Sept. 8, 1959 J. P. DONAHUE 2,903,376

METHOD AND APPARATUS FOR THE PRODUCTION OF FLOCK-COATED SHEET MATERIAL

Filed Nov. 5, 1956

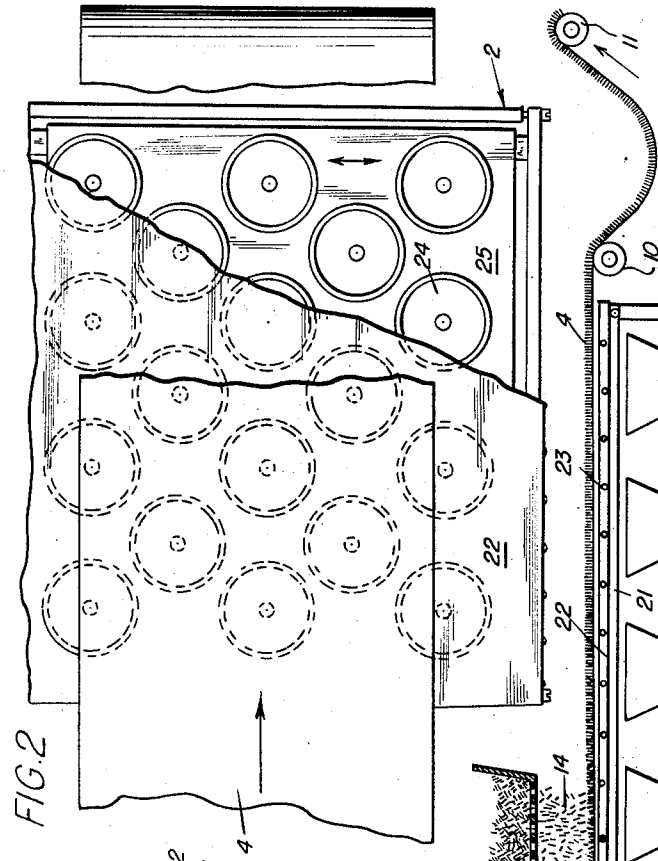

FIG. 2

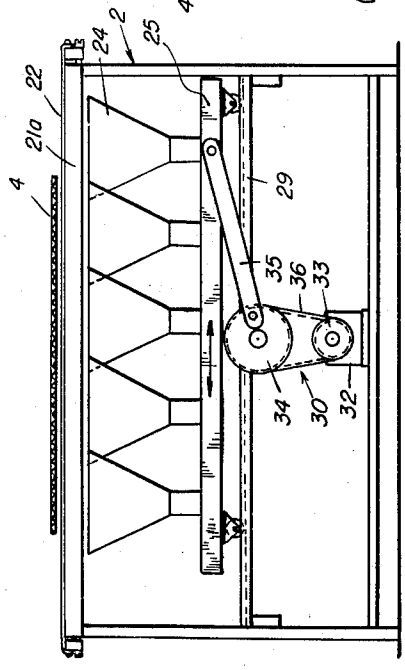

FIG. 3

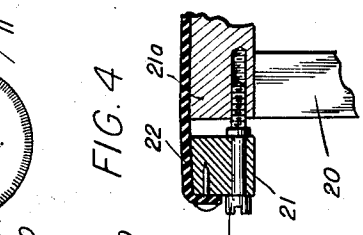

FIG. 4

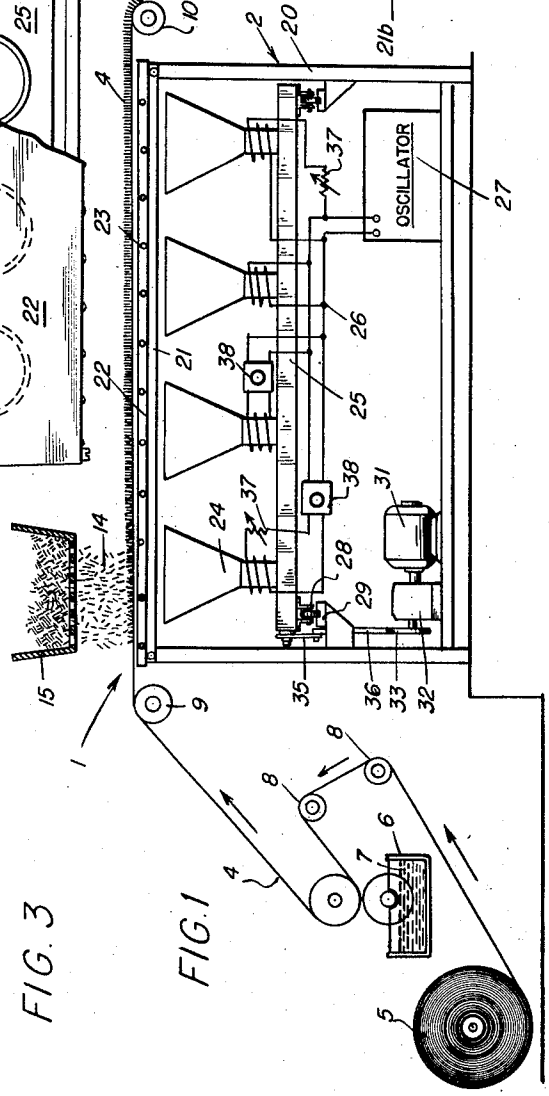

FIG. 1

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United States Patent Office 2,903,376 Patented Sept. 8, 1959

2,903,376

METHOD AND APPARATUS FOR THE PRODUCTION OF FLOCK-COATED SHEET MATERIAL

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Application November 5, 1956, Serial No. 620,247

5 Claims. (Cl. 117—20)

The present invention relates to the production of pile-surfaced or coated materials and more particularly relates to apparatus for and methods of coating sheet material with flock, tinsel or other particles using sonic or super-sonic compression-waves to vibrate the sheet material and the particles applied thereto during the coating process.

Pile surfaced, flocked, or other particle-coated materials are at present commonly manufactured by first coating the surface of the base material with an adhesive or by printing particle retaining designs thereon and by thereafter applying flock or other particles to the base material while vibrating the base material with mechanical beaters. The use of these beaters is effective in embedding flock fibers or other particles firmly in the adhesive or printed coating with a generally upstanding pattern with respect to the base material. However, the operation of the beaters to vibrate the material is accompanied by objectionable frictional contact between the beaters and the base material which causes wear and strain on the base material. The mechanical beating also requires a relatively large amount of power and is accompanied by an objectionable over-all vibration of the coating apparatus.

The present invention reduces these objectionable effects by accomplishing the vibration of the adhesively coated flexible material or web by a compression-wave generator, such as a sonic or super-sonic wave generator.

Accordingly, an object of the present invention is to provide an improved method and means for forming pile-surfaced materials or materials coated with abrasive particles or other relatively minute particles.

Another object of the present invention is to provide a method and means for vibrating the base material in the manufacture of flocked or coated goods in which the mechanical beaters are eliminated.

Another object of the present invention is to provide a method and means of flocking or coating in which the noise level and over-all vibration of the apparatus are reduced to a minimum.

Anoter object of the present invention is to provide a method and means of producing the pile-surfaced or coated materials which is easily controlled and which is adjustable for varying types of particles and base material.

Another object of the present invention is to provide a method of flocking using sonic and super-sonic waves.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

Fig. 1 is a diagrammatic side elevational view of the apparatus embodying the principles of the invention;

Fig. 2 is a top plan view partially cut away showing the apparatus of Fig. 1;

Fig. 3 is an end elevational view partially cut away of the apparatus of Fig. 1; and

Fig. 4 is an enlarged fragmentary sectional view of the upper portion of the vibrator mechanism showing the attachment of the flexible diaphragm at the edge of the vibrator frame and the diaphragm tension adjustor.

The method and apparatus will first be described in general with particular reference to Fig. 1. Fig. 1 illustrates a preferred embodiment of the flocking apparatus 1 comprising a vibrating means 2 above which the flexible sheet material 4 is moved between a supply roller 5 and a drying or other web handling means (not shown). The base sheet material 4 is carried over the vibrator means 2 from the supply roller 5 on suitable rollers 8, 9, 10, and 11, and it has an adhesive coating applied to its upper surface by an adhesive applicator 6 containing a supply of suitable adhesive 7. Any of the well-known adhesive applicators or base material printing means or stencils may be used in place of the applicator 6 illustrated in Fig. 1. One or more of the rollers 8, 9, 10, and 11 may be driven by a suitable drive mechanism so that the sheet material 4 is moved continuously from the supply roller 5 through the ahesive applicator 6, and above the upper surface of the vibrating means 2. Flock fibers 14 are applied to the adhesively coated surface of the web 4 as it reaches vibrating means 2 from a suitable flock hopper indicated at 15. Any of the commonly used flock or particle applying means may be used to supply an even and controlled amount of flock 14 to the adhesive 7 on the web surface.

As the web 4 passes above the top of the vibrating means 2, the vibrating means imparts a generally vertical vibratory motion to it, as will be more fully described below in connection with a more detailed description of the vibrating means 2. This vibratory motion of the web 4 causes the flocked fibers 14 to be implanted in the adhesive 7. By the time web 4 has reached the right-hand end of vibrating means 2, it has a uniformly coated surface of planted fibers or other particles 14. The coated material 4 is thereafter carried by suitable rollers, such as rollers 10 and 11, from the vibrating means 2 to a suitable storage or drying means (not shown) where the drying of the adhesive or printed coating 7 locks the implanted fibers or particles 14 in position.

A preferred embodiment of the vibrating apparatus is shown in Figs. 1 through 3. A plurality of compression-wave generators 24 are mounted in spaced relationship in a vibrator frame 20. The generators 24 may be suitable loud speakers such as electromagnetic or electrodynamic speakers or other electrically driven vibrators of the well-known types. It is preferred to use generators which have a relatively broad frequency response, so that they may be driven by a suitable variable frequency electric-wave generator or oscillator 27 at different frequencies for different materials and operating conditions to maintain the maximum operating efficiency.

As seen in Fig. 1, a plurality of generators 24 may be wired in parallel by wiring 26 to a suitable oscillator 27. Control of the output amplitude of the compression-wave generators may be obtained by controlling the output level of the oscillator 27, or individual volume controls such as are indicated at 37 may be inserted in the individual lead lines to the generators 24 so that the vibratory pattern over the surface of the vibrating means 2 may be controlled as desired by the adjustment of the output of each of the individual generators 24.

Such a volume control may consist of a variable resistor which is adjustable between a suitable high value and zero. Additional control of the vibratory pattern over the surface of the vibrating means **2** may be obtained by inserting a conventional phase control device into one or more of the individual speaker lead lines such as are indicated at **38** in Fig. 1. Such a phase control may be made adjustable for phase shifts between zero and a suitable maximum.

As illustrated in Fig. 1, the preferred location for the web **4** is above the upper surface of the vibrating means **2**. The upper surface of the frame **20** of the vibrating means **2** is also preferably covered with a flexible diaphragm member **22** such as a sheet of rubber or other flexible material. The diaphragm **22** is tacked or otherwise fastened to the outer edges **21** of the frame **20**. The flexible diaphragm **22** has a resonant frequency at which it will give the maximum vibratory response when the generators **24** are operated at that frequency. The vibrator means **2** is operated most efficiently at or near this resonant frequency. The resonant frequency of the flexible diaphragm **22** is made adjustable by providing an adjustable tensioning means therefor. As seen in Fig. 4, the side pieces **21** of frame **20** are connected to end pieces **21***a* by a rotatable screw fastener **21***b* so that rotation of screw fastener **21***b* varies the spacing between side pieces **21** to change the tension of flexible diaphragm **22**. The web **4** in the preferred embodiment is spaced about half an inch from the diaphragm **22**. An air cushion is therefore provided between the web **4** and the diaphragm **22**. The compression-waves from the generators **24** vibrate the web **4** through the intermediation of the vibratory motion of the diaphragm **22** and the air cushion existing between diaphragm **22** and web **4**.

In order to provide for an even distribution of the flocked fibers **14** on the adhesively coated surface of the web **4**, it has been found advantageous to oscillate the compression-wave generators **24** laterally of the direction of the web motion.

As seen in Fig. 3, the generators **24** are mounted on a movable generator mounting panel **25** which has rollers **28** on its lower surface which run in tracks **29**. A continuous oscillating or reciprocating motion is imparted to the generator mounting panel **25** by a drive system **30**. Drive system **30** comprises a drive motor **31** coupled to an adjustable speed reducer **32**. Speed reducer **32** drives a crank member **35** through the intermediation of pulleys **33** and **34** and drive belt **36**. Crank **35** is pivotally connected at one end to pulley **34** and at its other end to the generator mounting panel **25** so that rotation of the pulley **34** causes generator mounting panel **25** to oscillate on tracks **29** transversely of the path of the web **4**.

The operation of the preferred embodiment of the present invention, which has been disclosed in detail in connection with the above description, may be summarized as follows. The flexible base material or web **4** is fed from the roller **5** over rollers **8**, through the adhesive applicator **6**, and above the upper surface of the vibrating means **2** on rollers **9**, **10**, and **11**. Suitable drive means connected to one or more of the rollers **8**, **9**, **10**, and **11** moves the web **4** continuously along this path. The flock applicator **15** which is filled with flocked fibers **14** applies an even coat of the flock fibers **14** to the adhesively coated surface of web **4**. Oscillator **27** is energized when the adhesively coated web starts to move over vibrator means **2** so that the generators **24** vibrate the web **4** through the intermediation of the flexible diaphragm **22** and the air cushion between the diaphragm **22** and the web **4**. Drive motor **31** is simultaneously energized so that the drive system **30** oscillates the generators **24** transversely of the moving web to provide for an even distribution of the flock fibers **14**. As the web **4** with its coating of adhesive **7** and the flocked fibers **14** superimposed thereon moves above type of motion which is imparted to each of the flocked fibers causes one end of each fiber to be implanted in the adhesive **7** so that the fibers orient themselves in a generally uniform vertically oriented pattern, such as is seen at the right-hand side of Fig. 4, before the web **4** reaches the right-hand end of the vibrating means **2**. Thereafter, the flocked or pile surface of the web is carried by rollers **10** and **11** to suitable storage and drying means where the adhesive **7** dries to hold the flocked fibers **14** in position. Suitable adjustments of vibration amplitude and phasing are made by means of the oscillator output controls and the volume phasing controls **37** and **38**, respectively, to obtain an even and dense distribution of the flocked fibers **14**.

While the above disclosure describes and illustrates the flocking operation in connection with compression-wave generators of the loud-speaker type, operated at sonic or super-sonic frequencies, it is clear that other forms of pressure-wave generators may be used to produce sonic or super-sonic pressure or compression waves adjacent to the diaphragm **22**. The waves generated by the generators **24** in the air surrounding the diaphragm **22**, web **4**, and flock **14** are progressive longitudinal vibratory disturbances comprising condensations and rarefactions of the air. These are commonly referred to as sound waves where they are generated at sonic frequencies. In the present disclosure and claims these types of waves at both sonic and supersonic frequencies are termed compression waves and the generators are termed compression wave generators, for convenience.

Although fiber planting can be accomplished with the web **4** contacting the diaphragm **22**, greatly improved results in operating efficiences result when the web **4** is spaced slightly from the diaphragm **22** as described above.

It will be seen that the present invention provides an improved method of vibrating the base material in a pile surface coating operation. The method and device disclosed reduce wear and over-all vibration of the flocking apparatus and in addition provide an efficient vibratory system which is more flexible in use and more easily controlled and adjusted than the conventional mechanical types.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. In the manufacture of flock-coated sheet material, the improved method which comprises applying an adhesive coating to a surface of the sheet material, moving the sheet material past a generally horizontal flat flexible diaphragm along a path parallel to and slightly spaced therefrom, applying elongated flock particles to the adhesive coating, and generating compression waves adjacent to and directed toward the diaphragm and moving in a direction generally perpendicular thereto whereby the diaphragm and the sheet material are vibrated by the compression waves in a direction perpendicular to the plane of the diaphragm and the sheet material and the elongated flock fibers are implanted in the adhesive and are oriented generally vertically of the sheet material.

2. The method as claimed in claim 1 which further comprises moving the source of the compression waves transversely of the direction of motion of the sheet material to equalize the amplitude of the vibrations transversely across the sheet material.

3. A device for flock printing sheet material which comprises means to continuously coat the sheet material with a layer of adhesive, means to apply flock to the coated surface of the sheet material, means to continuously move the adhesively coated sheet material as a relatively flat sheet along a generally horizontal path be-

the vibrating means 2, the generally vertical vibratory neath the flock applying means whereby the flock engages and adheres to the adhesive, a flat flexible diaphragm beneath said sheet material and generally parallel thereto and slightly spaced therefrom, means adjacent said diaphragm to generate compression waves directed toward said diaphragm and traveling in a direction generally perpendicular to the plane of the sheet whereby the adhesively coated textile is vibrated to embed the flock in the adhesive.

4. The device as claimed in claim 3 which further comprises a movable mounting for said means to generate compression waves and a drive means operatively connected thereto and adapted to move said means to generate compression waves transversely of the moving sheet material.

5. The device as claimed in claim 3 in which said means to generate compression waves comprises a plurality of compression wave generators at least one of which includes a phase control adapted to adjust its phase with respect to another wave generator.

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CERTIFICATE OF CORRECTION

Patent No. 2,903,376 September 8, 1959

John P. Donahue

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 5, line 1, strike out "the vibrating means 2, the generally vertical vibratory" and insert the same between lines 1 and 2, in column 4.

Signed and sealed this 22nd day of March 1960.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents