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H. H. ROOT ET AL  
COMB FOUNDATION  
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2,331,231



FIG-1

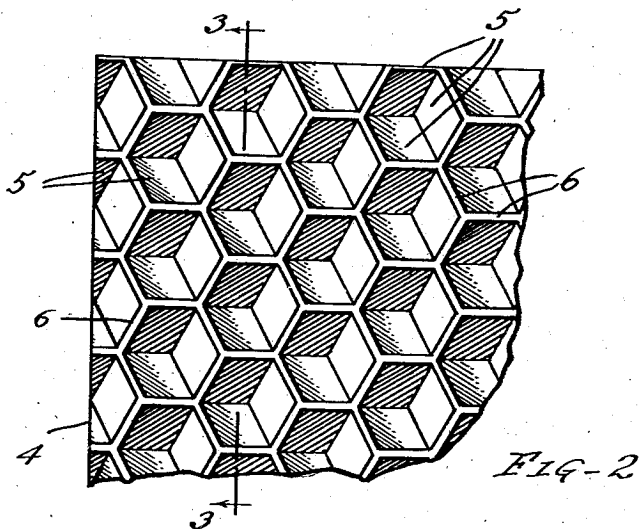


FIG-2

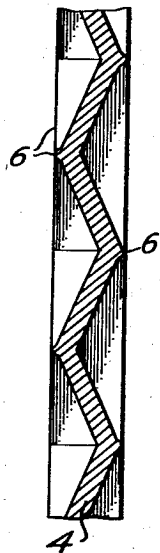


FIG-3

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## COMB FOUNDATION

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9 Claims. (Cl. 6—11)

The present invention constitutes an improvement in comb foundation for use in beehives. This indicates the general object.

Comb foundation, in order to serve most advantageously its intended purpose, must have somewhat more resistance to stretching and sagging than does natural beeswax as provided by the bees, must have at least the ductility of beeswax, and must be readily accepted by the bees as a base on which to build brood cells. Several ways of reinforcing beeswax in the making of comb foundation have been proposed or used. One of these is sufficiently close to the present invention to merit detailed discussion here, namely the blending with beeswax of a natural vegetable wax which is harder than beeswax and the use of the blend in sheet form as a center ply in a laminated product known as three-ply foundation. This is disclosed and claimed in United States Patent No. 1,583,605, issued to H. H. Root May 4, 1926. The vegetable wax which, prior to the instant invention was found most satisfactory as a hardener for such center ply is carnauba, but use of that wax in substantial proportions with beeswax reduces the ductility of the latter, hence workability by the bees. Consequently wherever the bees, in working the foundation, encounter center ply material including a substantial part of carnauba wax they waste a great deal of time in gnawing and trying to remove from the foundation the part which they find less ductile than the material, namely, beeswax, which they are accustomed to working. Moreover foundation containing a substantial proportion of carnauba wax, although stronger at normal temperatures than foundation made wholly from beeswax, is more apt to become fractured when handled at low temperatures.

A material for strengthening comb foundation, which material will blend uniformly with beeswax in substantial proportions of the whole, will effectively strengthen the beeswax when blended therewith—that is, will increase its tensile strength without decreasing pliability and ductility of the foundation as compared to foundation made wholly from beeswax—and which in addition, will be accepted readily by the bees has been sought for a long time. A large number of materials will satisfy some of the essential requirements but not all of them. Certain entire classes of materials are unsatisfactory for that reason. Some mineral waxes which will blend with beeswax, might be used except for the fact that certain markets for beeswax will not tolerate beeswax having any proportion of

mineral waxes. Usually however the bees reject waxes made in part from mineral oils because they find such wax lacking in ductility and therefore unsuited to their purpose. Some materials when blended with beeswax result in a composition which feels greasy or oily to the touch. Such materials obviously are unsuitable because the resulting composition lacks adequate tensile strength. Some are sufficiently different from beeswax in specific gravity so that uniform blending with beeswax is impractical, mainly because the blending operation requires constant stirring while the materials are molten. Even when such constant stirring is practiced, said materials may crystallize separately from the beeswax and thus result in an unsuitable product.

We have found that hydrogenated vegetable oil and particularly hydrogenated castor oil fulfills all the requirements stated above for a satisfactory strengthening material, particularly when blended with beeswax and used in the center ply of three-ply foundation. It can also be used for single sheet foundation, although the resulting product is not accepted by the bees as readily as that made of three plies and wherein the outer plies are wholly beeswax.

Hydrogenated castor oil has about the same specific gravity as beeswax and will blend uniformly with beeswax in all proportions. It saponifies about the same as beeswax; has no characteristic odor which is distasteful to the bees; does not reduce the ductility of beeswax when blended therewith in substantial proportions but nevertheless toughens it and increases its resistance to stretching and does not interfere with the welding of the composition to pure beeswax as is necessary in the making of three-ply foundation. Other hydrogenated oils having substantially the same physical properties as hydrogenated castor oil would of course be suitable for our purpose.

Preferably the hydrogenated oil comprises a substantial percentage, but less than half of the composition used for the center ply, the remainder being beeswax. Thus in three-ply foundation in which the sheet stock used for the center ply is about twice as thick as the stock for each outside sheet, and the outside sheets are wholly beeswax, the percentages given would amount to less than one fourth of the entire foundation. The ratio of strengthening wax and beeswax given in said patent to H. H. Root (page 1, lines 98-102 thereof) is satisfactory in respect to using hydrogenated castor oil as the strengthening wax. In other words for

each sheet employing hydrogenated oil such sheet would comprise from about 30 to 50% of hydrogenated oil and the remainder would be beeswax.

In the accompanying drawing, Fig. 1 is a view showing portions of three sheets of wax (greatly enlarged) being formed into a single sheet preparatory to making three-ply foundation thereof; Fig. 2 is an enlarged plan view of a corner portion of a sheet of comb foundation, and Fig. 3 is a sectional view taken as indicated by the line 3—3 on Fig. 2.

In Fig. 1 the sheets 1, 2 and 3 are preferably made by extrusion from a sheeter die into wide ribbon or sheet form and assembled as by pressure rollers into a single sheet 4. The assembling can be done as part of the embossing operation, that is, the necessary pressure accomplished by the embossing dies in a comb foundation mill. Standard or well known practice can be followed in making the foundation. The core sheet 1 contains the strengthening agent, e. g., hydrogenated castor oil, homogeneously mixed with beeswax as indicated above. Sheets 2 and 3 are wholly or substantially wholly beeswax, and these are each preferably about one half as thick as the sheet 1.

The embossed sheet, a fragment of which is shown in Fig. 2, has a uniform pattern of hollow triangular pyramids struck alternately toward opposite sides, the hexagonal areas 5 being partly raised and partly depressed with reference to the median principal plane of the sheet, as is well known. The pyramids may have ribs as at 6, at their hexagonal boundaries, for the purpose of assisting the bees in starting the comb cells. Fig. 3 further illustrates the manner in which the foundation stock 4 is embossed to form the comb foundation. The material for the ribs 6 is formed wholly from that of the sheets 2 and 3, Fig. 1, during the embossing; and, since only the rib formations are usually worked to any extent by the bees, the base surface portions of the cells will remain wholly beeswax; and the cells themselves will be composed of beeswax furnished by the bees. The three layers 1, 2 and 3 retain their original relative position notwithstanding the distortion of the sheets to form the hollow pyramids, and, except at the "starting" ribs 6, the embossed sheet is of the same thickness throughout its entire area. It is somewhat thicker than single sheet foundation, but the sag-preventing strengthening in the completed comb is due, almost entirely, to the use of the hydrogenated oil with the beeswax of the core layer. The bees usually reduce the thickness of the foundation if it is abnormally thick to begin with.

To summarize the advantages derived by the use of hydrogenated oil, particularly hydrogenated castor oil with beeswax in making comb foundation—the new foundation: (a) reduces stretching and sagging of combs in the hives without requiring such foreign material in the foundation as will be objected to by the bees; (b) reduces breakage during transportation of combs and extraction of honey therefrom; (c) reduces likelihood of gnawing of the center ply on part of the bees; (d) enables homogeneous welding together of the individual sheets notwithstanding the use of higher percentages of strengthening material than could be used with

safety heretofore, and (e) overcomes or greatly reduces likelihood of breakage when shipped or handled at low temperatures.

We claim:

1. Comb foundation comprising a mixture of beeswax and a substantial percentage such as 30 to 50% of a hydrogenated vegetable oil which will blend homogeneously with beeswax in all proportions and will increase the tensile strength of the foundation as compared to foundation made wholly from natural beeswax without rendering the foundation materially less ductile than foundation made wholly from natural beeswax.

2. Comb foundation in the form of a worked and compacted sheet of material embossed to form brood cell bases, said sheet comprising a homogeneous blend of beeswax and in the neighborhood of 30 to 50% of hydrogenated vegetable oil having substantially the physical characteristics of hydrogenated castor oil, which blend has materially greater tensile strength than natural beeswax.

3. Comb foundation comprising a plurality of sheets integrally joined together and embossed to form brood cell bases, one sheet consisting of natural beeswax and a substantial percentage such as 30 to 50% of hydrogenated vegetable oil, said sheet having materially greater tensile strength than if made wholly of natural beeswax, another sheet being substantially wholly natural beeswax.

4. Three-ply foundation comprising a core sheet of worked and compacted wax material embossed to form brood cell bases, said sheet consisting of natural beeswax strengthened by admixture therewith of from about 30 up to 50% of hydrogenated vegetable oil having substantially the physical characteristics of hydrogenated castor oil, and surface sheets wholly of natural beeswax substantially integral with the core sheet on its opposite sides.

5. Three-ply comb foundation comprising mainly beeswax, wherein the center ply contains, in addition to the beeswax, only a hydrogenated vegetable oil in sufficiently large proportions—as 30 to 50% to give the resulting blend substantially greater tensile strength than beeswax.

6. Comb foundation consisting of natural beeswax and from about 30% up to 50% of hydrogenated vegetable oil homogeneously blended therewith, which hydrogenated oil increases the tensile strength of said beeswax.

7. Comb foundation comprising natural beeswax reinforced with approximately 30 to 50% of hydrogenated castor oil.

8. Three-ply comb foundation, the center ply of which is a composition consisting of a major portion of beeswax and a minor but substantial portion—as 30% or greater—of hydrogenated castor oil.

9. Comb foundation consisting of a blend of natural beeswax and a hydrogenated oil capable of strengthening the beeswax and in sufficient proportion—as from about 30% up to 50%—materially to strengthen the beeswax, which hydrogenated oil does not render any part of the foundation unacceptable to the bees.

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