May 29, 1951 C. J. SCHROEDER 2,555,250

WAX MIXING DEVICE

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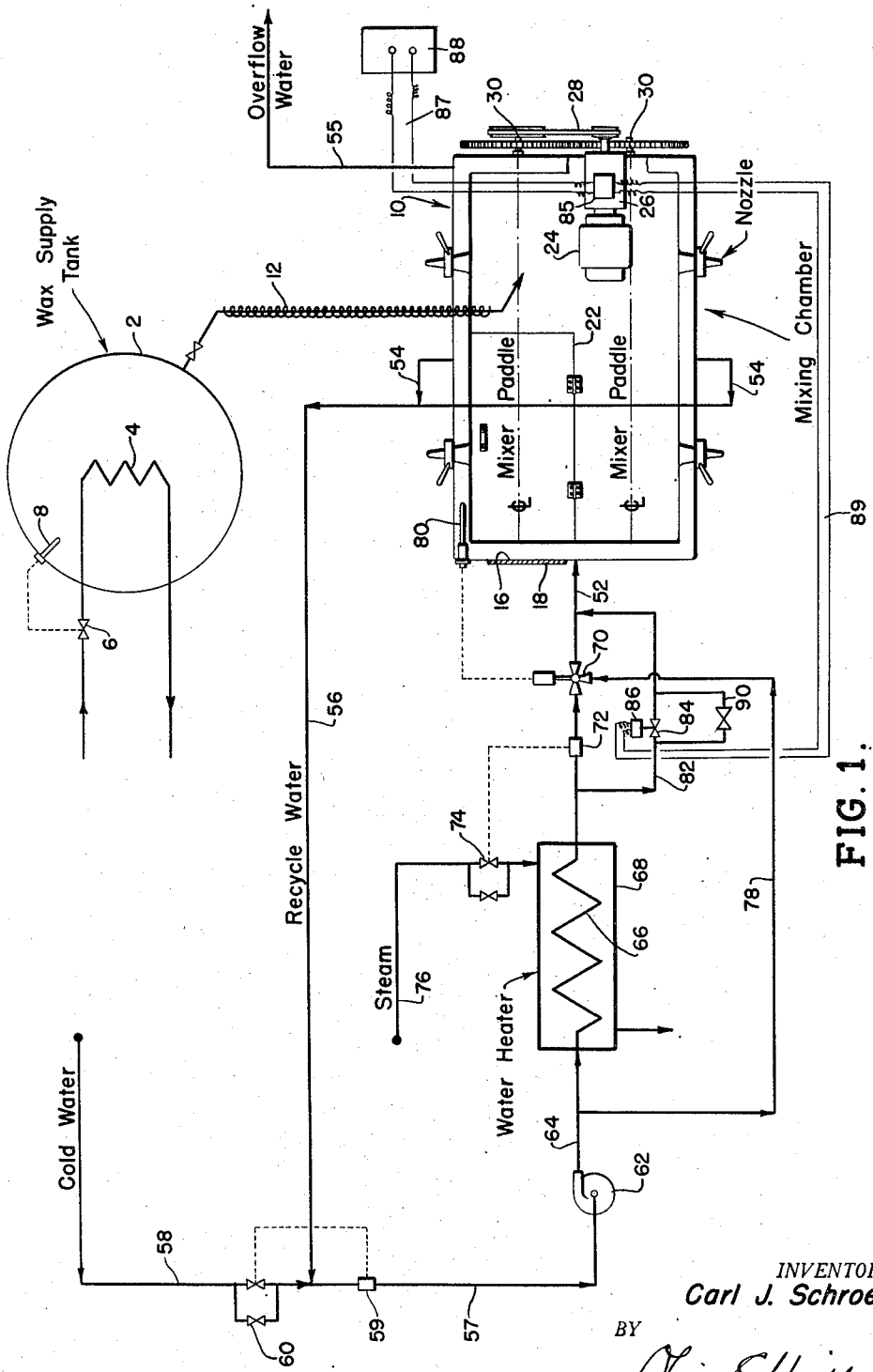


FIG. 1.

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FIG.2.

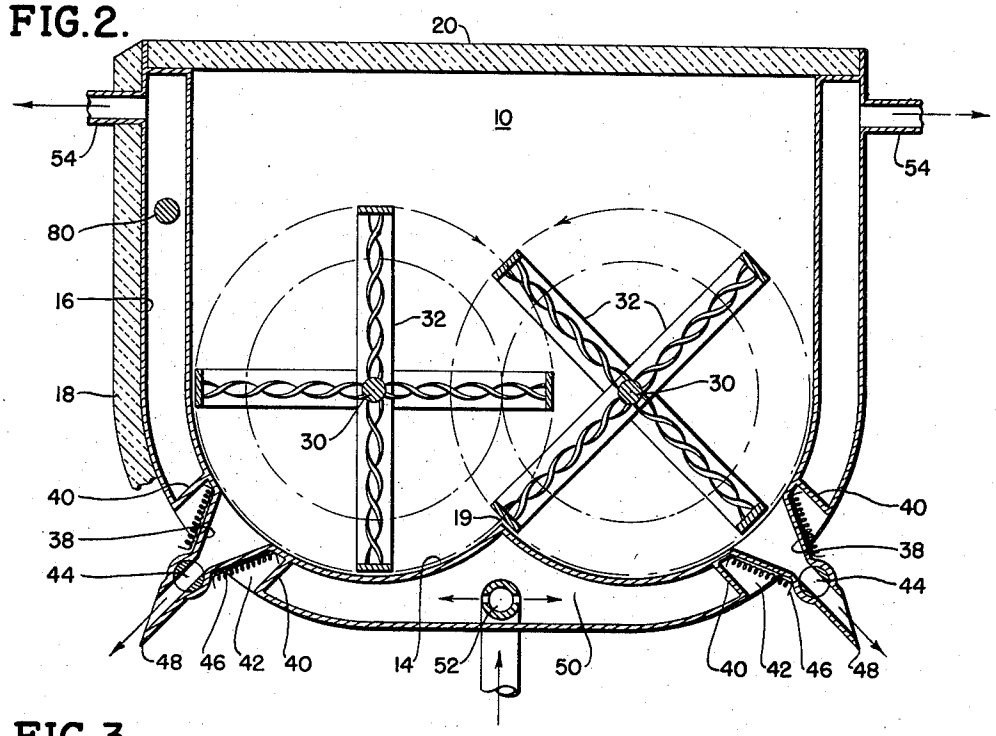
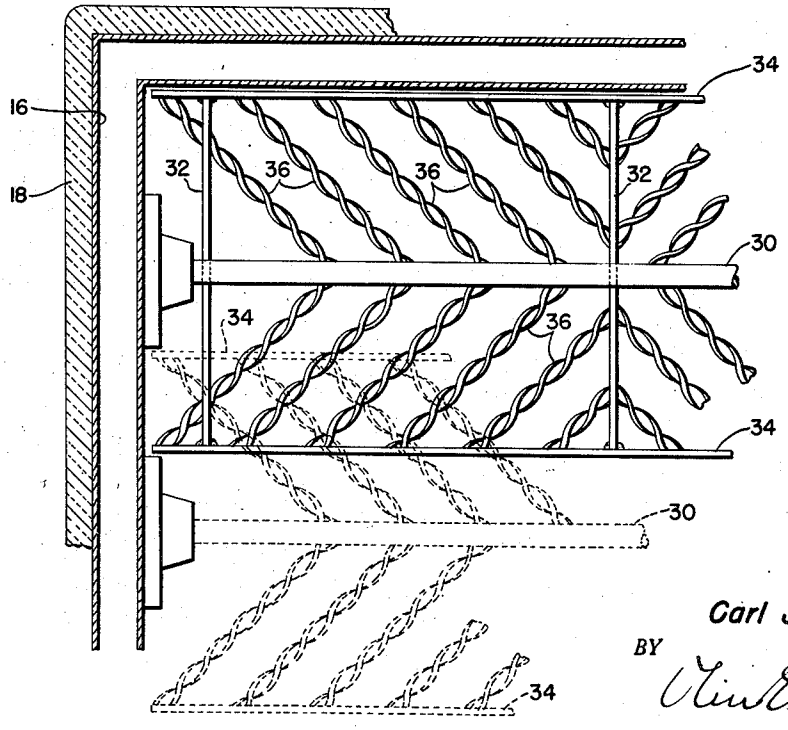


FIG.3.



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Patented May 29, 1951 2,555,250

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2,555,250

WAX MIXING DEVICE

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Application August 25, 1948, Serial No. 46,116

2 Claims. (Cl. 257—4)

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This invention relates to the treatment of wax, especially petroleum wax, and has reference more particularly to an improved means for homogenizing, or foaming air-wax mixtures.

Homogenized wax is a foamy wax body, resembling snow, having a large percentage of air mixed in with the wax when it is hot and trapped therein as the wax cools. The proportion of entrapped air and the texture of the product may be varied throughout a wide range but the range in which the product will flow and still retain small sized air bubbles and proper texture is quite narrow. It is an object of this invention to provide simple method and means whereby a homogenized wax can be prepared and maintained, ready for use, within this narrow range.

A primary use of homogenized wax is that of a filling medium for novelty candles or similar wax figures. Solid wax figures are very slow to solidify, even when formed in elaborate, water cooled metal molds. Shells constituting merely the outer layer can be produced more rapidly and of special qualities specifically adaptable to surface coating candles. Such shells when filled with homogenized wax are cool enough for subsequent handling and decorating much quicker than if solid wax figures were used, are lighter, and considerably reduce the cost of production.

Heretofore, in the production of homogenized wax, a batch of hot liquid wax has been piped into a crude mixer and mechanically agitated. The agitated mixture was watched carefully and when the mix reached a desired consistency it was rushed to the point of use in buckets and quickly poured into candle molds. As aforesaid, the proper temperature range for each selected wax is narrow; at higher temperatures the wax-air emulsion is broken and the entrained bubbles disappear, at lower temperatures the wax-air mix does not flow. An outstanding difficulty arose in the fact that wax-air mixtures at temperatures at which their emulsion is stable, could not be caused to flow through pipes. The aforesaid problem plus storage difficulties has heretofore caused the provision of automatic equipment for homogenizing wax or the elimination of the repeated necessity of remelting homogenized wax batches to be deemed infeasible.

Another object of the present invention is the provision of means whereby homogenized wax can be produced continuously and delivered continuously to its point of use on, for example, a production line.

A further object of the invention is the provision of automatically controlled apparatus for continuously producing homogenized wax.

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The invention has for further objects such other improvements and such other operative advantages or results as may be found to obtain in apparatus hereinafter described.

In accomplishing the above objects, the present invention provides a mixing apparatus having novel arrangement of mixer blades and auxiliary mixer bars disposed in improved relationship to the walls of a jacketed mixing tank and especially to the outlets thereof. The mixing tank for purposes of heat economy and control and cleanness of product is usually covered and ordinarily homogenizing is carried on at atmospheric pressure. The apparatus is adaptable, however, to the use of super-atmospheric pressure and this may, with certain waxes, be desirable in effecting ready discharge of wax-air mixtures from mixing apparatus.

The mixer blades and bars are so designed that they will beat air from above the surface of the wax down into it and therefore the direct introduction of air, or like compressible fluid into the agitated wax is unnecessary. However, it may speed the process of foaming, particularly when initiating the process, to add warm air in such direct manner as will be hereinafter described.

Furthermore, the mixer blades and bars are designed to overcome one of the difficulties encountered in producing homogenized wax by the earlier methods, namely the very slow rate of heat transfer from the surface of the heated vessel from its very low heat conductivity characteristics. The mixer blades and bars cause a uniform distribution of heat throughout the mass of wax. This is effected by a thorough kneading of the mass and a simultaneous sweeping of the wax across the heated vessel interior. This complex movement of the plastic wax gives the heat distribution necessary to maintain a uniform consistency throughout the mass rather than the heterogeneous mass produced by the mixer blades used in the earlier methods.

An additional feature of the present invention is the construction and arrangement of the nozzles through and by which the wax foam is delivered from the jacketed mixing tank. Prolonged investigation indicated that wax foam could not be drained through ordinary apertures or pipes because the air-wax mass would clog at any temperature low enough to still retain its homogenized, foamy characteristic. In the apparatus of the present invention, outlet nozzles are placed near the bottom of the jacketed tank and are arranged to be independently heated so that temperatures higher than that of the me-

dium in the jacket of the mixing tank can be maintained. It was found that the outlet nozzle and contained valve could be heated to a temperature just slightly above that permissible in the air-wax mass and that the wax foam or homogenized wax would then flow freely through the outlet nozzle without substantial impairment of its homogenized quality.

As will be shown to be particularly important in accomplishing the objects of the invention, the apparatus is provided with automatic temperature controls and with improved means for maintaining carefully the heat content of the wax being mixed, both by adjusted preheating of make-up wax and of water to be added to the jacket. The fact that the desired temperature of homogenizing each wax is in the softening range thereof and inasmuch as a sizable latent heat of fusion is involved, it is important that the heat content be carefully controlled and hence the aforesaid means for automatically adjustable preheating are essential to smooth operation of the process. Successful operation relies upon maintaining the heat content of the wax sufficiently high that some of the latent heat of fusion is provided but not high enough to cause the wax to melt entirely. This proper value can be determined within the said range by observation of the viscosity of the wax and fine adjustment of the water temperature of the jacket be made accordingly. This manual adjustment can be readily substituted for by automatic regulation in which variations in the torsion created in the mixing apparatus can be made to control the jacket temperature and in turn maintain the heat content of the mixture within a close range.

In the drawings which are illustrative of a specific embodiment of the invention,

Fig. 1 is a diagrammatic plan view of an arrangement of the mixer apparatus and supply and control means of invention;

Fig. 2 is a diagrammatic lateral elevational view of the air-wax mixer; and

Fig. 3 is a fragmental view of a portion of the mixer apparatus showing elements thereof in different operating positions and demonstrating the overlapping of stirrer apparatus.

The illustrated apparatus is hereinafter described in combination with an example of the preparation of wax foam.

A supply of molten paraffin wax is maintained in a supply tank **2** and is heated by a steam coil **4** having conventional inlet and outlet and an automatic valve **6** controlled by a thermocouple or thermobulb **8** and suitable relay means. Such wax can be any petroleum wax, which term includes a broad class of crystalline hydrocarbon compounds ranging in carbon chain length from C_{18} to about C_{26}. The usual paraffin wax employed in commerce and in the present apparatus ranges in carbon chain length from C_{22} to C_{36} and is relatively brittle, consisting of straight chain hydrocarbons which crystallize in large, thin plates. In this example of operation, the employed paraffin wax was obtained from pressing and sweating a petroleum wax having a melting point of 138° F.

Molten wax is flowed into a wax-mixing tank **10** through an electrically heated supply line **12**. When the said tank has been filled to a proper level and air-wax mixing is in operation, additional make-up wax is flowed through the heated line **12** at a very slow rate only so that the heat balance in the mixer tank **10**, as hereinafter described, will not be disturbed.

The said wax mixing tank **10**, shown in cross section in Fig. 2, may be of various dimensions and outward configuration and is here shown to be rectangular in plan view, of greater length than breadth, and it has a specially designed bottom **14** (cf. Fig. 2) so shaped that all of the wax in the tank will be subjected to a mixing action. The tank **10** is jacketed along the sides, at the ends, and along the bottom thereof for heat control purposes and the jacketed shell **16** is coated with an insulating layer **18**. The tank **10** is covered with an insulated cover **20**, a section **22** of which is hinged so that it can be lifted for inspection of a wax being mixed.

Arranged on the said cover plate **20** is an electric motor **24**, in the present example a three-quarter horsepower motor, and connected therewith is a speed transmission and gear reducer **26**, which is operably connected to a chain drive **28**. The chain drive **28** drives two shafts **30** which are longitudinally disposed in the tank **10**.

Referring now to Fig. 2, the aforesaid tank bottom **14** conforms to the shape of two parallel horizontally disposed and longitudinally intersecting semi-cylinders which thereby form along the said tank bottom two transversely semicircular sections divided by a ridge **19** formed at their intersection. The said longitudinally disposed shafts **30** journaled in each end of the tank **10**, lie along the axes of the semi-cylinders formed at the said tank bottom.

The rotatable mixing means to which shafts **30** provide such rotation comprise radial support members **32** positively fixed to the said axes at their centers and of a length slightly less than the diameter prescribed by a lateral section of the said semi-cylindrical tank bottom section. Paddle blades **34** are attached at the end of the radial members **32** and extend longitudinally parallel to the shafts **30**. The flat outer surfaces of the blades **34** are substantially on a tangent of a circle of slightly less diameter than, and concentric with, the said circle of which the semi-cylindrical bottoms form an arc in transverse section. In the present example, each shaft carries four paddle blades **34** but can be supplied with a greater number where such an application appears desirable. In the present example, a maximum paddle speed of 60 R. P. M. was found suitable for a vigorous mixing action in starting operation but after continuous operating conditions this speed is considerably reduced. The variable speed reducer **26** permits a fine adjustment of this paddle speed so that the influence of this factor on air-wax foam can be carefully controlled. Extending at approximately a 45 degree angle from the shafts and from support members **32** to the underside of the paddle blades **34** are volute mixer arms **36** consisting of helically twisted metal bars. The volute mixer arms **36** of each set, that is, of those which are connected to a single paddle blade, are mutually parallel and substantially equidistant one from the other and so arranged that the rectangular space between the shafts **30** and the paddle blades **34** are substantially uniformly "cross hatched" by the diagonal volute arms **36**.

The parallel shafts **30** and in turn the axes of the semi-cylindrical sections of the bottom **14** are at such distance from one another that the circles described by revolving paddle blades intersect and the paddle blades, support members

and mixer arms of the mixer apparatus supported on each shaft substantially overlap to the extent of about one-half of the radial length of each of the support members, as shown in Fig. 3. Paddle blades **34** and volute arms **36** of one parallel shaft **30** are shown, by dotted lines, in Fig. 3, one-eighth turn or 45° out of phase with the other mixer shaft thus demonstrating the full extent of overlap which occurs. As can be seen in Fig. 2, the mixer apparatus of one shaft, at any given time, is approximately 45 degrees out of phase with the other mixer apparatus. The shafts are operably so connected that one of them turns counterclockwise and the other clockwise and consequently a beating motion is provided to the wax mixing apparatus. Air is beaten into the wax which is maintained in the tank **10** at a level somewhat below the top of the mixing apparatus by a combination of this beating action and of the crossing over of the twisted blades with their characteristic change in surface direction and consequently enhanced mixing ability.

Two separately heated valved nozzles **38** of novel construction are provided in each of the semi-cylindrical sections of the tank bottom **14**. The said nozzles are separated from the jacketed sections **16** of the tank by partitions **40** which form an open channel **42** to the inner bottom **14** of the tank. The outlets feeding the said nozzles **38** are flush with the tank bottom **14** and are conical in section, the apex of each inverted cone being fitted with plug valve **44**. The nozzles **38** are provided with variable electric heaters **46** and the nozzle and valve are preferably constructed of cast aluminum which conducts the heat from the said heaters **46** to the tip **48** of the nozzles. The temperature of the nozzles was maintained in the example employing wax of 138° F. melting point at a temperature just slightly higher than the said melting point to facilitate a flow of wax-air foam through the nozzles. The nozzle tips **48** of novel design are formed by cutting a pipe nipple on an acute angle so as to expose the outflowing stream of wax-air foam to an operator and permit the filling of candle molds with greater facility. Another essential feature of the nozzle design is its streamlined passage and minimum throat length. The path of the paddle blades **34** in mixing the air-wax foam is so close to the outlet of the tanks at the said nozzles **38** that the wax-air foam will be urged through the opening and the beating action of the mixing apparatus will consequently aid also in discharging wax-air foam from the tank. The discharge of wax-air foam from the tank **10** can in addition be aided by imposing a low gauge pressure on the contents in the mixing tank.

The control of temperature in the mixing bath, and more particularly the accurate control of the supply of heat to the air-foam admixture is provided by a control of the temperature of water which is circulated through the annular space **50** between the shell jacket **16** and the tank bottom **14**. Water is introduced through an inlet pipe **52** which extends beneath the bottom of the tank along the aforesaid supporting ridge. Water flows from the pipe **52** through holes contained therein throughout the length of the pipe and flows up from the inlet manifold to paired outlets **54** on opposite sides of the tank. An overflow pipe **55** is also provided at the top of the tank whereby excess water can be discharged from the system. The water discharged through the outlet pipes **54** is recycled through a line **56** to the temperature control apparatus of the present invention.

The control apparatus, hereinafter described with particular reference to Fig. 1, by which means the temperature and heat content of the wax-air foam mixture can be carefully controlled is operable partly automatically and partly manually. It will be apparent, however, as the description progresses, that this apparatus can be devised so as to operate substantially entirely automatically or can, in large measure where it would be more economical, be operated almost entirely manually. The following apparatus will ordinarily be applied in operation to supply continuously a slight amount of heat to the air-wax mixture. However, when air-wax foam is being removed so rapidly and in turn molten feed wax is being supplied so rapidly that the heat content rises above the medium value required in present operation, cooling water can be introduced into the recycled water. This is accomplished by flowing cold water into pipe **57** from the valved pipe **58** which is thermally controlled by conventional thermostat means **59** inserted in the pipe **57**. The valve in pipe **58** can be by-passed by valved line **60** so that a very small amount of cooling water can continuously be introduced into the recycled stream. A pump **62** is disposed in line **57** beyond the said by-pass **60** and pumps the water through the cycle comprising the control means and the water jacket of tank **10**. Water from the outlet of the pump **62** flows through pipe **64** and heating coils **66** of an indirect steam heater **68**, and thence to a modulating valve **70**. The amount of heat supplied to the indirect steam heater **68** is controlled by thermostat means **72** varied by the water temperature leaving the said heater and controlling, in turn, a valve **74** in inlet steam pipe **76**. A by-pass from the outlet side of pump **62** is additionally supplied in line **78** which conveys water directly from the pump **62** to the said modulating valve **70**.

The said modulating valve **70** is controlled by thermostat means such as a thermobulb **80**, which is immersed in the water jacket and regulates through said valve the temperature of the inlet water flowing from the modulating valve into the tank through the said inlet pipe **52** by regulating the proportion of heated water introduced therein.

Of particular importance and an essential feature of the apparatus according to the present invention is a small by-pass line **82** provided between the indirect steam heater **68** and the thermostat means **72** permitting heated water to by-pass the said means **72** and the modulating valve **70** and flow directly into the inlet pipe **52**. This by-pass line **82** is provided with a needle valve **84** which can be manually adjusted so that a very slight amount of hot water is permitted to flow into the water jacket in addition to that called for by the thermostat means **80**. The adjustment of the valve **84** is made in response to deviations in the viscosity of the air-foam mix and will be increased when the mixture appears to be too stiff and decreased when air-wax foam is too fluid.

Inasmuch as this observed variation in the viscosity of the air-wax foam directly affects the load on the motor driving the shafts of the mixing apparatus by increasing or decreasing the torsional resistance to movement in the mixture, said gear reducer **26** can be of the type, for example, in which the torque placed thereon will operate planetary gears housed therein,

which will in turn operate an electrical switch also enclosed within the housing of the said reducer 26. This latter mechanism is represented in Figure 1 as torque switch 85. There is associated with the motor or the rotating shafts 30 and with valve 84, to maintain its adjustment so that the air-wax foam will always be at or near the preferred viscosity, a solenoid switch 86 that automatically governs the operation of valve 84, opening and closing the same in response respectively to increases or decreases in the viscosity of the wax in the tank 10 and in turn to changes in the torque imposed upon the shafts 30 and transmitted therefrom to the gear reducer 26 and the torque switch 85. Current flows through an electrical wiring 87 from a source 88 to the said switch 85 which is open under normal conditions but which when closed permits current to flow through electrical wiring 89 to connection with the said solenoid 86. Both the torque responsive gear reducer and the solenoid are devices readily available on the market. The operation of the by-pass line 82 and particularly of the solenoid-operated valve 84 will be improved by the addition of a valved by-pass line 90. In normal operation, this valve would remain very slightly open. The by-pass 90 can be substituted for by drilling a small hole in the gate of the said valve or nicking the seat of the valve to provide a slight constant leak.

As the usual operating conditions will establish a slight difference in temperature between the air-wax foam and the water in the water jacket, the latter being somewhat higher, valve 84 can also be controlled when operation remains relatively uniform by a thermostatic control operated by the temperature of the water in the water jacket or even by a differential temperature control controlled by differences in temperature between that of the air-wax foam and the water in the water jacket. In either case, a differential will be maintained such as will supply heat to keep the viscosity of the air-wax foam at desired level. It has been found, however, in practical operation, that such an additional automatic apparatus is unnecessary and that so long as uniform, continuous operation occurs a uniform setting of valve 84 with only very occasional readjustment will be adequate.

Although none is indicated or was any used in the example of apparatus hereinbefore described, warm air can be injected directly into the air-wax foam during mixing by flowing the air through warm water in the water jacket and the air then can be forced through holes in the tank bottom 14 directly into the air-wax foam. Again, it has been found that in usual practice sufficient air is beaten into the air-wax foam by the described mixing apparatus so that a homogenized wax of proper structure is manufactured and at a rate so that the foam can be removed through the nozzles 38 as rapidly as operators can fill wax shells. It is observed that the tank 10 can be suspended over an endless belt upon which are carried the wax shells and that in such case the nozzles 38 will be at convenient operating level for operators standing alongside of the belt.

Having thus described my invention, I claim:

1. Apparatus for homogenizing wax with air, which apparatus comprises a vessel having at least one opening for the introduction of wax and air, a heating jacket associated with the said vessel, a rotatable shaft located within the said vessel, beater elements disposed in such operational relationship with a supply of the said air that it will be beaten into the wax thereby and including paddle blades attached to the said shaft, one edge of the said blades being adjacent the bottom of the vessel during at least a portion of their period of rotation, means for supplying heat to the said heating jacket, a thermostatic control for regulating the rate of said heat supply in accordance with the temperature of the jacketed vessel, means responsive to torsional resistance by the wax to movement of the beater elements for modifying the amount of heat introduced into the jacketed vessel, a gravity-feed discharge conduit leading from a low point in the vessel, and a separate heating jacket around said discharge conduit whereby homogenized wax being discharged into molds from the vessel can be heated at the adjoining surfaces of the wax and conduit to a temperature slightly above that of the melting point of the wax.

2. A method of homogenizing paraffin wax to form an air-wax foam comprising the steps of heating the wax to substantially its melting temperature, maintaining the said wax at the said melting temperature, regulating, in response to variations in viscosity of the heated wax, the flow of heating medium into heat exchange contact therewith at such a rate as to maintain the heat content of the wax between a value which includes a portion of the heat of fusion of the wax and the heat content of completely melted wax, beating air into well dispersed admixture with the wax so maintained at a selected heat content thereby continuously preparing an air-wax foam, flowing the so-prepared air-wax foam from the zone, in which it was prepared, to receiving molding means through a heated passageway and maintaining that portion of the heated passageway that comes into direct contact with the air-wax foam at a temperature just slightly higher than the melting point of the wax in the air-wax foam so that the said foam will flow therethrough and can be delivered into molding means without substantial impairment of its homogenized structure.

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