assumed its lowermost position, then the lower terminal switch 66 reverses the drive motor 38 and the plate member 26 again moves upwards.

It is of considerable importance that the air entering the apparatus during the compacting operation can escape through the walls of the portion of the substantially hoselike filter member **48** which is now located externally of the housing **10**, as shown in FIG. **2**. Consequently, the separation of fibers and the maintenance of the suction effect of the ventilator **46** is insured even during the compacting operation. Due to the action of the spring member **62**, the hoselike filter member **48** is shortened in length via the hook member **60** and the ring members **56** and **58**, until it again assumes its original or starting length. During movement of the plate member **26** into its upper terminal position, such is stopped thereat by the upper terminal switch **66**.

Upon achieving the prescribed pressure differential, the entire cycle begins anew. If, during increase of the quantity of material filled into the sack **12**, the frequency of the compacting movement exceeds a predetermined measure or value, then by means of the evaluation device **75** a signal is transmitted which indicates that the sack **12** has been filled and should be replaced.

By means of the inventive apparatus, it is possible to fill sacks, bags or the like with a weight which is up to five times greater than if no compacting mechanism were provided.

If the sack or bag **12** which is to be filled is guided and supported by suitable means, then, it is also possible to erect the apparatus such that the sack is extended at an inclination or horizontally. Instead of providing an electromechanical drive arrangement for the plate member **26**, it would also be possible to provide a hydraulic or pneumatic drive. Furthermore, the hoselike filter member **48** can also be constructed in the form of a bellows or pleated bag, which upon extension of the plate member **26** will stretch, or, as mentioned previously, it can be elastic. Additionally, it is also, however, possible to couple the plate member with an extensible cylindrical jacket-like sieve which in the extended position of the plate member forms an air permeable wall between the connecting piece **16** and the plate member **26**.

Naturally, it is also possible to equip the apparatus with at least two sacks or bags, which can be alternately charged with fibers. Moreover, the indication that a sack is full can also be carried out by determining its weight, for instance with the help of a spring balance or scale, or any equivalent structure.

The advantages of the inventive embodiments disclosed herein resides in the fact that the filling weight which can be obtained is approximately 5 times higher than that which is achieved with equipment where the sacks are only filled by the conveying airstream or current. The manual operation which is required is limited to periodic replacement of the sacks or bags and the personnel attending to the apparatus, as a practical matter, are no longer subjected to the disturbing effects of fly and dust or other contaminants. Furthermore, there does not appear any periodic loading of the pneumatic system, resulting in increased longevity of these components. Additionally, there can be dispensed with the air transport conduits for the air cleaned of the conveyed material. Since the inventive apparatus operates quietly, it can be readily erected in a work place or room.

It should be apparent from the foregoing detailed description, that the objects set forth at the outset to the specification have been successfully achieved.

What is claimed is:

1. An apparatus for separating fibers from a conveying airstream, comprising housing means having an infeed side and an outfeed side for the fibers and conveying airstream, a stationary inlet means provided for said housing means for delivering the conveying airstream charged with fibers into said housing means at said infeed side, a container disposed at the region of said outfeed side of said housing means for collecting the ejected fibers separated from said conveying airstream, an axially displaceable plunger means provided with an opening disposed in flow communication with said inlet means for the conveying airstream charged with fibers, said plunger means having opposed plunger faces to opposite sides of said plunger opening, one of said plunger faces confronting said inlet means and the other of said plunger faces facing away from said inlet means drive means for said axially displaceable plunger means, and an air permeable filter member communicating said inlet means with said plunger opening and cooperating with said plunger means such as to permit escape of at least part of said conveying air through said filter member externally thereof while said fibers move through said plunger opening into said container to a position to be acted upon by said plunger means.

2. Apparatus for separating fibers from a conveying airstream as defined in claim **1**, wherein said filter member is a telescopically constructed element.

3. Apparatus for separating fibers from a conveying airstream as defined in claim **1**, wherein said container comprises a sack, and means for detachably connecting said sack with the apparatus.

4. An apparatus for separating fibers from a conveying airstream as defined in claim **1**, wherein said container is a sack, and where said filter member is secured to said plunger means and said filter member situated in front of said sack in flow direction of said conveying airstream forms the last portion of said inlet means.

5. An apparatus for separating fibers from a conveying airstream as defined in claim **1**, wherein said filter member is constructed to possess a substantially hoselike configuration.

6. Apparatus for separating fibers from a conveying airstream as defined in claim **5**, wherein said substantially hoselike filter member in its rest position is folded twice in opposite directions and is telescopically extensible.

7. An apparatus for separating fibers from a conveying airstream as defined in claim **6**, further including ring means between which said filter member is guided, said spring means for returning said filter member into its rest position.

8. Apparatus for separating fibers from a conveying airstream as defined in claim **1**, wherein said filter member is of substantially cylindrical configuration and is extensible conjointly with said plunger means.

9. Apparatus as defined in claim **1**, wherein said filter member defines a structure which itself is variable in length.

10. The apparatus as defined in claim **1**, wherein said filter member surrounds said plunger means.

11. Apparatus for separating fibers from a conveying airstream as defined in claim **10**, further including means defining an annular compartment surrounding said filter member, means providing a channel for the cleaned air, said annular compartment opening into said channel, and an air conveying device arranged in said channel.

12. An apparatus for separating fibers from a conveying airstream as defined in claim **11**, further including a conical discharge connecting piece arranged beneath said filter member, means provided for said conical discharge piece which prevents sliding back of the compressed material in a direction opposite to the direction of ejection of such material.

13. An apparatus for separating fibers from a conveying airstream as defined in claim **1**, wherein said stationary inlet means and said plunger opening are substantially coaxially aligned.

14. An apparatus for separating fibers from a conveying airstream as defined in claim **1**, wherein said air permeable filter member is extensible into a position where a portion thereof is disposed externally of said housing means at said outfeed side thereof, means for connecting said filter member with said plunger means, so that during axial displacement of said plunger means said filter member portion is disposed externally of said housing means to permit lateral escape of conveying air through said filter member.

15. An apparatus for separating fibers from a conveying airstream, comprising housing means having an infeed side and an outfeed side for the fibers and conveying airstream, a stationary inlet means provided for said housing means for delivering the conveying airstream charged with fibers into said housing means at said infeed side, a container disposed at

the region of said outfeed side of said housing means for collecting the ejected fibers separated from said conveying airstream, an axially displaceable plunger means provided with an opening positioned in flow communication with said inlet means for the conveying airstream charged with fibers, drive means for said axially displaceable plunger means, and an air permeable filter member for operatively connecting said plunger means with said stationary inlet means, said filter member being a flexible element.

16. An apparatus for separating fibers from a conveying airstream, comprising housing means having an infeed side and an outfeed side for the fibers and conveying airstream, a stationary inlet means provided for said housing means for delivering the conveying airstream charged with fibers into said housing means at said infeed side, a container disposed at the region of said outfeed side of said housing means for collecting the ejected fibers separated from said conveying airstream, an axially displaceable plunger means provided with an opening disposed in flow communication with said inlet means for the conveying airstream charged with fibers, said plunger means having opposed plunger faces to opposite sides of said plunger opening, one of said plunger faces confronting said inlet means and the other of said plunger faces facing away from said inlet means, drive means for said axially displaceable plunger means to move said plunger means from an inoperative position in a direction towards said outfeed side of said housing means, the fibers and conveying airstream moving from said inlet means towards said one plunger face and at that location of said one plunger face at least the fibers move through said plunger opening to the side of said other plunger face in a position to be acted upon and compacted by said plunger means when said plunger means is moving in said direction towards said outfeed side of said housing means, and an air permeable filter member cooperating with and disposed at a location with respect to said plunger means such as to permit escape of at least part of said conveying air through said filter member externally thereof prior to possible passage through said plunger opening when said plunger means is moving while out of said inoperative position.