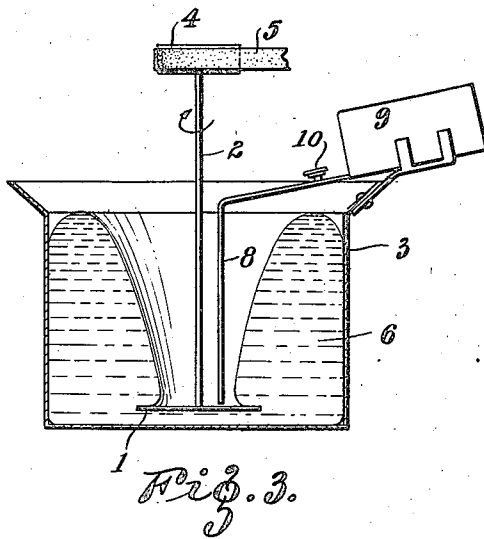
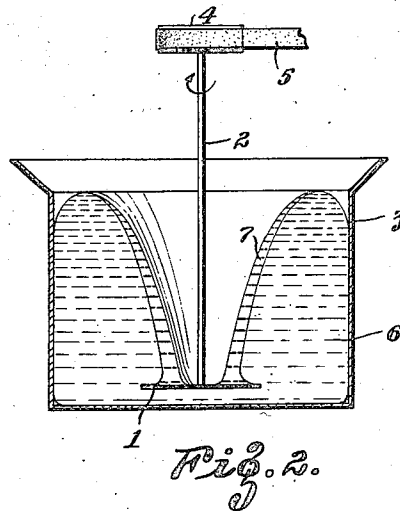
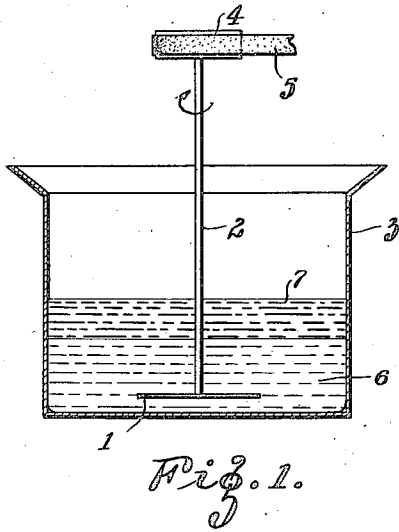


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METHOD FOR PRODUCING EMULSIONS.
APPLICATION FILED DEC. 6, 1920.

1,406,791.

Patented Feb. 14, 1922.



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METHOD FOR PRODUCING EMULSOIDS.

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Specification of Letters Patent. Patented Feb. 14, 1922.

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To all whom it may concern:

Be it known that I, ERNEST E. WERNER, a citizen of the United States, residing in the city of St. Louis and State of Missouri, have invented new and useful Improvements in Methods for Producing Emulsoids, of which the following is a specification.

This invention relates to a method for producing dispersed systems, dispersoids. More particularly the invention relates to the production of emulsoids, that is, the suspension of one liquid in another; but, as will later be apparent, suitable solids may be suspended in a dispersion medium by the practice of my method. Bredig produced dispersed systems by means of establishing electrical arcs of various natures and from various sources of currents between metallic points within a dispersion medium. This effect is due to the arc literally tearing off infinitesimal particles of the metal, particles so small as to maintain themselves in suspension, and this investigator thereby produced his well-known metal colloids of platinum, silver, etc. I have found by experiment, and by practical operation, that the Bredig effect may be produced by purely mechanical means. I have illustrated, diagrammatically, in the accompanying drawing, a simple and in part well-known form of apparatus which may be used for practicing my invention. In said drawings,

Figure 1 is a view in cross-section of a circular container with my improved emulsifying plate mounted for rotation therein and showing two liquids therein, of different specific gravities as they would appear before rotation of the plate;

Figure 2 is a view similar to Figure 1 and showing the formation by the liquid of a symmetrical inverted cone, as the result of the rapid rotation of the relatively smooth plate, and also illustrating the relative positions of the two liquids at the early stages of dispersion; and

Figure 3 is a view similar to the preceding figures and illustrating a means for supplying oil or other liquid of a lower specific gravity than the liquid constituting the dispersion medium.

In the practice of my method, I utilize a rapidly moving plate 1 mounted on the bot-

tom of a shaft 2 which, in turn, is mounted for rotation centrally of a circular container 3, the shaft 2 being rotated in any suitable manner, as by being provided with a pulley 4 on its upper end, rotated by a belt 5. The thickness of the plate is of no consequence as long as the said plate is capable of revolving and maintaining itself in a running balanced condition horizontally and as long as the said plate is capable of moving within the dispersion liquid with the minimum amount of agitation of the said liquid, or, in other words, with the minimum amount of stirring effect to the liquid. A plate immersed within a liquid and maintained at a fairly high peripheral speed, say, above two-thousand feet per minute, within a suitable container of proper proportions, will produce, by gyration, a "typhoon" effect, the liquid being maintained in the approximate form shown in Figure 2, in which the dispersion medium is indicated by the numeral 6, and the lighter liquid or oil by the numeral 7. The inverted apex of the cone moves at a somewhat higher speed than the superimposed base, the entire cone, however, maintaining its perfect symmetry. As is obvious, the lag between the liquid in contact with the plate and the plate itself will be very great since the plate is relatively smooth. The preferable form of plate which I use in the practice of my method is one that is perfectly flat, round and highly polished. Such a plate, while to the touch and eye appearing perfectly smooth, would nevertheless, when viewed or visualized in microscopic cross-section, have a highly serrated surface, the nature and degree of the serrations depending, of course, upon the degree of polish and nature of the metal.

With proper speed of the plate and a suitable quantity of liquid within the container, the shape or dimensions of the liquid cone is so adjusted as to leave a space in the center of the disc 1 into which space may be fed a liquid, as shown in Figure 3, by means of a pipe 8 leading from a container 9, and controlled by a stop-cock 10. This liquid will be carried by centrifugal force towards the periphery of the disc while having superimposed upon itself the hydrostatic pres-

sure of the dispersion medium, and be thereby held in intimate contact with the plate and its serrations. I find, in practice, that I can obtain thereby, a practically perfect emulsoid, as will be defined below. The feeding operation just described is not necessary, however, if the following procedure illustrated in Figure 1, is observed. The water, or other solvent 6 either with or without a protective colloid, is introduced into the container 3 and a film of oil, 7, to be dispersed is floated upon the top of the liquid. When the disc 1 is put into operation and the conical form of the liquid established, the natural tendency is for the heavier liquid 6, this being either the dispersion medium or the properly formed emulsion, to maintain itself, due to centrifugal action, in proximity to the walls of the container; whereas the lighter liquid, in this case, the oil 7, will maintain itself on the surface of the cone, as shown by Figure 2, and flowing downward, come in contact with the plate to be at least in part disrupted and thereby dispersed, and the free oil, will again tend to maintain itself on the surface of the cone to be re-exposed to the dispersing action until within a very brief time, a perfect emulsoid is produced which will readily pass through a filter having interstices of approximately one micron, and, which will exhibit under the microscope a vigorous Brownian movement such as corresponds to a particle diameter of one micron or less.

Thus it will be seen that the effect accomplished by Bredig's electrical means is accomplished by purely mechanical means by the practice of my method, and under suitable conditions to the same extent. When emulsifying, say, water and oil, the viscosity of the suspension liquid is at times an important factor, and this may be properly regulated by the addition of, say, gumarabic, dextrin, or milk. For filtration, or the exhibition of the Brownian movement, it may be necessary, in certain forms of emulsion, due to their viscosity as produced, to subsequently dilute them to obtain these phenomena.

I am aware that the term "serrated" as above used, applies more properly to an edge than to a surface; and when using the term "serrated" in the specification or claims, I mean the microscopic appearance of a cross-section of the plate and not the serrations of the periphery.

It is, furthermore, obvious that a solid or semi-solid substance may be subjected to the abrasive action of the disc at the circumferential line where cone and plate make contact when in operation, and, due to a selected form of serration, produce particles sufficiently small to come within the scope

of dispersed systems, thus truly producing, mechanically, Bredig's electrical effect.

I am aware of the fact that so called homogenizers have produced very satisfactory emulsions by forcing two liquids under high pressure between closely set plates or through apertures. I am also aware that various types of paddles and agitating devices have been used for the purpose of mixing and of more or less emulsifying oils into milk, or oils into solutions of albumen, etc. In the practice of my invention, however, I secure, mechanically, Bredig's effect by causing the minimum agitation of the liquid, maintaining it in a symmetrical form, a procedure which is the exact opposite in principle to the theory and action of homogenizers and the various mixing and emulsifying devices. I may explain further that the results secured by the practice of my method are due, to a large extent, to the fact that oil adheres to, and diffuses over the surface of metal, to a greater extent than does water, and this explains, I believe, the rapidity with which, and the degree to which emulsification occurs, as, in the rotation of the disc a microscopic film of oil, or microscopic particles of oil, are continuously projected over the surface of the disc beneath the superimposed body of the dispersion medium, and thereby completely disrupted.

While I have spoken of the inevitable serrated condition of any polished plate when visualized or contemplated from the microscopic stand-point, it will be a perfectly obvious procedure, and within the scope of my invention, to artificially serratate the plate with minute lines or grooves resembling somewhat the lines of the refraction spectroscopy in minuteness and design. Any character of serrated surface, with artificial serrations microscopic in character, and so disposed as to impart the minimum amount of agitation to the liquid, for example, concentrically, might be used for my purpose.

In the use of the form of apparatus shown in the drawing, a peripheral speed of the disc 1, of two-thousand feet per minute, will suffice for liquids of low viscosity; liquids of higher viscosity will naturally call for a higher peripheral speed of the disc. In the commercial form of apparatus, a disc for treating one hundred gallons of liquid would have a diameter of from twelve to eighteen inches and the container, a diameter substantially three times that of the disc. It may be stated, however, that the speed of the disc will govern the action and not its diameter. However, it is desirable to keep the apex of the liquid cone of relatively small diameter to obtain the maximum abrasive action of the disc.

I wish it to be understood that a factor in the novelty of my method and one which

distinguishes it from prior methods, resides in the fact that my disc produces, mechanically, in the first instance, particles sufficiently minute to be properly termed "colloidal", within the dispersion medium, so that the particles are immediately surrounded and suspended at the time of their production, within the dispersion medium, and tend to arrange themselves in zones coinciding with the degree of their dispersion.

Finally, it should be stated that the successful practice of my method in forming an emulsoid, is dependent upon the use of two substances to be emulsified, between which a wide difference in specific gravities exists. This is necessary in order that the substance to be suspended in the dispersion medium will float upon the latter as a distinct layer or stratum during the movement of the liquids produced by the rotation of the plate, and thus be brought into contact with the plate in advance of the area of contact of the dispersion medium with the plate. This insures that the lighter substance, usually oil, or a substance of an oily nature, will engage, be diffused over and be disrupted by the plate, being thereby continuously interposed between the surface of the plate and the superimposed body of the heavier dispersion medium. Where the dispersion medium and the substance to be suspended therein do not differ greatly in their specific gravities, such independent action upon the lighter substance becomes impossible, there is less opportunity for the plate to gradually produce by abrasion a suspension of the lighter substance in the dispersion medium, and while, as is known, a very complete mixing, or inter-mixture, of the two substances will result, a true emulsoid will not be produced. In other words, the two substances will become mixed, the lighter substance will be held in suspension in the dispersion medium out of contact with the plate, and the latter will not have the opportunity of operating upon such lighter substance in the manner herein described.

I claim:—

1. The method of emulsifying oil and a heavier liquid, which consists in continuously causing the oil, while in a state of flotation on the heavier liquid, to pass into contact with the exposed face of a rapidly revolving, relatively smooth plate, by the movement of the liquids produced by the motion of the plate and characterized by a substantial absence of agitation.

2. The method of emulsifying oil and a heavier liquid inclosed in a container, which consists in continuously causing the oil, while in a state of flotation on the heavier liquid, to pass into contact with the exposed face of a rapidly revolving plate, normally submerged in the heavier liquid and having a relatively smooth surface, by the move-

ment of the liquids produced by the motion of the plate and characterized by a substantial absence of agitation.

3. The method of emulsifying oil and a heavier liquid inclosed in a container, which consists in rapidly revolving a plate having a relatively smooth surface and normally submerged in the heavier liquid, to produce by gyration, a typhoon whirl and cause the oil, while in a state of flotation, to form the wall of the resulting liquid cone and to be continuously passed, by the movement of the liquids, into contact with the exposed surface of the plate until complete emulsification has occurred.

4. The method of emulsifying oil and a heavier liquid inclosed in a container, which consists in producing a typhoon whirl of the liquids, with minimum agitation thereof, by rapidly revolving a smooth-surfaced plate normally submerged in the heavier liquid, the motion of the liquids causing the oil, while in a state of flotation on the heavier liquid, to continuously pass into contact with the exposed surface of the plate until emulsification occurs.

5. The method of emulsifying oil and a heavier liquid inclosed in a container, which consists in continuously causing the oil, while in a state of flotation on the heavier liquid, to pass into contact with the exposed portion of a rapidly moving abrasive surface by revolving a plate normally submerged in the heavier liquid and having a surface of a sufficient degree of smoothness to produce, under centrifugal action, a gyratory movement of the liquids in which the oil will form continuously diminishing strata within the liquid cone and the two liquids and resulting emulsoid will gyrate with the minimum of agitation.

6. The method of emulsifying oil and a heavier liquid which consists in rapidly revolving a plate having a microscopic abrasive surface in the body of the heavier liquid to thereby gyrate said heavier liquid and expose a portion of said plate, and continuously subjecting the oil to the abrasive and centrifugal action of said plate in advance of the zone of contact of the heavier liquid therewith to simultaneously cause disruption of the oil and suspension thereof in the heavier liquid.

7. The method of producing an emulsoid, which consists in rapidly revolving a relatively smooth plate in a liquid dispersion medium to cause gyration of the liquid above the plate and exposure of a portion of the latter, and simultaneously maintaining another substance in contact with the exposed surface of said plate independently of the contact therewith of the liquid dispersion medium, whereby to disrupt the substance and simultaneously cause its suspension in the dispersion medium.

8. The method of producing an emulsoid of two immiscible liquids, which consists in rapidly revolving a relatively smooth plate in the heavier of said liquids, constituting the dispersion medium to cause gyration of the liquid above the plate and exposure of a portion thereof, and simultaneously feeding the lighter liquid into contact with the exposed surface of said plate independently of the contact therewith of the liquid dispersion medium to cause disruption of said lighter liquid and its simultaneous suspension in the dispersion medium. 10

In testimony whereof, I have hereunto set my hand.

ERNEST E. WERNER.