June 10, 1924. 1,496,858

R. KNOLLENBERG

MIXING LIQUIDS

Filed Feb. 17, 1923

Fig. 1.

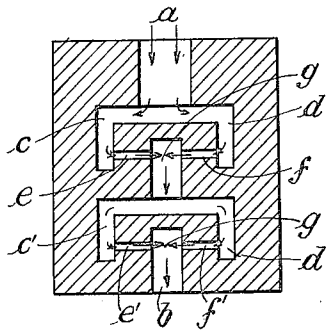


Fig. 2.

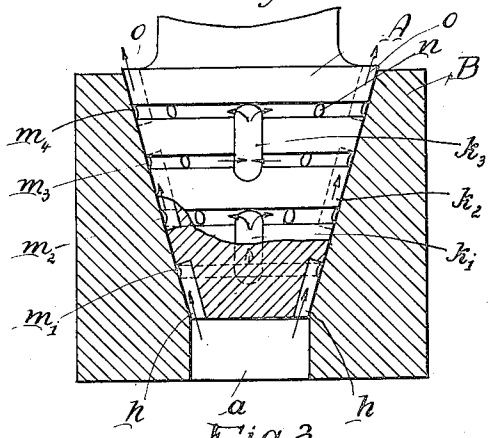


Fig. 3.

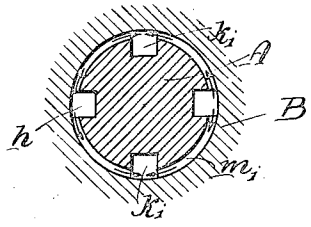
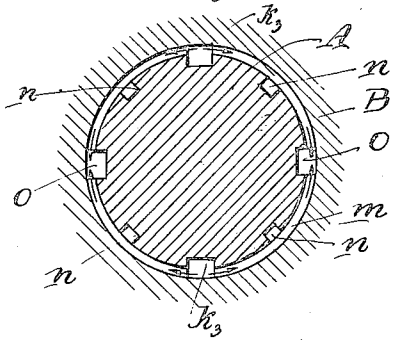


Fig. 4.



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UNITED STATES PATENT OFFICE.

RUDOLF KNOLLENBERG, OF LUBECK, GERMANY.

MIXING LIQUIDS.

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To all whom it may concern:

Be it known that I, RUDOLF KNOLLENBERG, a citizen of Germany, residing at Lubeck, Germany, have invented certain new and useful Improvements in Mixing Liquids, of which the following is a specification.

My invention refers to the mixing of liquids and its particular object is a method and the means for effecting the mixing of not easily mixable liquids in an easier and more effective manner than was hitherto possible.

Mixable liquids can easily be combined into a homogeneous liquid by mere pouring together and stirring. With liquids which are not mixable, such as a fatty and a watery liquid, this is not possible and the mixing of such liquids can be effected only with the aid of certain preparatory steps which are commonly termed homogenization. Homogenization is effected in general by breaking up and shattering the liquids so as to subdivide them into minute particles, thus making them more apt to be mixed. According to well known methods of homogenization this is brought about as a rule by triturating or grinding the particles of liquid, and to this end the liquids to be homogenized were forced through under high pressure, between surfaces tightly pressed upon one another, the particles of liquid being torn asunder by friction in contact with these surfaces. The homogenizing effect was further improved by imparting to the homogenizing surfaces a grinding movement. However, this method requires extremely high pressure involving considerable losses by friction and low output per unit of time. Moreover, the fine gaps through which the liquids are forced, are liable to get clogged easily and must be machined with extraordinary care.

In contradistinction to these methods my invention entirely dispenses with such high pressure, narrow gaps and the like. I succeed in mixing all kinds of liquids by causing jets of such liquids to impinge upon each other with the highest possible velocity, whereby the liquid particles are broken up and mixed simultaneously without the aid of any grinding devices.

I prefer causing the jets of liquids to strike each other repeatedly and at different points, and I thus succeed in completely shattering the particles of liquid in the most perfect manner without any preliminary frictional treatment being required. Inasmuch as all that is required, is to cause the jets of liquid to hit upon each other, there is no necessity of employing narrow gaps requiring minute machining, the cross-sectional area of the jet nozzles being such that the velocity of flow is increased as far as possible without any unnecessary frictional losses. In consequence of this manner of proceeding I obtain a high velocity of flow and I avoid the danger of the passages getting clogged.

In the drawings affixed to this specification and forming part thereof the new method and a device for carrying it into effect are illustrated in a purely diagrammatic manner by way of example. In the drawings—

Fig. 1 is a diagram illustrating the way in which jets of the liquids to be mixed are made to impinge upon each other in order to break the liquids up and render them fit for mixing.

Figs. 2 to 4 are purely diagrammatic views of a homogenizing device according to the invention,

Fig. 2 being a vertical longitudinal section, partly in elevation, while

Figs. 3 and 4 are two cross sections on the line I—I and II—II in Fig. 2, respectively.

Referring first to Fig. 1, a metal block is provided with a number of coaxially extending channels communicating with one another only indirectly by way of radial conduits. The liquids to be mixed enter the first axial channel at a and in passing outwards the radial conduits c, d, are diverted once more into axial direction whereupon they enter narrow radial channels e, f disposed in exact alignment with their inner ends directly toward each other and giving into the second central channel g. On issuing from the radial conduits e, f, the jets of liquids strike each other with great vehemence in the axial chamber or channel g, being at the same time broken up into fine particles and intermixed so as to reach the radial channels c^1 c^3 in mixed condition. In these channels the stream of liquid is again forced outwards and through the outer axial channels reaches another pair of inwardly directed radial channels e^1 f^1 leading to the third axial channel b. The jets of liquid issuing from the channels e^1 f^1

strike each other with great vehemence, being thereby broken up once more and intermingled, whereby the mixture affected during the passage through the channels *e f g* is rendered still more intimate and homogenous. From the channel *b* this mixture can now be conducted to another mixing device of a like or different nature or can be conveyed directly to the place of consumption.

In the device designed in accordance with the principles above disclosed and which is illustrated in Figures 2–4, a conical body A is ground into and tightly seated in a block B provided with a central boring *a* playing the roll of the first central channel *a* in Figure 1. A perfect contact being secured between the conical body A and its seat, no narrow gaps affording a passage between the conical body and its seat are provided. The mixing and homogenizing of the liquids introduced through *a* is effected by the aid of annular grooves extending one above the other on the conical surface of the body A. Adjoining pairs of annular grooves are connected with each other by comparatively wide longitudinal channels. The liquids introduced through *a* first enter the lowermost longitudinal channels *h* which are disposed diametrically opposite to each other and lead to the lowermost annular groove m^1, which is connected with the next following groove m^2 by a pair of longitudinal channels k^1 disposed intermediate the channels *h*. Through the channels k^1 the liquid arriving through each channel *h* is divided in two branches, each of which will flow around one quarter of the annular groove m^1 before entering one of the second longitudinal channels k^1. On entering these channels the jets of liquids strike one another with great vehemence, owing to the pressure exerted on the liquid entering the device and are broken up and intermixed. After rising in the channels k^1 the liquid mixture is again divided into four branches flowing around one quarter of the cone before reaching the third pair of longitudinal channels k^2. Upon entering these channels, the branch jets once more strike each other and intermingle whereupon the mixture rises in the channels k^2 until it enters the third annular groove m^3 which leads the branch currents of liquid to the fourth pair of longitudinal channels k^3 wherein the liquid is broken up and intermixed anew before reaching the fourth annular groove m^4 from which it issues into the longitudinal channels *o* in order to escape from the device.

Obviously the repeated breaking up of the liquid under pressure will result in an intimate intermixing of its constituents, so that the mixture issuing from the channels *o* is absolutely homogenous.

Obviously, instead of arranging a pair of opposite longitudinal channels between the annular grooves, a single channel might be provided. Similarly, instead of a single pair of annular grooves, three or more such grooves may be connected by one or several longitudinal channels.

Shallow sharp edged depressions *n* may be provided in the annular grooves which serve to create whirls in the liquid in order to prevent it from flowing through smoothly, whereby the homogenization is further improved.

The longitudinal channels *h* k^1 k^2 . . . which are wider than the relatively narrow annular grooves at the same time act for collecting and distributing the liquid and for breaking it up.

I wish it to be understood that, although I have shown in Figures 2–4 a particular form of a device adapted for carrying out the method of homogenization forming part of the present invention, I do not desire to be limited to the number, configuration and mutual arrangement of parts shown and described, as many obvious modifications will occur to a person skilled in the art.

I claim:—

1. The method of mixing and homogenizing liquids, consisting in causing several jets of the liquid or liquids to be mixed to strike each other with high velocity.

2. The method of mixing and homogenizing liquids, consisting in causing oppositely directed jets of these liquids to strike each other repeatedly under pressure.

3. The method of mixing and homogenizing liquids, consisting in so conducting the liquids under pressure, that they are forced to meet and intermingle and the mixture thus obtained to separate into several streams or jets which will meet again with high velocity.

4. Liquid mixing and homogenizing device comprising in combination, a body, a plurality of borings extending through said body in longitudinal direction and substantially radial channels interconnecting adjoining pairs of such longitudinal channels.

5. Liquid mixing and homogenizing device comprising in combination, a perforated body, a solid body tightly seated in the perforation of said first body, a plurality of longitudinal channels formed in one of the contacting surfaces of said bodies and separated from one another and substantially circumferential grooves connecting adjoining pairs of longitudinal channels.

6. Liquid mixing and homogenizing device comprising in combination, a perforated body providing a conical seat, a cone tightly seated in the conical seat of said body, longitudinal channels in the circumference of said cone separate from each

other and circumferential substantial annular channels interconnecting said longitudinal channels.

7. Liquid mixing and homogenizing device, comprising in combination, a perforated body providing a conical seat, a cone tightly seated in said seat, a plurality of annular circumferential grooves in one of the contacting surfaces and pairs of oppositely arranged longitudinal channels interconnecting adjoining pairs of such annular grooves, the longitudinal channels between the second and third annular groove being staggered relatively to the longitudinal channels between the first and second grooves.

8. Liquid mixing and homogenizing device comprising in combination, a body, a plurality of borings extending through said body in longitudinal direction, substantially radial channels interconnecting adjoining pairs of such longitudinal channels and shallow sharp edged depressions in said channels.

In testimony whereof I affix my signature.

RUDOLF KNOLLENBERG.