Jan. 13, 1970 E. BABCOCK 3,489,607

METHOD AND APPARATUS FOR HANDLING ALLERGEN LADEN DUST

Filed Oct. 2, 1967

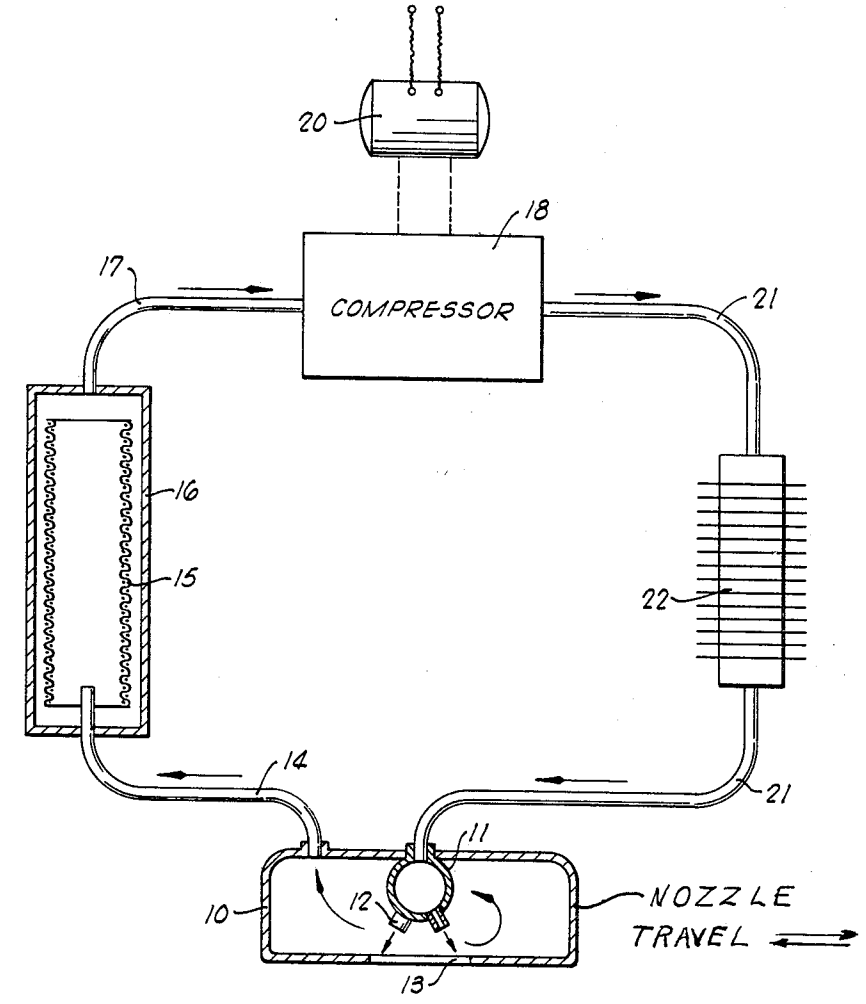

Fig. 1

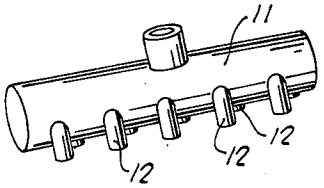

Fig. 2

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METHOD AND APPARATUS FOR HANDLING ALLERGEN LADEN DUST

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ABSTRACT OF THE DISCLOSURE

The present invention seeks to remedy the pollution of air with gaseous allergens while removing dust from a carpet or rug. It is a known fact that gaseous adsorbates are removed from an adsorbent if the adsorbent is crushed and heated. Most modern vacuum cleaners crush and heat the dust particles lifted from a rug, so the allergens, if there are any adsorbed in the dust, are freed and pass right through the filter, being in gaseous phase. In accordance with the present invention, dust is lifted from the floor covering and delivered to a filter with as little friction as possible. No mechanical agitator is interposed in the flow of the air as it travels from the nozzle to the filter, and the blower or compressor is on the down-stream side of the filter. Actually, some cooling of the dust is contemplated. To agitate the pile of the rug to loosen the dust, a "closed circuit" cleaner is used, i.e., one in which the cleaning air is recirculated. The filtered air is returned to the nozzle, and directed into the nozzle through staggered jets. Thus, upon the nozzle being moved over the rug, the fibers of its pile are blasted and moved back and forth as well as crosswise of the direction of movement without being unduly heated or without beating the particles of dust. The air in the nozzle remains at atmospheric pressure, so the nozzle slides easily over the rug without the rug being lifted off of the floor.

An allergen, as that term is used herein, may be defined as a substance that induces harmful reactivity in a living organism following exposure to it. As so defined, the word includes poisonous gases. Some allergens may be in liquid or solid phase, but the present invention is concerned only with those in gaseous phase, or which behave like gases in that they pass right through an ordinary filter and are capable of being adsorbed or occluded in house dust or other adsorbents which collect on floor coverings such as rugs and carpets.

Ordinarily, whenever a vacuum cleaner is run over a floor covering containing house dust, an odor is given off, and some people are allergic to it.

For example, some people are allergic to the odorous tars and other gases in tobacco smoke. They may also be allergic to some gases that cannot be smelled, such as carbon monoxide, which is also present in tobacco smoke. Tobacco smoke, like all smoke, contains volatilized products of partial combustion, but it also contains fine particles of carbon in the form of charcoal. Such carbon is an adsorbent. As it cools, following the combustion, it adsorbs the gases present. The adsorbed gases include volatile nicotine alkaloid ($C_{10}H_{14}N_2$), which is very poisonous. In time, the carbon particles, so laden, sink into the floor covering, where they remain unless disturbed.

It is a known fact that heating and crushing of particles of adsorbent material expel the gases adsorbed therein. See Rosaire v. Baroid, 218 F. 2nd 72, and the patents cited therein.

Some modern vacuum cleaners have a fan or compressor in the path of the flow of air from the nozzle to the filter. Others have beaters or brushes in this path. Such devices strike the dust particles and create a lot of frictional heat therein, as well as break up the particles. The gases thus expelled pass through the filter and pollute the air in the room. Nothing could be worse from the standpoint of the operator if she happens to be allergic to such gases.

Other modern cleaners, such as those of the canister type, and some very old designs, such as the Spencer, seek to clean a rug by vacuum alone. They may have the fan or compressor on the downstream side of the filter, and since they have no beater or brush in the nozzle, there is little heating and breaking up of the dust particles flowing from the nozzle to the filter. The trouble here, however, is that these cleaners do not do a good job of removing the dust from the rug.

It is recognized in the industry that agitation in the nozzle is necessary to do a good job of cleaning, and that the suction in the nozzle should not be so high as to cause the rug to be sucked firmly to the lips of the nozzle so as to cut off the flow of incoming air. Cutting off incoming air only impairs the removal of dust from the rug, and makes it difficult to push the nozzle across the rug.

The "Dial-A-Matic" Model 1120 cleaner made by The Hoover Company of North Canton, Ohio, has a filter bag in a sealed, airtight container, and has a blower on the downstream side of the filter. Thus, the blades of the blower do not strike the dust particles flowing from the nozzle to the filter. This cleaner has a beater in the nozzle, however, and the dust particles are heated and broken up by it.

It was old in the art many years ago to have what is called "closed circuit" cleaners, i.e., those in which the same air is recirculated round and round through the nozzle. The nozzle is the only part open to the atmosphere. See, for example the patent to Squires, No. 1,664,092; the patent to Storm, No. 2,475,808, and the patent to Farnsworth, No. 1,383,456. Here, also, however, the mechanism is such that the particles of dust picked up from the floor covering are crushed and heated by friction as they pass from the nozzle to the point of removal from the air stream.

Accordingly, insofar as is known, nowhere in the prior art is consideration given to the problem of pollution of the air in a room by gaseous allergens expelled from dust picked up by a vacuum cleaner. No known vacuum cleaner is capable of doing what is necessary to do an effective job of removing the dust from a floor covering and at the same time avoiding such pollution. It is the object of the present invention to solve this problem by providing both a method and an apparatus for reducing such pollution.

In the accompanying drawing:

FIG. 1 is a flow diagram of a vacuum cleaner constructed in accordance with the present invention; and

FIG. 2 is a view in perspective of one form of means for delivering jets of air to the nozzle housing of a cleaner of the invention.

The flow diagram of FIG. 1 is intended to apply to all types of vacuum cleaners, whether they be of the unitary type with a motor and compressor integral with the nozzle and with a filter bag attached to the handle (as in the patents to Kirby, No. 2,221,746, and Smellie, No. 1,999,667), or of the type where the motor, compressor and filter are in a unit remote from the nozzle housing and connected thereto by a flexible hose.

In the drawing, the hollow nozzle housing of a vacuum cleaner is diagramatically illustrated at **10**. It has a manifold **11** therein provided with staggered jets, which are directed downwardly along spaced lines toward the opening **13** in the bottom of the nozzle housing **10**, the jets being designated **12**.

From the nozzle housing **10**, air is intended to flow through a conduit **14** directly into a filter bag **15** in a sealed container **16**. The conduit **14** should be as short as convenient, and of a large diameter to be as free of friction to the air flow as possible.

There is a conduit **17** connecting the impervious housing or container **16** to a compressor **18**, which is driven by an electric motor **20**. The motor is air cooled, but the air which cools it is not part of the cleaning air. Thus, the motor does not heat the circulating cleaning air. The compressor **18** may be of any known type, and the word, "compressor" as used herein, is intended to include known types of fans and blowers.

The discharge side of the compressor **18** is connected to the manifold **11** by a conduit **21**. Thus, there is a combination of a nozzle housing, a filter, a compressor and jets for the nozzle housing, all connected in series, in that order, in a closed circuit vacuum cleaner, as shown in FIG. 1 of the drawing.

In addition, a heat radiator of any suitable design, such as copper tubing with heat radiating fins attached thereto, is provided in the conduit **21**. This is represented by the numeral **22** in the drawing.

The nozzle housing **10** may be secured to a flat plate (not shown) so that it may slide easily over the floor covering the way a flatiron slides over an ironing board. No wheels for the nozzle housing are necessary (though they may be provided if desired), because the pressure in the nozzle remains at atmospheric pressure during operation of the machine. The covering is not sucked up off of the floor.

As stated, the present invention is limited to a method and system in which the air pressure in the nozzle is maintained at atmospheric pressure, or substantially that pressure during the operation of the machine. The present invention is not limited to the maintenance of any particular pressures in the other parts of the system, however. The pressure drop across the filter will depend on what type of filter is used. In the conduit **21**, the pressure may be quite high, this depending on the nature of the compressor, the number and nature of the jets **12** and other factors of design.

By the proper design of the jets **12** and their location in the nozzle housing **10**, along with the proper air pressure in the conduit **21**, as much agitation can be imparted to the pile of the floor covering being cleaned as desired without subjecting the particles of dust to mechanical abrasion and heating. Because of the staggered position of the jets **12**, each fiber of the pile is moved first forward and then backward as well as transversely to the right and left of the direction of movement of the nozzle housing over the rug or carpet.

It will be seen that the jets **12** perform two functions; they serve to agitate the pile, as explained above, and they also serve as expansion orifices to restrict the flow of air from the compressor to the nozzle housing. Thus, in connection with the heat radiator **22**, they complete mechanism for obtaining some refrigeration. As the air is compressed in the compressor **18**, it becomes very hot. Some of the heat of compression is dissipated in the conduit **21** and radiator **22**. The air then fed to the jets is

at a high pressure, but at a temperature not much above that of the atmosphere. Upon expanding through the jets **12**, it may then actually cool the dust particles as they are blasted out of the rug or carpet, so that there is less tendency for the absorbed, harmful gases to be expelled from the dust.

It may be true that only a small amount of harmful gases are absorbed in the dust particles. It is a mistake to assume, however, that because this is so, that their expulsion in cleaning a floor covering is of no importance. When allergic persons inhale only small amounts of allergens, great harm may result. A small amount of irritation may trigger an asthma attack or the like.

In the operation of the system described, initially, as the motor **20** starts up, there may be sub-atmospheric pressure in the nozzle housing **10**, as well as in the rest of the intake side of the compressor **18**. Just as soon as the jets **12** are delivering enough air to the nozzle housing **10**, the pressure in the nozzle housing will rise until it reaches atmospheric pressure, and there it will remain. Of course, as the nozzle housing is moved over the floor, some air may be exhaled or inhaled by the nozzle housing so that the pressure therein varies to some extent due mainly to turbulence. That was what was meant by the statement above that the pressure in the nozzle will remain substantially at atmospheric pressure.

It is within the purview of the invention to sprinkle some additional adsorbent material, such as activated charcoal or silica gel, on the floor covering some time before cleaning it in order to remove allergens from air in a room. Then, by operation of the method and apparatus herein described and claimed, such adsorbents can be conveyed to a filter without expelling the allergens therefrom.

It is also within the purview of the invention to place additional adsorbent material in the filter bag **15** or in the housing **16** before operation of the cleaner, so that if any harmful gases are unintentionally expelled from the house dust in the floor covering, they will be readsorbed and remain in the system until the filter bag is emptied.

From the above, it will be seen that many changes may be made in the arrangement and construction of parts, as well as in the application of the method without departing from the spirit of the invention or the scope of the annexed claims.

I claim:

1. The method of removing allergen laden dust from a floor covering including the steps of placing a nozzle housing over a portion of the floor covering, subjecting that portion to blasts of air to remove the dust therefrom, causing such dust to move by an air stream flowing directly from the nozzle housing to a filter by subjecting the filter to less than atmospheric pressure while maintaining substantially atmospheric pressure in the nozzle housing, then compressing the air leaving the filter to a pressure higher than that of the atmosphere, feeding it back into the nozzle housing to supply the air for the blasts, and removing sufficient heat of compression from the compressed air before it is fed back into the nozzle housing to obtain some refrigeration in the nozzle housing.

2. Apparatus for removing allergen laden dust from a floor covering including, in combination, a hollow nozzle housing, a filter, an air compressor, a heat radiator and jets located in the nozzle housing whereby air emitting from said jets expands into the hollow nozzle housing, together with air conduits connecting the elements listed in series, in the order listed, in a closed circuit cleaner, said jets being so arranged as to direct compressed air against the floor covering adjacent to the nozzle housing and blast the dust out of it, the arrangement being such as to cause the dust to move directly from the nozzle housing to the filter with little abrasion and without being heated substantially by friction, as the compressor forces the air to flow through the elements

herein mentioned in the sequence listed, said heat radiator being of such capacity and design as to cause some refrigeration in the nozzle housing.

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15—346; 134—17, 37