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O. NIELSEN

HOMOGENIZING PROCEDURE AND APPARATUS THEREFOR

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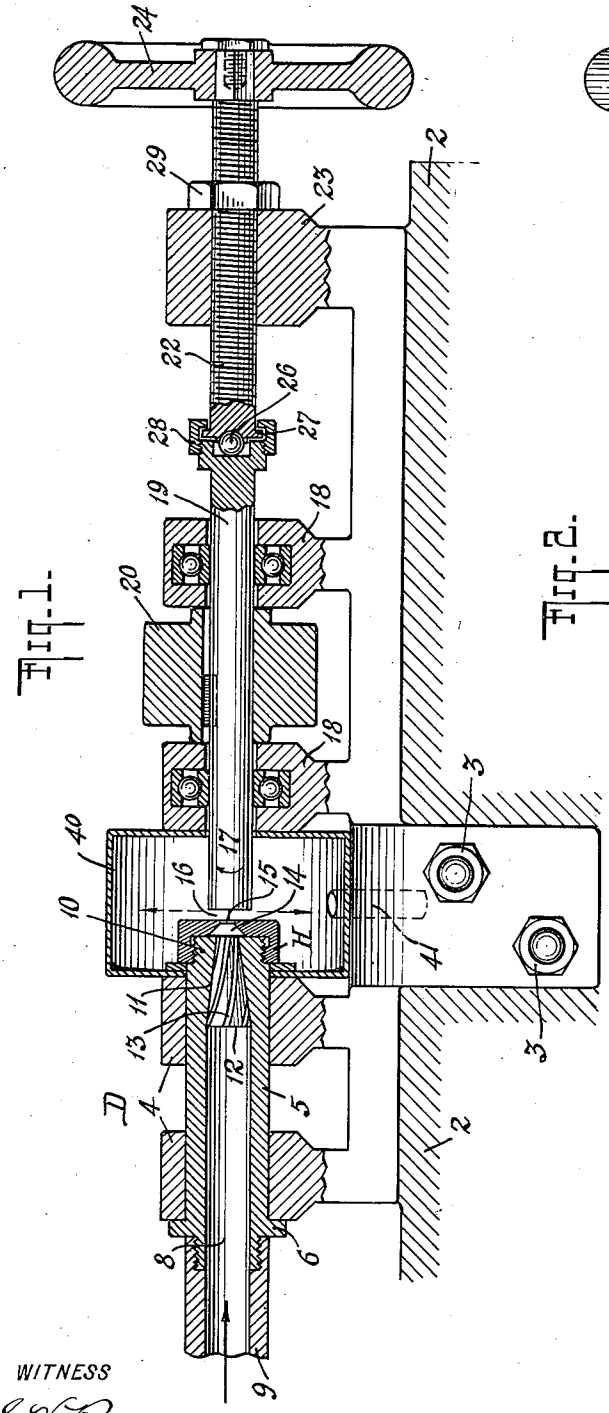


Fig. 1.

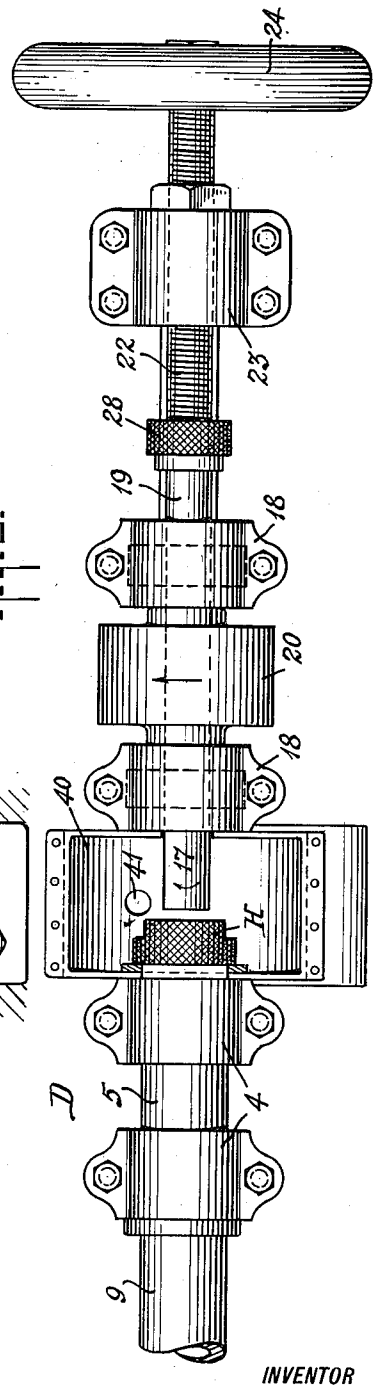


Fig. 2.

WITNESS

G. V. Rasmussen

INVENTOR

OTTO NIELSEN

BY

Nissen & Schmidt

ATTORNEYS

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OTTO NIELSEN, OF NEW YORK, N. Y., ASSIGNOR TO ELECTROPHONE RECORD CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

HOMOGENIZING PROCEDURE AND APPARATUS THEREFOR.

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This invention relates to methods of homogenizing and to apparatus by means of which to practice the methods. In the preferred embodiment of the invention it aims at producing colloids or mixtures of a colloidal type, such as emulsions derived from substances having characteristics similar to a solution of formaldehyde and phenols on the one hand and organic fats, fatty acids, paraffin or wax mixed with turpentine on the other.

The object of the invention is to bring about a more intimate or relatively permanent collodial mixture between substances than has heretofore been possible.

In the emulsification of certain substances it is exceedingly difficult to obtain an emulsion at all and more so, to obtain a stable emulsion. This is particularly true of the effort to emulsify two fluids having materially different specific gravities or having what might be termed incompatible characteristics. In such cases the tendency to separate, after the initial mix has been prepared is often effective anterior to the point where the actual homogenization is to take place, so that at the homogenization point the liquids are then separately acted upon and the homogenization procedure is practically defeated by the behavior of the liquids. Various methods of meeting the problems presented by cases of this kind have been suggested, but thus far none of them, so far as I am aware, has proved satisfactory. The present invention has been demonstrated in practice to meet the requirements and in principle it contemplates a homogenization which is the result of a compound action on the mixed fluids, whereby the same are first passed through a homogenizing orifice, being then, while still in the state of nascent homogenization, immediately subjected to the necessity of passing through a narrow gap, one surface of which rotates at relatively high speed.

The invention will be described in reference to the accompanying drawings in which Fig. 1 is an elevation partly in section, illustrating the new homogenizing apparatus and Fig. 2 is a plan view of Fig. 1, certain parts being omitted for the sake of clarity.

In the drawings the numeral 1 designates the supporting base of the homogenizer which is secured to a suitable foundation 2, by any appropriate means such as bolts and nuts 3. Supported on the base 1, at the dispersing end D of the machine, a channel member 5 is rigidly held in supports 4. At the inlet end 8 of the channel member 5 it is provided with flange 6 and with a threaded extension which mates with supply pipe 9 through which the mixed raw material is fed into the channel member 5. It is to be understood that the material entering at 9 has been previously mixed and is preferably introduced through the supply pipe 9 into the channel member under considerable pressure, say 200 atmospheres. Pressure apparatus capable of placing mixtures under such pressures are well known in the art and do not require specific description. The mixed fluid under pressure passing through the channel member 5 meets an obstruction in the form of a conical plug 12. This plug 12, which is provided with helical or spirallike slots or grooves 13 is lodged within the tapered end 11 of the channel member 5. Its location at this point compels the fluid to be homogenized to find its way through the slots 13. This arrangement has the effect of compelling the liquid to pass through the discharge orifice 15 of the dispersing head H as a rotating stream. The dispersing head H is firmly attached to the forward end of the channel member 5 and is provided with an orifice 15 of such limited dimensions as to be capable of producing homogenization or partial homogenization with easily homogenizable mixtures. Due to the fact that the walls of the orifice 15 are subjected to considerable wear it is preferable to make the head H as a separate cap of specially hard or hardened wear-resisting material. The fluid mixture which passes through the orifice 15 in the apparatus illustrated in the drawings of this application will emerge in the form of a whirling or revolving mass of material in which partial homogenization has taken places. The fluid, while in this condition, is now compelled to pass through the gap 16 which is formed between the outer face of the homogenizing head H and the smooth face of the rotor 17. This rotor 17 is keyed to pulley 20 and is given a rotation of say 1500 R. P. M. The rotor 17 is shown as supported by ball-bearings mounted in brackets 18. The rotor is adjustable toward and away from the homogenizing head H and in Fig. 1 is shown in a retracted position leaving

a wide gap 16 between the rotor and the head H. When the machine is in operation, however, the rotor is moved toward the head H until a gap of the desired thinness is established. The thinness of the gap may vary for different mixtures, but is readily and exactly adjustable to any dimension upward of 1/1000 to 2/1000 of an inch and even to finer dimensions if the liquid to be homogenized is capable of passing through a finer gap which is however, rarely the case. The gap must not be too fine, as otherwise the temperatures resulting from friction may become so elevated as to deleteriously affect the product. Preferably, as indicated in the drawings, the rotation of the rotor is in a direction opposite to the rotation of the fluid mass emerging from the orifice 15 of head H.

In its homogenizing region, the machine is preferably provided with a casing 40 having a withdrawal duct 41 located at or near its lowest point. The hommogenizing head H is also preferably provided with the tapered clearance 14.

The control of the movement of the rotor 17 to secure the desired size of the gap 16 is effected by the mechanism showing the right-hand part of the drawing. A jack screw 22 operated by the hand wheel 24 and mounted upon standard 23 moves the rotor 17 to close the gap 16 by bearing against the ball 26. In opening the gap 16 the flange 27, associated with the end of the jack screw 22, contacts with the flanged ring 28 forming an extension of the rotor 17. The movement allowed between the end of the screw 22 and the rotor 17 is limited in order not to unseat the ball 26. Once a gap 16 of a suitable width is established, the devices can be set to maintain the gap at that point by tightening the lock nut 29.

The principle of the machine is that it permits homogenization of two different types to be imparted to the material under treatment at substantially the same portion of the machine, the fluid to be treated first receiving that type of homogenization which may be obtained by forcing the liquid under pressure through a fine orifice, said liquid thereupon, while fresh from said operation, immediately receiving the other type of homogenization which is obtainable by passing the liquid in the form of a thin film through a gap of very restricted dimensions at least one element of the gap rotating at a relatively high speed. It is apparent that numerous variations in detail of construction may be made in the machine without departing from the spirit of the invention. For example, both elements constituting the gap may be made to rotate in opposite directions or, the rotor may be the stationary element and the homogenizing head be rotated. Then again, the smooth end of the rotor 17 and the co-operating surface of the head H may be conical or tapered surfaces, the taper running in either direction according to whether the liquid passing through the gap 16 is to be retarded or speeded in its passage through the gap as the result of a centrifugal force effective upon the material in the gap as the result of the rotation of the rotor 17. The dimension of the rotor 17 may be increased or decreased according to the nature of the gap desired. In these and many other respects modifications of the specific machine shown in the drawings may be made without departing from the fundamental characteristics of the device.

Assuming the machine to have been set so as to have a gap of the proper dimension between the rotor and the head H, the homogenizing process is as follows: A mixture of say formaldehyde and resorcin or phenol is stirred together in a glass tank with a mixture of paraffin or wax or the like in turpentine under conditions of thorough agitation and mixing of the ingredients. From the glass tank the mixture is supplied to a plunger pump (not shown) in which the mixture is put under pressure of approximately 200 atmospheres and is under said pressure passed through feed pipe 9 into channel member 5 through the slots 13 into the clearance 14 and then through the constricted orifice 15 of the homogenizing head H. As the mixture emerges through the orifice 15, moving therethrough under the influence of the whirling movement established by the direction of the grooves or slots 13, the liquid now partially homogenized, at once encounters the oppositely rotating smooth head of the rotor 17 and is compelled to find its way to the outlet of the gap 16 through the narrow space afforded by said gap. During its passage through this gap the liquid, in a state of preliminary homogenization acquired by it in passing through the orifice 15, is subjected to the intense action which occurs in a smooth-surfaced homogenizing gap, one member of which moves at relatively high speed. After the liquid passes out of the gap 16, it collects within the casing 40 and is withdrawn through 41 in the condition of a thoroughly homogenized fluid. In the case of the substances mentioned for illustrative purposes which are particularly resistant with respect to inter-homogenization it has been found that the homogenized mixture, the result of the new process, remains stable as a homogenized mixture for a long period of time, sufficiently long at any rate to permit the mixture to be used for industrial uses without encountering the danger of separation of the ingredients. For example, the mixture or emulsion specifically referred to may be used to advantage in the manufacture of disc talking machine records, and can

be subjected to pressure and heat, thereby producing durable and satisfactory records. Prior attempts to make phonograph records from the same ingredients have not proven very successful, mainly because of the tendency of the ingredients to separate and then to act individually and not to react together as a unitary mass of substantial homogeneous constitution throughout. Many other compositions than the specific one mentioned in the example can, of course, be treated in this machine wherever a particularly thorough, complete, and vigorous homogenization is desired.

It will be observed that the invention is of an exceedingly simple nature, that the apparatus is not complicated, but is relatively inexpensive, requiring no delicate or intricate mechanism, positive in action and easy to operate.

I claim:

1. The process of producing emulsions which comprises forcing the materials to be emulsified through a homogenizing orifice, under pressure, and then passing the thus treated material in the condition of a relatively thin film through a gap, of which at least one face moves at relatively high speed.

2. The process of producing emulsions which comprises forcing the materials to be emulsified through a homogenizing orifice, under pressure, and then passing the thus treated material as it emerges from the orifice in the condition of a relatively thin film through a smooth-surfaced gap, of which at least one face moves at relatively high speed.

3. The process of producing emulsions which comprises forcing the materials to be emulsified through a homogenizing orifice under pressure and, while the fluid is fresh from said treatment, passing it as a film through a gap of restricted dimensions and in said gap completing the formation of a relatively stable emulsion.

4. The process of producing emulsions which comprises forcing the materials to be emulsified through a homogenizing orifice under pressure and with a whirling motion, and, while the fluid is fresh from said treatment, passing it as a film through a gap of restricted dimensions and in said gap completing the formation of a relatively stable emulsion.

5. The process of producing emulsions which comprises causing mixed materials to be emulsified to be set in whirling motion under pressure and forcing the material, while whirling, through a homogenizing orifice and then subjecting the emerging material to the homogenizing influence of a narrow gap, one face of which moves at relatively high speed in a direction opposed to the whirling motion of the liquid escaping through the orifice.

6. A homogenizer comprising a dispersing member having a restricted orifice and, opposed to said orifice, a rotating element adapted to establish between itself and the walls adjacent to the orifice a homogenizing gap through which material leaving the orifice must pass as a thin film.

7. A homogenizer comprising a dispersing member having a restricted orifice and, opposed to said orifice, a rotating element adapted to establish between itself and the walls adjacent to the orifice a homogenizing gap through which material leaving the orifice must pass as a thin film and means for selectively adjusting the width of said gap.

8. A homogenizer comprising means including a homogenizing orifice, means to force the materials undergoing treatment through said orifice and means contiguous to the orifice for according to the material which has passed through the orifice a final homogenizing treatment effective upon the material while in a condition of a thin film.

9. A homogenizer comprising a channel member, a homogenizing orifice at one end thereof and, opposed to the said orifice, a rotating element closely adjacent to the outer face walls contiguous to the exit side of the orifice.

10. A homogenizer comprising a channel member, a homogenizing orifice at one end thereof and, opposed to the said orifice, a rotating element closely adjacent to the outer face walls contiguous to the exit side of the orifice, and means for adjustably positioning the rotating member relative to the said walls.

11. A homogenizer comprising a channel member, a homogenizing orifice at one end thereof, means in said channel rearwardly of said orifice for imparting a whirling motion to fluid passing through said channel in the direction of the orifice, and, opposed to the said orifice, a rotating element closely adjacent to the outer face walls contiguous to the exit side of the orifice.

12. A homogenizer comprising a channel member, conically constricted in the region of its exit, a conical plug externally grooved, seated within said conical portion of the channel, a homogenizing orifice at the exit of said channel forward of the said plug, and, opposed to the said orifice, a rotating element closely adjacent to the outer face walls contiguous to the exit side of the orifice.

13. A homogenizer comprising a channel member, conically constricted in the region of its exit, a conical plug externally grooved, seated within said conical portion of the channel, a homogenizing orifice at the exit of said channel forward of the said plug, and, opposed to the said orifice, a rotating element closely adjacent to the outer face walls contiguous to the exit side of the

orifice, and means for adjustably positioning the rotating member relative to the said walls.

14. A homogenizer comprising a channel member, conically constricted in the region of its exit, a conical plug externally grooved, seated within said conical portion of the channel, a cap containing a homogenizing orifice at the exit of said channel forward of the said plug, and, opposed to the said orifice, a rotating element closely adjacent to the outer face walls of the cap contiguous to the exit side of the orifice.

In testimony whereof I have hereunto set my hand.

OTTO NIELSEN.