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P. H. LANG ET AL

2,521,985

PROCESS OF MAKING FIBROUS UNITS

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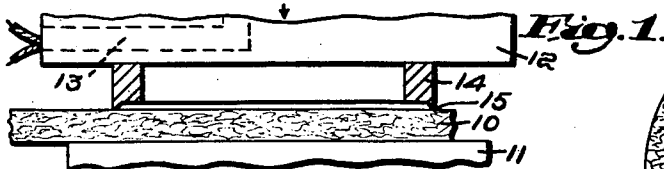


Fig. 2.

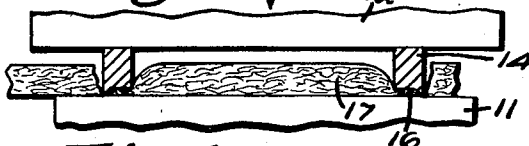


Fig. 4.

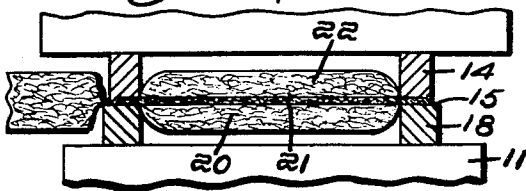


Fig. 7.

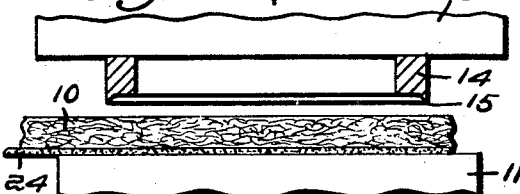


Fig. 8.

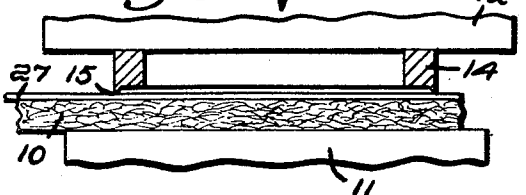


Fig. 13.

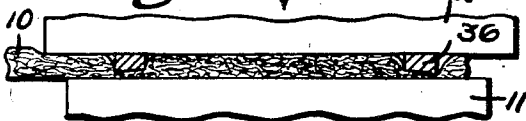


Fig. 14.

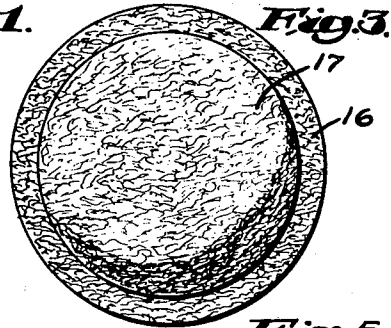
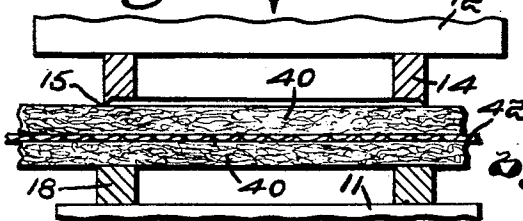


Fig. 5.

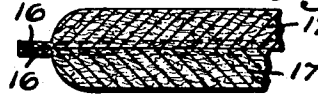


Fig. 6.



Fig. 9.



Fig. 10.



Fig. 11.

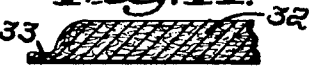
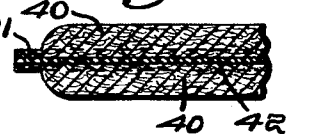


Fig. 12.



Fig. 15.



Inventors:

William H. Lehberg,
Charles M. Foggett &
Philip H. Lang.

by Henry, Jones, Witten & Hildreth,
Attorneys

UNITED STATES PATENT OFFICE

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PROCESS OF MAKING FIBROUS UNITS

Philip H. Lang, Summit, N. J., William H. Lehmburg, Riverside, and Charles M. Foggett, Greenwich, Conn., assignors to American Felt Company, Boston, Mass., a corporation of Massachusetts

Application September 16, 1948, Serial No. 49,624

1 Claim. (Cl. 154—101)

This invention comprises a new and improved process of making fibrous units, a process which may be carried out, if desired, by automatic machinery at a rapid rate and at low cost. Such units are the subject matter of copending application Serial No. 748,983, filed May 19, 1947.

It has been discovered that a relatively thick batt of mixed fibres such as are commonly used in the production of felt, loosely associated but not completely fully or hardened, is highly effective as a filter of aerosols and for other uses. We have been successful in solving the problem of incorporating such a loose batt into a self-sustaining unit in which the construction of the loose batt is preserved while the unit as a whole may be conveniently stored, distributed and assembled in its operative position.

One important field of use for such filter units is in vacuum cleaners, and for purposes of illustration the invention will be described in that connection, although being in no sense limited thereto.

Going more into detail, the fibrous unit of preferred construction comprises a homogeneous body containing intermingled, fusible and non-fusible fibres, the said fibres being compacted and unified by heat and pressure so that they form a thin peripheral rim which is resilient and retains its shape permanently, while the enclosed fibres remain as a fluffy, relatively thick batt surrounded by the said rim. In the construction described it will be seen that many of the individual fibres, both fusible and non-fusible, extend from the loose batt into the relatively hard compact rim, and thus the soft, thick, center portion of the unit is permanently united and anchored to the rim by which it is supported and sustained.

The production of our fibrous unit is characterized by subjecting an annular zone of the batt to pressure between two flat surfaces compressing said zone of the batt and forming it into a relatively thin flat rim and to a bonding treatment to permanently maintain the rim, and then severing the portion of the batt disposed exteriorly of the rim. Thus the unit is produced rapidly and at practically a single operation by merely presenting the loose batt in sheet form to forming and severing dies of the proper shape.

These and other features of the invention will be best understood and appreciated from the following description of several preferred embodiments thereof, selected for purposes of illustration and shown in the accompanying drawings in which:

Figs. 1 and 2 are views in elevation, partly in

section, showing a batt being operated upon by a ring shaped die,

Fig. 3 is a plan view of a completed filter unit made by the process,

Fig. 4 is a view, similar to Fig. 2, showing cooperative ring dies operating to form a double-faced filter unit,

Fig. 5 is a fragmentary view in cross-section of a multi-ply filter unit,

Fig. 6 is a like view of the unit shown in Fig. 4,

Fig. 7 is a view, similar to Fig. 1, showing a batt with an underlying ply of felt in operative position beneath a ring die,

Fig. 8 is a similar view showing a batt with an interposed ply of fabric or paper in operative position beneath the ring die,

Figs. 9, 10, 11 and 12 are fragmentary views in cross-section showing fibrous units of different ply constructions,

Fig. 13 is a view, similar to Fig. 2, showing a platen with a shallow ring die adapted slightly to compress the body portion of the unit,

Fig. 14 is a view similar to Fig. 2 but showing an inner reinforcing fabric ply incorporated within the unit, and

Fig. 15 is a fragmentary sectional view of the fibrous unit constructed in Fig. 14.

The composition of the batt offers a wide range of choice. If the unit is designed for use as a filter in a vacuum cleaner, the batt may be formed by picking and blending approximately 80% India cotton with 20% thermoplastic cellulose acetate fibres, carding the blended fibres into a batt in a manner similar to that practiced in the manufacture of felt, but carrying the batt only through the carding stage and leaving it in a soft, fluffy, loosely compacted condition approximately $\frac{1}{2}$ inch in overall thickness. In Fig. 1 such a batt 10 is shown as supported upon the platen 11 of a press. Vertically movable above the platen 11 is a plunger or top platen 12 provided with a heating unit 13 and carrying a ring die 14 having a flat shouldered end face surrounded by a projecting circumferential cutting flange 15. The filter unit is formed from the batt 10 in a single stroke of the upper platen 12 with the ring die 14. As these elements are forced downwardly, the batt 10 is compacted and compressed in an annular rim 16, and by the action of heat and pressure the thermoplastic fibres caught beneath the flat end face of the ring die and the flat face of the platen are fused and made to coalesce, thereby unifying all the fibres in this zone into a thin, relatively hard, resilient rim 16 of substantial width, for example, one-eighth or one quarter inch. The body 17 of fibres

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disposed within this rim 16 remains substantially unaffected and constitutes a relatively soft, fluffy center portion adapted to perform the filtering operation of the unit, although the outer ends of some of the fibres are caught and solidified in the flat marginal run of the unit.

The single ring die shown in Figs. 1 and 2 produces a filter flat on the face engaged by the platen 11 and somewhat convex or dome shaped at its other face. As shown in Fig. 11 the dome shaped portion 32 merges into a thin flat rim 33. In Fig. 4 I have illustrated a double ring die adapted to produce a filter dome shaped at both faces. This die is like that shown in Figs. 1 and 2 except that a ring 18 is mounted on the platen 11 opposite to the ring 14. The opposite inner portions 20 and 22 of the batt are uncompressed and form the two domes of the filter within the flat compressed rim 21 of substantial width, as shown in Fig. 6. A double dome filter of this nature can also be made by cementing together at their rims 16 two filters 17 as illustrated in Fig. 5.

In Fig. 7 we have illustrated the making of the filter shown in Fig. 9 and comprising a fabric base 24 of felt or the like bonded to the filter body 26 at the marginal rim 25. The batt 10 and fabric 24 are placed on the platen 11 and the filter is formed by one stroke of the top platen 12 in the manner illustrated in Fig. 2. The fabric can also in like manner be applied to the top face of the filter if desired and the filter body 29 will in that case be entirely enclosed within bottom and top fabric covers 28 and 30 as illustrated in Fig. 10. The fabric 24 is bonded to the rim 25 of the body 26 by any suitable method such as incorporating a bonding fibre or element into the fabric or applying an adhesive or the like thereto.

We have found that the filter can be produced with a less abrupt break between the fused edge and the dome shaped portion by employing a suitable separator of fabric or paper between the die and the batt in the forming operation, and in Fig. 8 we have illustrated such a separator 27 so disposed. When the die descends the separator acts as a surface cushion between the die and batt and produces the product shown in Fig. 10 which comprises a dome 29 merging more gently into the fused edge 31. It will be understood that the separator will be of a composition treated to cooperate with but not adhere to the product.

The body portion of the filter thus far described is loose, fluffy and wholly uncompressed and is adapted to function with high porosity and permeability. It may be desirable in some cases to produce a filter or the like of more compact composition and having decreased porosity and permeability, as the filter illustrated in Fig. 12. In Fig. 13 we have illustrated the formation of such a filter by employing a relatively shallow ring die 36. When the die descends the batt 10 within the annular zone of the die is engaged by the top platen 12 and slightly compressed simultaneously with the compressing of the batt at said zone. The resulting product is a filter having a somewhat compressed dome with a flat top surface 34 merging into the fused edge 35.

It will be apparent that the blend of fibres employed will depend upon the function desired of the product and that the shape of the product can be varied to meet requirements. The composition of the batt can be wool, rayon, ramie, silk and other natural or artificial fibres either alone or in combination with each other, and in

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the preferred form of the invention 5% or more of a suitable thermoplastic fibre is added to effect fusing under heat to form the retaining rim 16. For example, the forming of a filter suitable to be employed for vacuum cleaner use will utilize a batt constructed by blending 80% of India cotton with 20% of thermoplastic cellulose acetate fibres as heretofore described. The filters will be formed from the batt merely by the dieing operation herein illustrated and described.

The filters shown in Figs. 9 and 10, having one or more cover layers of felt, flannel or the like at one or both faces, are employed under conditions where it is necessary to provide a filter having an open and porous batt-like face with a reinforcing secondary filter to strengthen the unit and screen out the fine particles which are not trapped by the primary filter.

The weight and thickness of the batt before pressing can be varied to obtain a soft or hard fused edge, a thick or thin product, or one of different density, porosity, and permeability. The porosity, permeability and shape of the product can also be varied by somewhat compressing the inner filter portion as illustrated in Fig. 13. The filter as thus formed has increased dust retention efficiency and decreased porosity and permeability.

In Fig. 1 it is suggested that the platen 12 be heated by an electrical heating unit 13 and such construction is satisfactory. Alternatively one or both platens may be steam heated and under those circumstances a convenient cycle has been found to be a thirty second cycle including five seconds for pressing and cutting at 300° F. and twenty-five seconds for opening and closing. The design of the lower pressing plate is such that the fused edge portion is elevated above the plate so that the unused portion of the batt is not pressed and may be recarded thus reducing waste to a minimum. Further, instead of using an integral pressing and cutting die as shown in Figs. 1 and 2 a steel ribbon die may be secured to the circumference of the ring-pressing portion of the die.

It has been found desirable in some instances to include in the filter or fibrous unit an inner reinforcing ply of metal or plastic screening, fabric, felt, paper, netting and similar materials either alone or in combination with similar reinforcing or porosity modifying elements on one or both surfaces. The construction of a unit of this nature is illustrated in Fig. 14 wherein two carded batts 40 are run into the press simultaneously with a reinforcing fabric 42 between them and the three elements pressed and bonded into a single unit.

While we have herein more specifically illustrated and described the production of filter units employing a minor percentage of thermoplastic fibres adapted to heat seal the marginal portion of the product at 16 to produce a flat stiff retaining rim of substantial width, it will be understood that the invention is applicable to the production of other fibrous units as, for example, air conditioning filters, oil filters, auto filters, powder puffs, cosmetic pads, garment pads, surgical pads, hat bands, etc. with or without the thermoplastic fibres. The subjecting of an annular zone of the batt to pressure between two plane surfaces forms the marginal rim of the product in a single plane and effects the bonding of the fibres in the compressed zone to form permanently the retaining rim, and the severing of the outside portion of the batt from the rim completes the self-contained

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unit. When no thermoplastic fibres are employed the bonding will be effected by suitable adhesives applied to the zone to be compressed prior to the dieing out operation, or by suitable other methods such, for example, as the employment of resin treated natural fibres in the batt or adhesive and resin impregnated carded batts, and the use of solvents in combination with any of the foregoing, as well as in combination with synthetic thermoplastic fibres.

We desire it to be understood that the invention includes the formation of filters or other fibrous units composed of any desired mixture of fibres which, after blending and carding, are partially hardened and/or felted before final bonding or fusing, or the fibres can be left wholly loose within the retaining rim as heretofore described, all of which will depend upon the character and function of the product it is desired to produce.

Furthermore, while we have illustrated and particularly described fibrous units provided with marginal retaining rims, it is to be understood that the process is applicable to the formation of fibrous units with retaining bands or zones formed in any location or arrangement on the batt. The process may be employed to fabricate partially fused articles square, rectangular, oval or odd shaped in outer contour, with an unfused inner area or an inner area partially fused to form a waffle configuration or the area may be striped with radially fused lines or stripes running to the outer margin.

Having thus disclosed our invention what we claim as new and desire to secure by Letters Patent is:

The process of making a fibrous unit which consists in carding cotton and thermoplastic cel-

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lulose acetate fibres into a relatively thick and fluffy batt of substantially uniform thickness with the fibres intermingled homogeneously throughout the body of the batt, partially felting the batt, laminating a pair of batts thus formed with an inner reinforcing fabricated ply therebetween, subjecting an annular zone of the laminated structure to heat and pressure between two flat annular surfaces, compressing said zone of the batt and forming it into a relatively thin flat and compact retaining rim lying in a single plane, bonding the fibres and fabricated ply in said compressed zone to permanently maintain said retaining rim, and severing from the flat rim the portion of the structure disposed exteriorly of the rim.

PHILIP H. LANG.
WILLIAM H. LEHMBERG.
CHARLES M. FOGGETT.

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