The invention relates to a vacuum cleaner provided with components made of expanded polypropylene, wherein at least one component of the device body or at least one insert fixed to said body is made of expanded polypropylene.
VACUUM CLEANER WITH EXPANDED POLYPROPYLENE COMPONENTS

[0001] The invention relates to the electric household appliance field of vacuum cleaners and more particularly the structure of a vacuum cleaner.

[0002] Historically, household electric appliances, which include vacuum cleaners, integrate beneficially various plastics that have become available with the development of the technology of producing polymers and according to their differentiated performance, each one being specifically selected for a particular function: resistance to temperature, rigidity or flexibility, acoustic damping, aesthetic aspect, etc. Today, one finds more than a half dozen different plastics in the body of a vacuum cleaner: ABS, polyamide, polyethylene, polylpropylene, PVC, elastomers, etc.

[0003] Several elements are thus manufactured separately and attached to form the body of the appliance as well as the lid for the housing of the dust recovery bag, the supports of the filter elements, etc.

[0004] The plastics used in vacuum cleaners are as thin as possible so as to limit the weight of the appliance, and to reduce the effort necessary for handling the vacuum cleaner during use, this handling being an important cause of fatigue, for example when stairs are to be climbed or when staircases are to be cleaned.

[0005] A first problem encountered during manufacture of a vacuum cleaner is thus the reduction of the weight of the appliance, this problem being a constant concern for the manufacturers of vacuum cleaners.

[0006] The desired weight decrease is achieved by thinning the shell and the body, which diminishes the sturdiness of the appliance. In fact, the weight of the plastic employed for the manufacture of a vacuum cleaner quickly reaches a limit fixed by the sturdiness of the assembly.

[0007] A second problem is thus to maintain the sturdiness of the shell and the body while substantially reducing the weight of the plastic employed and that of the vacuum cleaner.

[0008] The reduction in thickness of the shell and existing vacuum cleaners also has a negative effect on the noise of the appliance. The consequence of the reduction in material is that the noise of the motor is not sufficiently confined and the vacuum cleaner is noisy, which often leads to surrounding the motor with a foam.

[0009] Noise pollution of all kinds are today very much combatted, as well as at the level of general noises as domestic noises produced by people themselves, and in particular the noises generated by housework.

[0010] A third problem is thus to decrease the noise of the vacuum cleaner all while maintaining the sturdiness of the shell and the body of the appliance, while reducing the weight of the assembly.

[0011] Passage of the vacuum cleaner through the house is generally not a task considered as very pleasant and indeed, the appliance is used without care, it thus frequently occurs that the appliance bumps up against furniture, walls or various objects placed in the residence. On this occasion, taking into account the rigidity of the frame of the vacuum cleaner, the impacted part is often damaged.

[0012] A fourth problem that arises for the manufacturers of vacuum cleaners is thus to combine good mechanical characteristics of the frame with a possible absorption of shocks to limit the effects caused by imprudent handling. A solution to this problem can in particular be found by rubber bands surrounding, like a belt, the body of the appliance. Such a solution generates a non-negligible cost increase.

[0013] In addition, in the current situation of recycling of waste of all kinds, and in particular electric household appliances at the end of their lifetime, all manufacturers concerned with the environment and enlisting in the effort towards a durable development seek solutions to limit the weight of the materials to be recycled and use as much as possible materials that can be recovered easily. It is in effect known that the environmental impact of a vacuum cleaner comes, in great part, from its composition.

[0014] A fifth problem that is presented is thus to manufacture a vacuum cleaner whose materials can be easily, and if possible completely, recycled.

[0015] The invention thus has for an object to solve these principal difficulties, i.e. aims at producing a light-weight vacuum cleaner of increased sturdiness, a level of noise lower than what is known for this type of appliance, being able to absorb shocks and having an enhanced recyclability at the end of its lifetime.

[0016] According to the invention the vacuum cleaner comprising plastic parts is characterized in that at least one element among the components of the body of the appliance is made of expanded polypropylene.

[0017] By body of the appliance, it is necessary to understand the visible external part of the appliance, which can have various names: case, shell, housing . . .

[0018] Advantageously, at least one insert fixed on said body of the appliance is made of expanded polypropylene.

[0019] Expanded polypropylene (EPP) is made from beads that are molded into objects using a press in the presence of vapor, or steam. Mainly used as a shock absorbing material, in particular recently in cars (shock absorber), EPP has multiple qualities: durability at temperatures up to 100°C, excellent stability, lightness, impact resistance, ability to be recycled, etc., which makes it attractive. However, its low mechanical strength makes it for the moment only a complementary material during the fabrication of sub-assemblies.

[0020] The present invention thus proposes to provide constituent parts of the body of the vacuum cleaner, requiring a certain rigidity, sturdiness and mechanical strength, made of EPP, which has not been envisaged previously for this use.

[0021] Another goal of this invention is to give greater importance to polypropylene in the choice of the plastic. Another objective of the invention is to use more than 90% of only one type of plastic, polypropylene, in the entire body of the vacuum cleaner. Polypropylene can then be employed in two forms: traditional polypropylene (PP) which has the traditional properties of plastics and expanded polypropylene (EPP).

[0022] Other characteristics and advantages of the invention will emerge from the description that will follow with regard to the annexed drawing which is given only as a non-limiting example.

[0023] FIG. 1 is a side view, in simplified longitudinal cross section, of a vacuum cleaner.

[0024] As this FIG. 1 shows, a vacuum cleaner conventionally consists of a motor 4 generating the suction force and air circulation from the end of a pipe (not represented) coming to be connected in an opening arranged on the body of the vacuum cleaner, up to the discharge towards the back of the
appliance. In this process for elimination of dust, the flow of air crossses the housing containing the filter bag for recovery of dust.

The body of the vacuum cleaner is composed of two assembled principal parts separately manufactured then assembled with one another:

1. a lower body having a housing for motor, sound-proofing elements in the form of internal partitions, and various spaces arranged for the passage of the electric wire, the positioning of the motor filters and maneuvering bodies such as wheels and casters. The lower body also has an insert for connection of the pipe that is to be connected to the suction nozzle.

2. an upper body on which come to be fitted control elements of the lid for closing of the housing of the dust bag and possibly a housing with its lid intended to receive the various vacuuming accessories such as a small brush, suction nozzle, etc.

A handle, foldable or fixed, or a rectex performing the function of a handle, is sometimes disposed on the shell, preferably on lower body 1 of the appliance.

According to the invention the constituent material of the vacuum cleaner, at least lower body 1, and preferably also upper body 2, is made of expanded polypropylene (EPP).

Like any material containing a large quantity of air, EPP has an extremely high thermal insulation and sound insulation capacity, which makes it a material adapted particularly well to absorb loud noise of this type of electric household appliance.

The capacity for damping the noise of the motor by the use of EPP in all the elements that is possible in the vacuum cleaner can involve, depending on the shapes, a reduction in this harmful effect compared to a vacuum cleaner made from the usual plastics made of ABS or nonexpanded polypropylene.

The low mechanical strength of EPP has however required a considerable increase in the thicknesses of the walls to have a sufficient sturdiness. However, and in a surprising way, even if the necessary volume of material leads to a vacuum cleaner that is bulkier than normal, the mass of the plastic can be greatly reduced, and the weight of the completed vacuum cleaner can be divided in half.

The smaller quantity of material is also advantageous from an economic point of view since the vacuum cleaner is less costly to manufacture.

The great flexibility of EPP allows an improved shock absorption compared to other plastics traditionally used to manufacture vacuum cleaners. With this great flexibility is associated, depending on the degree of expansion, an elastic memory of the material, which also has important advantages in terms of assembly of the various complementary parts fixed on the body of the appliance. Indeed, it is thus possible to pivotally mount for example the various lids without a hinge and to simply secure them in place by deforming the material. This interesting characteristic also makes it possible to fix inserts, by nesting, or interlocking, without difficulty.

It is sufficient in effect to force the material to become deformed in order to lock or fix an insert, the material regaining its shape after the deformation to maintain the assembly.

The various parts are thus assembled in a very tight way, which has an important advantage with respect to the transmission of noise, for the effectiveness of suction by the motor and the efficiency of the various filter bodies. The great flexibility of EPP makes it possible to lock many parts, inserts or electric cables in the absorbent material without the possibility of movement, more particularly over the course of time, under the effect in particular of the vibrations of the motor.

This excellent sealing by the material itself makes it possible to avoid, or at least to greatly reduce, the use of seals, in particular at the level of the suction duct, which is economically in terms of quantity of material and time required to assemble the vacuum cleaner.

The vacuum cleaner thus advantageously comprises at least one operation of assembling a part made of expanded polypropylene and another part, which involves deformation of the expanded polypropylene part. This deformation can allow, aside from the mechanical strength of the parts, a seal to be created.

Because of the great possibility of deformation of the material, various inserts can be force fitted into the lower body 1 or the upper body 2 during the process of assembly. The inserted parts are thus simpler to manufacture, without counterparts for fixing being necessary on the body of the appliance.

By judicious and effective design of the fittings and always thanks to the flexibility of the material and to its capacity to regain its shape, it is desired to seek an elimination of all the fastening screws for different components (electronic circuit card, wheels, etc.) and of the parts between them, this in order to facilitate dismantling at the end of the lifetime.

The EPP material, always because of the large quantity of air trapped in the material, presents an increased aptitude to absorb vibrations, which vibrations often generate noise in addition to that of the motor, for example at the level of the maneuvering bodies.

According to the invention it is envisioned to make a maximum possible number of parts of EPP and where this material cannot be used to employ standard polypropylene, so as to facilitate recycling of the vacuum cleaner at the end of its lifetime. This recycling, once the motor is removed, is easier if the same polymer is used for the various constituent parts.

It is in effect imaginable to manufacture buttons, indicators, wheels and casters of another material than EPP, in particular for functional reasons, for example a luminous indicator must be manufactured from a transparent plastic. In this eventuality standard polypropylene will be preferred over other polymers so as to be compatible with the body of the appliance. An operation of melting or crushing of the whole of the vacuum cleaner, once the motor has been removed, to recover polymer and to reuse it, is thus possible.

The use of a single plastic material constitutes an important contribution in the reduction of raw material stocks and at the end of the lifetime increases in an important way the effective rate of valorization of appliances at the end of their life. The dismantling of the appliances will mainly consist in isolating the metal parts (essentially the motor and the electric wiring) from the single plastic material.

Another advantage of EPP material is its soft touch, a vacuum cleaner made up with this product is more pleasant to handle which can have an additional commercial advantage associated with the principal technical functionalities previously described.
Several alternatives are possible for the vacuum cleaner according to the invention, it can in particular be envisioned to place an automatic reeling device for the electric power cord for connection of the motor inside lower body 1 or a manual device on its circumference, for example in the form of projecting members, and to produce a vacuum cleaner with varied functionalities without departing from the framework of the invention.

There can also be envisioned different shapes for the lower or upper body and the constituent parts of EPP without departing from the framework of the invention. A variable number of inserts, lids, handles, or added elements can be placed without departing from the framework of the invention.

In a preferred manner, lower body 1 of the vacuum cleaner, upper body 2, lid 3 and the possible transport, or carrying, handle 6, are manufactured from EPP. The indicators, control units 5 and maneuvering bodies 9 can be developed from nonexpanded polypropylene, but it is also envisioned to manufacture various added parts such as the maneuvering bodies, wheels or casters, from EPP without departing from the framework of the invention.

Certain models of vacuum cleaners can be envisioned with the entirety of the plastic parts of polypropylene, expanded or conventional.

Of course, the invention is not limited to the embodiments described and represented as examples, but it comprises also all the technical equivalents as well as their combinations.

Expanded polypropylene will be used having degrees of expansion defined by the quantity of material (polypropylene) per liter. Use will be made in a way preferred manner of contents ranging between 40 g and 80 g of material per liter.

As an example, the production of a vacuum cleaner comprising a lower body, an upper body and a lid of EPP (at 60 g of material per liter), makes it possible to pass from a weight of 6.7 kg if the material used to make these parts is mainly ABS to 3.5 kg with fabrication of these parts of EPP, even though the walls are approximately four times thicker with the use of EPP.

In addition, in operation, the appliance has a good rigidity with a very good behavior of the elements added to the parts made of EPP.

Moreover, one passes then from a rate of recyclability of the appliance of 70% to more than 90%.

In addition, the great thickness of the walls can make it possible to form the housing for the small cleaning accessories in this thickness, by suitable cutting.

The advantages of such a vacuum cleaner manufactured with expanded polypropylene parts are thus multiple:

1. The total weight of the vacuum cleaner can be greatly decreased, without loss of the characteristics necessary for sturdiness, the density of expanded polypropylene being very low.

The noise during operation of the appliance is low, the air contained in the material substantially absorbing the noise of the motor.

The material is elastic, the vacuum cleaner can thus easily absorb shocks, which thus limits the risks to the furniture and the walls.

The quantity of material is reduced.

Different plastic parts for different uses in the vacuum cleaner can be manufactured with the same polypropylene polymer, preferably in its expanded form, which facilitates recycling of the vacuum cleaner at the end of its lifetime.

Vibrations are absorbed by the material, which contributes to the comfort of use.

The manufacturing cost of such a vacuum cleaner is lower than that of a conventional vacuum cleaner, particularly by the fact that assembling is facilitated, by the fact that the elements can be designed more simply and that certain parts, such as seals, can be eliminated.

Lastly, the material itself presents a more pleasant feel than that of the plastics employed to manufacture the vacuum cleaners known and used to date.

1. Vacuum cleaner comprising a body having a plurality of plastic components, wherein at least one of said components of said body of said vacuum cleaner is made of expanded polypropylene.

2. Vacuum cleaner according to claim 1, wherein said components comprise at least one insert fixed on said body of said vacuum cleaner and made of expanded polypropylene.

3. Vacuum cleaner according to claim 1, wherein said body of said vacuum cleaner comprises a lower body (1) and an upper body (2), and at least said lower body (1) is made of expanded polypropylene.

4. Vacuum cleaner according to claim 3, wherein said vacuum cleaner further comprises a lid and a transport handle, and wherein said lower body (1) of said vacuum cleaner, said upper body (2), said lid (3) and said transport handle (6) are made of expanded polypropylene.

5. Vacuum cleaner according to the claim 1, wherein said vacuum cleaner further comprises indicators, control units (5) and maneuvering bodies (9) all made of polypropylene.

6. Vacuum cleaner according to claim 1, wherein said vacuum cleaner further comprises an additional part that is assembled to said at least one of said components by temporary deformation of said at least one of said components.

7. Vacuum cleaner according to claim 1, wherein the expanded polypropylene of said at least one of said components has a density of between 40 g and 80 g per liter.