Jan. 26, 1954 H. HEMFORT 2,667,338

APPARATUS AND METHOD FOR CENTRIFUGALLY MIXING LIQUIDS

Filed March 15, 1950 2 Sheets-Sheet 1

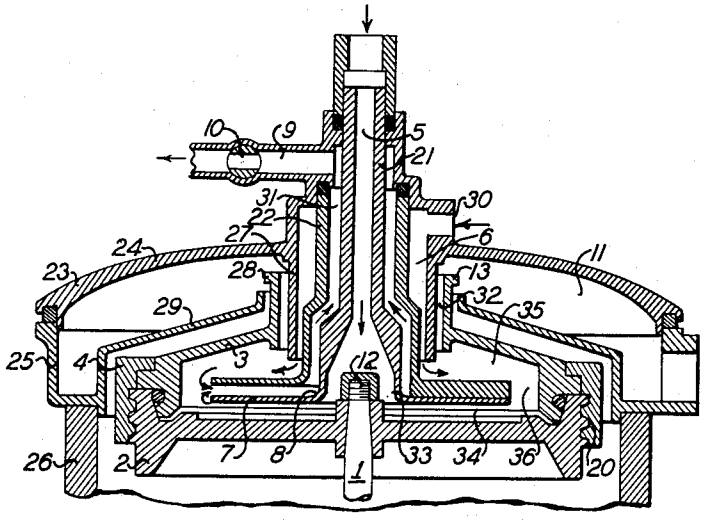


FIG. 1

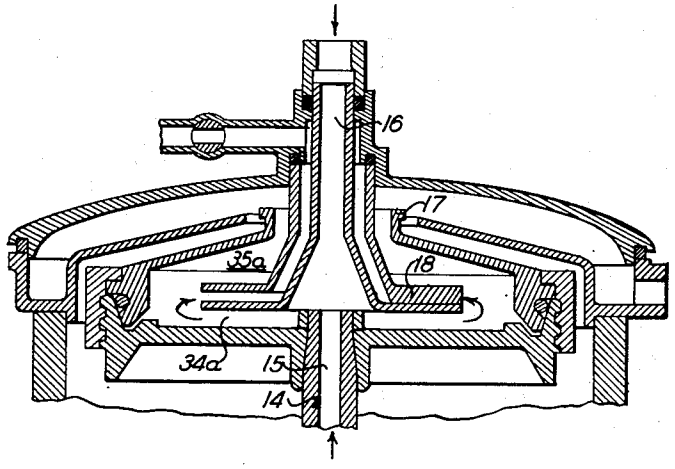


FIG. 2

INVENTOR
HEINRICH HEMFORT

BY Burgess & Dinklage

ATTORNEY

Jan. 26, 1954 H. HEMFORT 2,667,338

APPARATUS AND METHOD FOR CENTRIFUGALLY MIXING LIQUIDS

Filed March 15, 1950 2 Sheets-Sheet 2

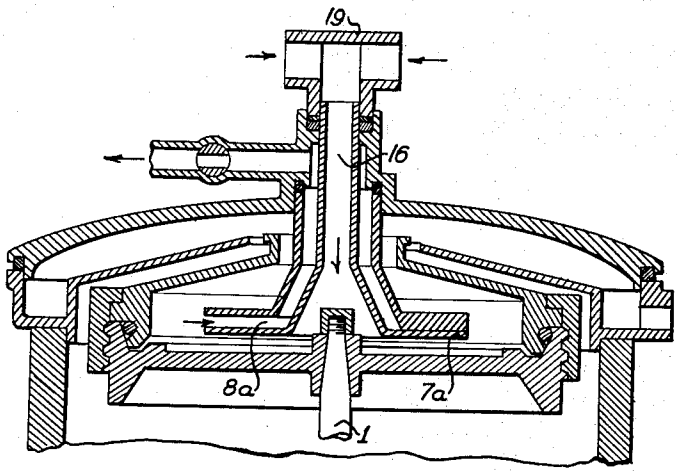


Fig. 3

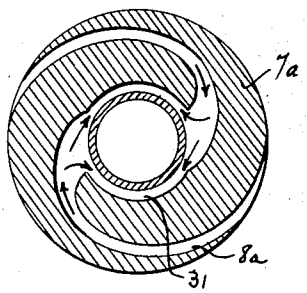


Fig. 4

INVENTOR
HEINRICH HEMFORT

BY Burgess & Dinklage

ATTORNEY

Patented Jan. 26, 1954

2,667,338

UNITED STATES PATENT OFFICE

2,667,338

APPARATUS AND METHOD FOR CENTRIFUGALLY MIXING LIQUIDS

Heinrich Hemfort, Oelde (Westphalia), Germany, assignor to Westfalia Separator A. G., Oelde, Westphalia, Germany, a corporation of Germany

Application March 15, 1950, Serial No. 149,658

Claims priority, application Germany, June 13, 1949

13 Claims. (Cl. 259—3)

1

This invention relates to new and useful improvements in the mixing of liquids.

Most devices for the mixing of liquids are characterized by various disadvantages. Stirrers and similar mixing means introduce easily air into the mixture. For this reason, high speed stirrers cause foam formation. Furthermore, some of the mixing devices for liquids do not easily lend themselves to continuous operations. Though pumps are frequently used for the substantially continuous mixing of liquids, the resulting mixture is in many cases not sufficiently intimate. Many mixing devices, such as pumps, are, however, relatively cumbersome in their operation and their cleaning and sterilization where used in connection with foodstuffs or other spoilable liquids is connected with difficulties.

One object of the instant invention comprises among others the centrifugal mixing of liquids in a simple continuous operation. This and further objects of the invention will be apparent from the following description.

In accordance with the invention, two specifically differing liquids are continuously fed into a volume confined zone and into contact with a stripping disc in this zone, the liquids being continuously subjected to centrifugal action in this zone and are continuously discharge as a mixture from the stripping channel of the disc, the feeding of one of said liquids being maintained in amount less than the total discharging liquid. The device for accomplishing this purpose essentially comprises a rotatable centrifuge drum, a stationary stripping disc within said drum substantially coaxial with the drum axis of rotation, conduit means for feeding liquid into said drum, and liquid discharge means in communication with the stripping channel of said disc.

The invention is exemplified by the drawings in which

Fig. 1 represents a cross sectional side view of part of a construction embodying the invention;

Fig. 2 is a cross sectional side view of part of the construction in accordance with the invention embodying an alternative construction;

Fig. 3 illustrates a cross sectional side view of part of the construction in accordance with the invention illustrating a further alternative structure; and

Fig. 4 shows a cross sectional top view of a stripping disc of the construction shown in Fig. 3 on the plane IV—IV thereof.

Referring to Fig. 1, the centrifuge drum com-

2

posed of the bottom member 2 and cover 3 held together by way of the locking ring 4 is mounted on rotatable centrifuge spindle 1 being secured thereto by way of the nut 12. Stationary outer centrifuge housing 26 carries the top or hood portion 23 composed of the cover 24 and the bottom 29 extending into the side wall portion 25. Hood portion 23 carries the central shaft 21 arranged substantially coaxial with the axis of rotation of the centrifuge drum 20. Central shaft portion 21 carries cocentric therewith and spaced apart therefrom the tubular member 22 defining between the outer surface of shaft portion 21 and inner surface of the tubular member 22 the liquid discharge conduit or duct 31. Duct 31 around shaft 21 is in communication with the discharge tube 9 controlled by the valve 19. Hood 23 carries the cylindrical inner wall member 27 spaced apart from and extending to below the bottom member 29 of hood 23. Cylindrical inner wall 27 is arranged substantially cocentric with the axis of rotation of said drum and thus with the stationary center shaft 21. Cover 3 of drum 20 carries a substantially cylindrical collar member 13 spaced apart from and substantially cocentric with the inner wall 27 of the hood 23 defining therebetween the conduit 32. Rotatable collar member 13 of drum 20 carries at its top liquid overflow lip 28. Inner hood member 27 and cylindrical member 22 define therebetween the liquid conduit 6 in communication with the inlet duct 30. Stationary center shaft 21 defines the central conduit 5 defining at its bottom with the outside surface of screw 12 the discharge duct 33. Center shaft 1 carries at its lower end the stripping disc 7, the stripping channel 8 of which communicates with the discharge conduit 31 around the outer surface of the inner shaft 21. A typical stripping disc is for instance illustrated in Fig. 4.

In the practical operation of the device exemplified in Fig. 1, a specifically lighter liquid (indicated by the broken outline) is fed through center conduit 5 and discharge duct 33 into the inner centrifugal drum space 36, flowing into the portion 34 thereof below the stripping disc 7. The specifically heavier liquid (indicated by solid outline) is fed through conduit 30 and annular channel 6 into the drum interior 35 flowing into the space 35 above the stripping disc 7. Upon rotation of the centrifugal drum 20 the specifically heavier liquid will go to the outer wall of the centrifugal drum being banked against the same while the specifically lighter liquid will be superimposed upon the heavier liquid level. If

the two liquids are fed into the centrifuge simultaneously the lighter liquid will first come into contact with the outer opening of the stripping disc 7 inasmuch as it assumes the innermost position being banked on top of the centrifugally outwardly moving heavier liquid. There will be, therefore, then first specifically lighter liquid stripped by the stripping disc 7 and discharged through conduits 31 and 9. If the amount of liquid feed is so adjusted that one of the two liquids is fed in amount less than the total liquid stripped by the stripping disc and discharged through conduit 9, the interphase between the specifically lighter and specifically heavier liquid will soon reach the outer stripping opening of conduit 8 of the stripping disc 7 and thereafter both liquids will be gripped by the stripping disc being mixed therein and discharged through conduits 31 and 9 in the form of an intimate mixture. The stripping disc acts essentially as a reverse centrifugal pump. It may be for instance seen by reference to Fig. 4 the specifically lighter and specifically heavier liquids are forced through their centrifugal rotation into the opening of the stripping channel 8a which spirals inwardly towards the center of the stripping disc. The continuing centrifugal pressure then forces the liquids which have become intimately mixed in the stripping channels 8a upwardly through the annular duct 31 to be discharged as an intimate mixture of the liquids.

The operation is similar if the one or the other of the two liquids should be first fed into the centrifuge before the other is admitted. Assuming, for instance, that specifically heavier liquid is admitted as such, or in mixture with specifically lighter liquid in a manner where the specifically heavier liquid preponderates to an extent that the stripping disc will first dip into the specifically heavier liquid, the latter will be discharged until again the interspace between the specifically lighter and specifically heavier liquid is reached. In the particular embodiment of Fig. 1, the drum interior portions 34 and 35 separated by the stripping disc 7 constitute communicating chambers and the two liquids will assume positions of balance in each. Valve 10 is so adjusted that the rate of discharge through conduit 9 is larger than the rate of feed of one of its components. Valve 10 furthermore is so adjusted to the discharge through conduit 9 that the levels of the two liquids remain such that the liquid level of the liquid within the upper portion 35 of the centrifugal interior 36 is maintained between the outer periphery of the stripping disc 7 and the inner periphery of the collar member 13. If the discharge is restricted too much, the liquid within the upper portion 35 of the drum interior 36 will discharge through conduit 32 over overflow lip 28 into the interior 11 of the hood 23. On the other hand, if the valve is opened too wide so that the liquid mixture discharge is out of proportion to the feed rates of the liquids, the liquid levels within the centrifuge interior 36 may recede to a point where air is sucked in to the stripping disc.

Though Fig. 1 illustrates the feeding of the specifically heavier liquid to above the stripping disc and of the specifically lighter liquid to below the stripping disc, it is possible to reverse the feeds of these liquids and have the specifically lighter liquid pass into the centrifuge interior above the stripping disc and the specifically heavier liquid into the centrifuge interior to below the stripping disc. Alternatively, an arrangement as exemplified in Fig. 2 may be used. As there shown, the specifically heavier liquid is admitted through the central conduit 16. Spindle 14 of the centrifuge is of the hollow type and defines the central conduit 15 for the admission of the specifically lighter liquid. Again the two liquids seek individual liquid levels which in their differential in the upper and lower portions 35a and 34a are controlled by the differentials in their specific gravity. Again, the interphase of the two liquids reaches the stripping circumference of the stripping disc 18. In this case, there is thus the specifically heavier and the specifically lighter liquid each introduced to the space below the stripping disc. In this case, however, the liquid level of the specifically heavier liquid in the upper portion 35a of the drum interior is controlled not only by the amount of specifically lighter liquid within the space 34a but also by the specifically heavier liquid being centrifugally moved through the specifically lighter liquid. The particular construction of Fig. 2 has the advantage that it is possible to make the inner diameter of the collar member 17 smaller than that of the corresponding collar member 13 of Fig. 1. This in turn permits a smaller outer diameter of the stripping disc 18. There is thus in this construction less power required for the operation of the mixing device. Instead of introducing the specifically heavier liquid through conduit 16, as illustrated in Fig. 2, the specifically lighter liquid may be introduced through this conduit while passing the specifically heavier liquid through conduit 15. Alternatively, both liquids may be introduced through the conduit 15 of the hollow spindle 14. Instead of defining conduit 15 as part of rotatable spindle 14 so that the conduit walls rotate with the spindle, it is possible to define conduit 15 by way of a stationary tube or conduit within the rotating hollow spindle 14.

Fig. 3 demonstrates a construction similar to Fig. 2 except that both liquids are introduced by way of the central conduit 16 being each separately fed into the same by the T-connection 19.

The method and device in accordance with the invention have many valuable practical applications in the mixing of liquids. One of the foremost applications is that in connection with the mixing of liquids for extraction purposes in which one of the liquids is a solute while the other is the extracting solvent possessing a preferential solubility for the material dissolved in the solute. Their application may further include the emulsification of certain liquids particularly in the presence of emulsifying agents.

I claim:

1. Device for the intimate mixing of liquids which comprises a rotatable centrifuge drum, a stationary center shaft extending to within said drum substantially coaxial with the drum axis of rotation, a stationary stripping disc carried by said shaft cocentric therewith within said drum, first conduit means defined by said shaft for feeding one of two specifically differing liquids into said drum below said disc, second conduit means for admitting the other of said liquids into said drum, third conduit means in communication with the stripping channel of said disc for discharging a mixture of said liquids, and means defining an annular overflow channel from the upper inner end of said drum.

2. Device in accordance with claim 1 in which said third conduit is essentially defined between the outer surface of said shaft and an essentially

tubular member cocentric with said shaft in spaced relation thereto.

3. Device in accordance with claim 1 in which said second conduit exits into said drum above said disc.

4. Device in accordance with claim 1 in which said third conduit means are provided with valving means for variably adjusting mixture flow therethrough, in which said third conduit is essentially defined between the outer surface of said shaft and an essentially tubular member cocentric with said shaft in spaced relation thereto, in which said annular overflow channel is defined between an inner and outer cylindrical member cocentric with said shaft, and in which said second conduit is defined between the outer surface of said tubular member and the inner surface of said inner cylindrical member.

5. Device in accordance with claim 1 in which said second conduit exits into said drum below said disc.

6. Device in accordance with claim 5 in which said second conduit is defined within the centrifuge spindle.

7. Device in accordance with claim 6 in which said third conduit means are provided with valving means for variably adjusting mixture flow therethrough, in which said third conduit is essentially defined between the outer surface of said shaft and an essentially tubular member cocentric with said shaft in spaced relation thereto, and in which said annular overflow channel is defined between the inner surface of a tubular extension of the drum cover cocentric with said shaft and a portion of the outer surface of said tubular member.

8. Method for the intimate mixing of liquids which comprises establishing a volume confined zone, continuously feeding two specifically differing liquids into said zone, continuously subjecting said liquids in said zone to centrifugal action to establish an interphase therebetween, continuously stripping and forcing for discharge from said zone a portion of each said liquids from said interphase along a stationary centrally spiralling confined path while maintaining the feeding of one of said liquids in amount less than the total discharging liquid.

9. Device for the intimate mixing of liquids which comprises a rotatable centrifugal drum, a stationary stripping disc of smaller diameter than the inside diameter of said drum positioned within said drum substantially co-axial with the drum axis of rotation with its outer perimeter in spaced relationship to the inner wall of said drum defining an annular space therebetween for a body of liquid of appreciable depth, conduit means for feeding two specifically differing liquids into said drum, overflow means from the upper inner end of said drum, and liquid discharge means in communication with the stripping channel of said disc for removing a mixture of said liquids.

10. Device according to claim 9 in which there are additionally provided valving means on said discharging means for variably adjusting mixture flow through said discharging means.

11. Device according to claim 9 in which said conduit means comprises a first conduit for feeding one of said liquids into said drum and a second conduit for feeding the other of said liquids into said drum.

12. Device according to claim 11 in which said first conduit exits below said disc and said second conduit above said disc.

13. Device according to claim 11 in which said conduit means exit into the drum space below said disc and including valving means on said discharging means for variably adjusting mixture flow through said discharging means.

HEINRICH HEMFORT.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
814,720	Monroe	Mar. 30, 1906
1,624,037	Butler	Apr. 12, 1927
1,771,321	Snow	July 22, 1930
2,171,136	Bergner	Aug. 29, 1939
2,273,835	Cornell	Feb. 24, 1942
2,318,293	Cornell	May 4, 1943
2,341,536	Fash	Feb. 15, 1944