

08 AUG 2000

-1-

ELECTROSTATIC PROCESSING CHAMBER FOR PERFORMING
ELECTROSTATIC FLOCKING AND COATING OPERATIONS

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

The present invention relates to an electrostatic processing chamber for performing an electrostatic flocking operation and an electrostatic coating operation, wherein a strip-like elongated workpiece assuming a flat plate shape is subjected to an electrostatic flocking operation and an electrostatic coating operation in the electrostatic processing chamber.

2. Description of the Related Art

When an electrostatic processing operation such as an electrostatic flocking operation, electrostatic coating operation and the like is performed in a condition in which: a strip-like elongated flat plate having wound into a roll is unwound to longitudinally extend; and, the thus unwound and extended flat plate (including sheets of paper, textile fabrics, not limited only to metal sheets) is electrically grounded to serves as a workpiece to be flocked and coated when passed through an electrostatic flocking chamber and an electrostatic coating chamber in a condition in which the flat plate is spaced apart from an electrostatically charged element, a problem arises in the electrostatic flocking and the electrostatic coating operation, which result in a poorly flocked product and a poorly coated product, respectively. More specifically, in each of the poorly flocked product and the poorly coated product, the opposite longitudinal side areas adjacent to each of longitudinal corner edge portions of these products are small in flock density and in paint density. In contrast with this, each of the longitudinal

corner edge portions itself are large in flock density and in paint density.

This will be clearly described with reference to an example shown in Fig. 1 in cross section. Namely, in the flocking operation of the short fibers 4 with respect to the surface of the strip-like elongated flat plate 2 (on which surface the adhesive layer 3 has been formed), the poorly flocked portion and the excessively flocked portions both described above appear in the opposite longitudinal side areas adjacent to each of the longitudinal corner edge portions of the flocked product and in each of the longitudinal corner edge portions itself, respectively.

Consequently, it is necessary to prevent the above phenomenon from occurring in the electrostatic flocking operation of the workpiece. This is because the flocked product having been subjected to such phenomenon fails to become a sound product. In other words, in order to obtain the sound product which is uniform in flock density, it is necessary to remove the opposite longitudinal side portions of the flocked product having been subjected to the above phenomenon.

Applicant is a company, which was established on September 16, 1979. Since this company's establishment, development in technology relating to the electrostatic flocking process and the electrostatic coating process is proceeding so that a considerable amount of technological experience has been obtained by the company (i.e., Applicant). However, the company or Applicant does not know in the art any electrostatic flocking chamber having a construction or means for effectively preventing the above phenomenon from occurring.

In filing the subject Patent application of the present invention relating to the electrostatic processing operation such

as the electrostatic flocking operation, the electrostatic coating operation and the like in which the workpiece (i.e., strip-like elongated flat plate having been unwound from its roll to extend in its longitudinal direction) to be flocked and coated is passed
5 through the electrostatic flocking chamber and the electrostatic coating chamber in a condition in which the longitudinally extended flat plate is electrically grounded and spaced apart from the electrostatically charged element, various kinds of developments relating to the present invention have been required to be
10 accomplished. As a result, it is necessary to solve the above-mentioned problem, which arises when the workpiece is subjected to the electrostatic processing operation. The reason why the above problem arises is that: when the strip-like elongated flat plate (workpiece) is subjected to the electrostatic flocking
15 operation in a condition in which the flat plate is electrically grounded and passed through the electrostatic flocking chamber, the electric lines of force appearing in the electrostatic field produced between the electrode (charged with the high voltage electrostatic energy) and the workpiece having been electrically
20 grounded are not uniformly distributed in line density (which is the number of the electric lines of force per unit area) on the surface of the workpiece being flocked. In other words, since the electric lines of force are concentrated in the longitudinal corner edge portions of the flat plate, the floating short fabrics are
25 concentrated in these longitudinal corner edge portions. In contrast with this, the opposite longitudinal side portions adjacent to such longitudinal corner edge portions in the flat plate are small in line density, and therefore poor in flock density (which is the number of the short fibers per unit area). This phenomenon has been

found in the above-mentioned developments. Substantially the same phenomenon as that found in the above has been found also in the electrostatic coating operation.

The basic principles are identical for both the electrostatic flocking process and the electrostatic coating process, which will be now described hereinbelow.

In each of the electrostatic flocking technology and the electrostatic coating technology, there is provided the electrode to which a high voltage electrostatic energy is applied, wherein the workpiece to be electrostatically processed is electrically grounded and oppositely disposed from the electrode in the interior of the electrostatic processing chamber. In operation, the high voltage electrostatic energy is applied to the electrode to cause an electric discharge oriented toward the workpiece, so that: by using the electric lines of force issued from the electrode to the workpiece in the electrostatic field created between the electrode and the workpiece, fine objects floating between the electrode and the workpiece in the interior of the electrostatic processing chamber are electrically charged; and, the thus charged fine objects are driven to fly toward the workpiece. This is the basic principles of the electrostatic processing operations such as the electrostatic flocking operation and the electrostatic coating operation.

A remarkable difference between the electrostatic flocking technology and the electrostatic coating technology resides in that: in the technology relating to the electrostatic flocking operation, the fine objects floating in the electrostatic processing chamber are short fibers which are electrically conductive; the workpiece to be electrostatically processed is an electrically grounded object coated with an adhesive layer formed of an adhesive which is still

not dried; and, the electrostatic flocking operation of the workpiece is performed in a manner such that: the short fibers are electrically charged when the electrostatic field is created between the electrode and the workpiece; and, by using the electric lines of force formed in the electrostatic field, the short fibers are driven to fly toward the adhesive layer of the workpiece, and thereby having their front end portions stuck into the adhesive layer of the workpiece, whereby the electrostatic flocking operation is completed, wherein: an air flow may be produced in a manner such that the air flows from the electrode to the workpiece; or, any air flow does not exist between the electrode and the workpiece.

In contrast with this, in the technology relating to the electrostatic coating process: the above-mentioned fine objects floating in the interior of the electrostatic processing chamber are constructed of a fine coating powder or liquid provided with insulation properties; the workpiece to be electrostatically processed is an electrically grounded object still not coated with any adhesive layer; and, by using the electric lines of force in the electrostatic field created between the electrode and the workpiece, the electrostatic coating operation is performed in a manner such that: the coating powder or liquid is electrically charged; an air flow is formed between the electrode and the workpiece so as to have the air flow from the electrode toward the workpiece; and, due to a synergistic effect between the electrostatic field and the air flow, the coating powder or liquid is driven to fly toward the surface of the workpiece, so that the coating powder or liquid is attracted to the surface of the workpiece under the effect of the electrostatic charge of the coating powder or liquid.

The basic principles are identical for both the electrostatic

flocking process and the electrostatic coating process since both the electrostatic processes use the electric lines of force in the electrostatic field created between the workpiece and the electrode. However, these electrostatic processes are different from each other as to only two points, that is, : the workpiece to be electrostatically processed; and, the fine objects electrically charged to float. As for the arrangements or positional relationship between the electrode and the workpiece in the housing, there is substantially no difference in construction between these electrostatic processes.

In other words, in construction of the housing: the electrode is disposed; and, oppositely disposed from this electrode is the workpiece having been electrically grounded. Due to the above construction, the electrostatic field is created between the workpiece and the electrode, so that the electric lines of force extend from the electrode to the workpiece.

SUMMARY OF THE INVENTION

It is an object of the present invention to realize a uniformly flocked or a uniformly coated surface of a workpiece by preventing fine objects from being: poorly flocked in or applied to opposite longitudinal side areas of the workpiece, which side areas adjacent to each of longitudinal corner edge portions of the product; and, excessively flocked in or applied to each of the longitudinal corner edge portions itself when an electrostatic flocking operation or an electrostatic coating operation is performed in a condition in which: a strip-like elongated flat plate having wound into a roll is unwound to longitudinally extend to form a flat plate which forms the workpiece; and, the workpiece is electrically grounded so as

to be flocked and coated when passed through an electrostatic flocking chamber.

Consequently, regardless of the movements of the flat plate, the electrostatic processing operation is not performed with respect to the flat plate when the flat plate is held by a holding member
5 having been electrically grounded.

In accordance with a first aspect of the present invention, the above object of the present invention is accomplished by providing:

10 In an electrostatic processing chamber for forming an electrostatic flocking apparatus to perform an electrostatic flocking operation, wherein a strip-like elongated flat plate serving as a workpiece coated with an adhesive layer and electrically grounded is oppositely disposed from an electrode and transferred
15 in a condition in which short fibers having been electrically charged are electrostatically implanted in the flat plate, the improvement wherein: electrically grounded elongated elements are disposed in opposite longitudinal side areas of the flat plate to extend in parallel with a longitudinal direction of the flat plate in a passage
20 of the strip-line elongated flat plate being flocked.

In accordance with a second aspect of the present invention, the above object of the present invention is accomplished by providing:

An electrostatic processing chamber for forming an
25 electrostatic coating apparatus to perform an electrostatic coating operation, wherein a strip-like elongated flat plate serving as a workpiece electrically grounded is oppositely disposed from an electrode and transferred in a condition in which the workpiece is subjected to an electrostatic coating operation, the improvement

wherein: electrically grounded elongated elements are disposed in opposite longitudinal side areas of the workpiece to extend in parallel with a longitudinal direction of the flat workpiece in a passage of the strip-like elongated flat plate being coated.

5

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, advantages and features of the present invention will be more apparent from the following description taken in conjunction with the accompanying drawings in which:

10

Fig. 1 is a view illustrating the prior art applied to the workpiece; and

Fig. 2 is a view illustrating the present invention applied to the workpiece.

15

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The best modes for carrying out the present invention will be described in detail using embodiments of the present invention with reference to the accompanying drawings.

20

The present invention may, however, be embodied in various different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those skilled in the art.

25

The basic technical idea of the present invention has resulted in the provision of a suitable means for preventing the electric lines of force from concentrating in each of longitudinal corner edge portions of the workpiece. The provision of such a suitable

means is capable of solving the following problem, which will be now described in detail: namely, when an electrostatic processing operation such as an electrostatic flocking operation, electrostatic coating operation and the like is performed in a condition in which: a strip-like elongated flat plate having wound into a roll is unwound to longitudinally extend; and, the thus unwound and extended flat plate (hereinafter referred to as the workpiece 2) is electrically grounded so as to be flocked and coated when passed through an electrostatic flocking chamber and an electrostatic coating chamber, the problem arises in the electrostatic flocking and the electrostatic coating operation, which result in a poorly flocked product and a poorly coated product, respectively, wherein: the opposite longitudinal side areas adjacent to each of longitudinal corner edge portions of these products are small in flock density and in paint density; and, each of the longitudinal corner edge portions itself are large in flock density and in paint density.

According to the present invention, as shown in Fig. 2, in construction of each of the electrostatic flocking chamber and the electrostatic coating chamber (both of which chambers are hereinafter referred to as the housing): an electrode 1 is disposed inside the housing (not shown); oppositely disposed from the electrode 1 is the workpiece 2 which is constructed of the strip-like elongated flat plate and transferred in the interior of the housing; and, a plurality of electrically grounded elongated elements 5 are disposed in opposite longitudinal side areas of the workpiece 2 to extend in parallel with a longitudinal direction of said the workpiece 2 in a passage of the workpiece 2 being electrostatically processed, wherein each of the grounded elements 5 is slightly spaced

apart from the workpiece 2.

It is possible to mount each of the electrically grounded elongated elements 5 in the housing by using the same mounting means as that used in mounting an electrically grounded shelf (which supports the workpiece thereon) in the housing. Consequently, no special provision of means for supporting the elongated elements 5 is required in the present invention.

Hereinbelow, the electrostatic flocking operation of the workpiece 2 will be described, as an example.

The electrostatic flocking operation is performed in a condition in which: the electrically grounded elongated elements 5 are mounted along the passage of the workpiece 2 in the housing; the workpiece 2 is transferred through the passage; and, flock or short fibers 4 are electrostatically charged to float in the housing as is in the conventional ordinary operation.

In other words, in the above operation, the workpiece 2 is electrically grounded and transferred in the housing in a condition in which the workpiece 3 has its adhesive-layer formation surface 3 oppositely disposed from the electrode 1, wherein: an adhesive layer is formed on the adhesive-layer formation surface 3 of the workpiece 2; and, a high voltage higher than that used in the conventional ordinary process is applied to the electrode 1.

In the above operation, an electrostatic field is created between the electrode 1, workpiece 2 and the elongated elements 5. The electric lines of force in this electrostatic field extend to the adhesive-layer formation surface 3 of the workpiece 2.

As a result, the short fibers 4 charged inside the housing are electrostatically driven to fly toward the adhesive-layer formation surface 3 of the workpiece 2 and also toward the elongated

elements 5, so that the short fibers 4 reached the adhesive-layer formation surface 3 of the workpiece 2 have their front end portions stuck in the adhesive-layer formation surface 3, whereby the workpiece 2 is electrostatically flocked. On the other hand, the short fibers 4 flying toward the elongated elements 5 fail to have their front end portions stuck in the elongated elements 5 since the elongated elements 5 are not coated with any adhesive layers.

As shown in Fig. 2, in the present invention: since the electrically grounded elongated elements 5 are disposed adjacent to and parallel to the opposite longitudinal side areas of the workpiece 2, the electric lines of force appearing in the electrostatic field created between the electrode 1 and the adhesive-layer formation surface 3 of the grounded workpiece 2 substantially uniformly extend also to the opposite longitudinal side areas adjacent to each of the longitudinal corner edge portions of the workpiece 2, without concentrating only in the longitudinal corner edge portions of the workpiece 2.

In other words, the electrically grounded elongated elements 5, which is disposed adjacent to and parallel to the opposite longitudinal side areas of the workpiece 2, function to prevent the electric lines of force from concentrating in the longitudinal corner edge portions of the workpiece 2.

Due to the above effect of the elongated elements 5, it is also possible to prevent the short fibers 4 (which are electrically charged to float) to concentrate in the longitudinal corner edge portions of the workpiece 2.

As a result, it is possible to prevent the longitudinal corner edge portions of the workpiece 2 from being excessively flocked, and therefore also possible to prevent the opposite longitudinal

side areas adjacent to each of the longitudinal corner edge portions of the workpiece 2 from being poorly flocked.

Although the workpiece to be electrostatically flocked has been described in the above with reference to the example,
5 substantially the same phenomenon that is observed in the above may be observed also in the electrostatic coating operation, provided that the electrostatic coating operation is different from the electrostatic flocking operation in that: the workpiece used in the electrostatic coating operation is not covered with the adhesive
10 layer; and, the fine objects to be applied to the workpiece are coating materials in the electrostatic coating operation.

Further, the present invention is applicable not only to the up-type electrostatic flocking chamber, but also to a down-type electrostatic flocking chamber, a side-type electrostatic flocking
15 chamber, and the like.

The effect of the present invention is as follows: namely

As described above, according to the present invention, it is possible to uniformly flock the workpiece through the electrostatic flocking operation by the provision of the
20 electrically grounded elongated elements disposed adjacent to the opposite longitudinal side areas of the workpiece, wherein the workpiece is oppositely disposed from the electrode.

Finally, the present application claims the Convention Priority based on Japanese Patent Application No. Hei 11-228367
25 filed on August 12, 1999, which is herein incorporated by reference.



What is claimed is:

1. In an electrostatic processing chamber for forming an electrostatic flocking apparatus to perform an electrostatic flocking operation, wherein a strip-like elongated flat plate serving as a workpiece coated with an adhesive layer and electrically grounded is oppositely disposed from an electrode and transferred in a condition in which short fibers having been electrically charged are electrostatically implanted in said flat plate, the improvement wherein:

electrically grounded elongated elements are disposed in opposite longitudinal side areas of said flat plate to extend in parallel with a longitudinal direction of said flat plate in a passage of said strip-line elongated flat plate being flocked.

2. In an electrostatic processing chamber for forming an electrostatic coating apparatus to perform an electrostatic coating operation, wherein a strip-like elongated flat plate serving as a workpiece electrically grounded is oppositely disposed from an electrode and transferred in a condition in which said workpiece is subjected to an electrostatic coating operation, the improvement wherein:

electrically grounded elongated elements are disposed in opposite longitudinal side areas of said workpiece to extend in parallel with a longitudinal direction of said flat workpiece in a passage of said strip-like elongated flat plate being coated.