June 2, 1936. F. MAURER 2,043,108

MIXING APPARATUS FOR LIQUIDS

Filed April 8, 1931

Fig. 1.

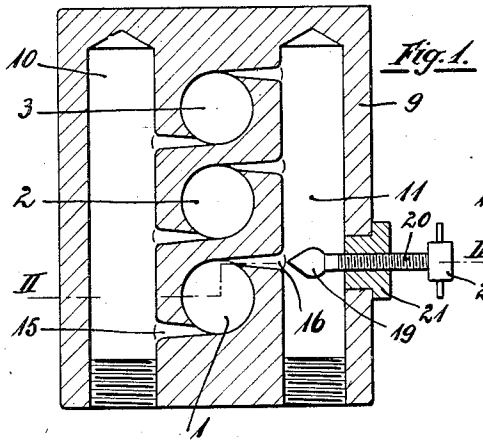


Fig. 3.

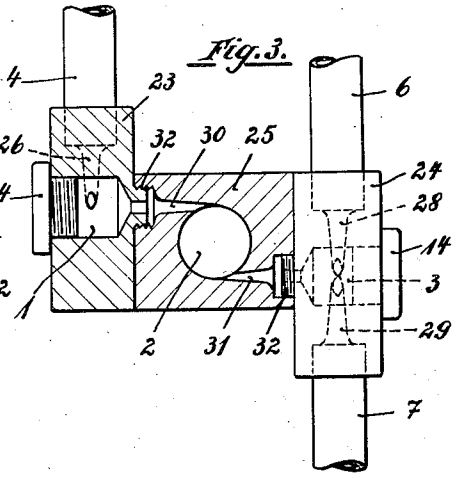


Fig. 2.

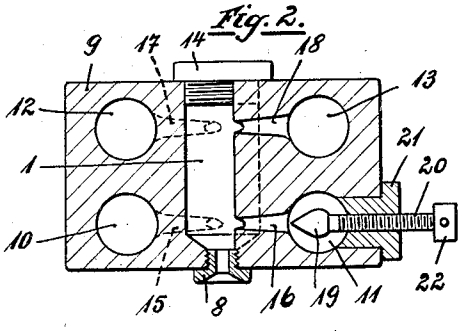


Fig. 4.

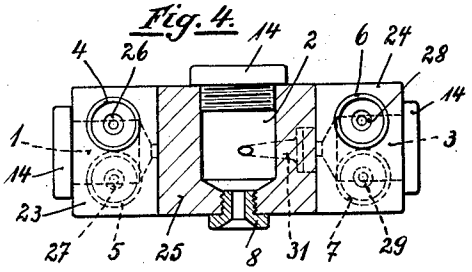
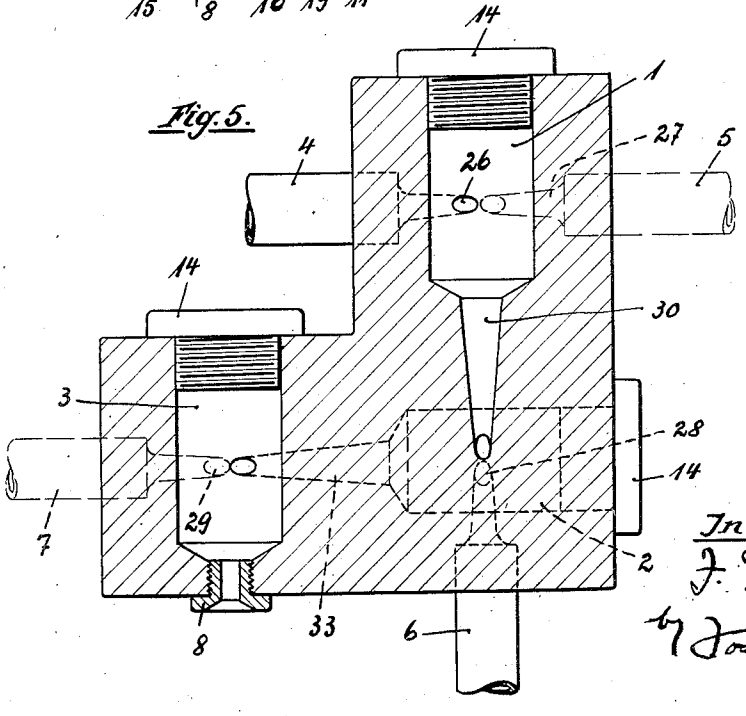


Fig. 5.



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MIXING APPARATUS FOR LIQUIDS

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Application April 8, 1931, Serial No. 528,675
In Germany April 22, 1930

4 Claims. (Cl. 137—111)

My invention relates to a mixing apparatus in which the liquids to be mixed are finely distributed in mixing chambers of substantially circular cross section having tangential inlet ducts and an axial discharge.

It is an object of my invention to so improve an apparatus of this type that it combines high output and high efficiency. To this end I subdivide the single mixing chamber of the usual apparatus into a plurality of units.

It has been found that if apparatuses of the kind referred to are designed for high output their efficiency decreases as the size of the mixing chamber increases. This is due to the fact that the rotational velocity of the liquids in the mixing chamber decreases in proportion as its diameter increases. This leads to a decrease of the centrifugal action at the rate of the square of the initial velocity at which the media are delivered to the chamber.

By replacing the large mixing chamber by several smaller ones I eliminate these drawbacks and I obtain high output without sacrificing efficiency. Efficient mixing is particularly important if it is desired to obtain not only a mixture or a solution, but if chemical reactions are to be performed along with the mixing.

By providing a plurality of mixing chambers according to this invention another advantage is obtained: if several liquids are to be mixed, and two or more of them will not dissolve immediately one in the other, the mixing operation is performed to perfection in stages.

It is important that the mixing operation should be so performed that the liquids mix in the chamber, as distinguished from old apparatus in which each liquid performs its rotary or whirling movement separately and the liquids are only mixed in the discharge opening of the chamber, as obviously the time available for the mixing operation is very short and mixing is inefficient.

In the drawing affixed to this specification and forming part thereof, various types of apparatus embodying my invention are illustrated diagrammatically by way of example.

In the drawing—

Fig. 1 is an elevation of an apparatus having three mixing chambers connected in parallel to the supply passages,

Fig. 2 is a section on the line II—II in Fig. 1,

Fig. 3 is a partly sectional elevation of an apparatus having a divided casing and three mixing chambers arranged in parallel, the central chamber having the discharge nozzle.

Fig. 4 is a section on the axis of the central mixing chamber of Fig. 3, and

Fig. 5 is a sectional elevation of an apparatus having an undivided casing with its chambers arranged in series, but in which the last chamber is provided with the discharge nozzle.

Referring now to the drawing, and first two Figs. 1 and 2, **9** is a casing or block which may be of rectangular cross-section. **10**, **11**, **12** and **13** are parallel inlet feeds for the liquids to be mixed, these inlet feeds are parallel and extend upwardly in the casing **9**, and **1**, **2**, **3** are mixing chambers arranged intermediate the inlet feeds and connected with each pair of opposite inlet feeds by tangential ducts, the ducts **15**, **16** connecting the inlet feeds **10** and **11**, the ducts **17** and **18** connecting the inlet feeds **12** and **13** to the chamber **1** being indicated in Fig. 2. It will be understood that the ducts of the other mixing chambers **2** and **3** are arranged in a similar manner and need not be described in detail. **14** is a threaded plug which closes one end of each mixing chamber, and **8** is a nozzle which is inserted at the other end for the discharge of the mixture. It is to be understood that any number of inlet feeds and ducts may be combined with as many mixing chambers as required.

If instead of the three mixing chambers illustrated, or any other number of mixing chambers, a single mixing chamber were provided, its diameter would have to be very large to enable it to receive all the liquid supplied, and the disadvantage of large chambers which has been set out above, would result. By providing smaller chambers, the total volume of which is equal to that of the supposed single chamber, high rotational speeds are obtained and the mixing is as efficient as in a single-chamber apparatus of the usual type with a chamber of normal diameter. However the output of an apparatus of this latter kind is only one third of that of an apparatus according to the present invention in which three mixing chambers **1**, **2** and **3** have been shown by way of example.

If desired, I may equip any or all of the tangential ducts **15**, **16** with means for varying their free sectional area. Such means are illustrated by way of example for the duct **16** in Figs. 1 and 2, **19** being a needle valve adapted to penetrate into the opening of the duct **16** in the passage **11**, **20** being a threaded spindle, at the end of which the needle valve is provided, **21** being a threaded sleeve in the casing **9** for the reception of the spindle **20**, and **22** being a handle at its outer end. The drilling of the ducts **16** is greatly facilitated by providing the sleeves **21** which act as jigs for the drilling tools.

Obviously similar means might be provided for other ducts than the duct **16**, and for the ducts of other chambers than the chamber **1**.

Referring now to Figs. 3 and 4, the casing of the apparatus is subdivided into two outer units **23** and **24** and a central unit **25**. The mixing chamber **1** is arranged in the first outer unit **23**, the

mixing chamber 2 is arranged in the central unit 25, and the mixing chamber 3 is arranged in the second outer unit 24. Pipes 4, 5 are provided for supplying two of the liquids to be mixed to the first outer unit 23 and pipes 6 and 7 are provided for supplying two more liquids to the second outer unit 24. 26 is a duct connecting the chamber 1 to the pipe 4 and 27 is a duct connecting it to the pipe 5. Similarly ducts 28 and 29 extend from the pipes 6 and 7 respectively, to the chamber 3. 30 is a duct extending from the chamber 1 to the central chamber 2, and 31 is a duct extending from the chamber 3 also to the central chamber. The ducts 30 and 31 are preferably constituted partly by threaded nipples 32 projecting from the inner faces of the outer units 23 and 24 into bores in the end faces of the central unit 25. The chambers 1, 2 and 3 are equipped with the threaded plugs 14 at one end, but only the central chamber 2 has the discharge nozzle 8 at the end opposite its plug 14.

This type of apparatus is particularly designed for liquids, only two of which will dissolve immediately in each other. With regard to this property of the liquids, the mixing chambers 1, 2, 3 are not arranged in parallel, but in series so that the mixtures prepared from immediately soluble liquids in the chambers 1 and 3 are mixed with each other in the central chamber 2.

In the present instance two liquids are first mixed with each other in each of the chambers 1 and 3, and the mixture from the four liquids is finally discharged through the nozzle 8 of the central chamber 2. It is supposed that the first and second liquids will mix with each other, and so will the third and fourth liquids, but the third liquid will not mix with the first and second liquids. The first and second liquids are supplied by pipes 4 and 5, the third and fourth liquids by pipes 6 and 7, and mixed in the chambers 1 and 3 respectively. The preliminary mixtures from 1 and 3 are delivered to 2 through the ducts 30 and 31, and the final mixture is discharged from 2 through nozzle 8.

It will be understood that in this manner direct mixing of any two liquids which are not suitable for such mixing, is avoided by mixing such liquids, for instance, the first and the third liquid, with other more suitable liquids, and then mixing with each other the mixtures formed from each two liquids. In the central chamber 2 the mixtures are reduced to a very fine degree of subdivision and discharged through the nozzle 8 in perfectly divided condition.

Referring now to Fig. 5 the design of this apparatus is based on the fact that chemical reactions will be the more efficient, the greater the concentration of the reacting elements. Therefore the apparatus is so designed that to a first liquid a second liquid is admixed in concentrated condition in order to obtain a more efficient reaction, and the liquid is only diluted with one or more other liquids after the reaction has been completed. The pipes 4 and 5 are connected to the chamber 1 by their ducts 26 and 27, as described, and the first and second liquids, one or both of them being in concentrated condition, are mixed in the chamber 1 and are discharged into the chamber 2 through the duct 30. In this chamber another liquid is admixed to the mixture from pipe 6 through duct 28, and the mixture is discharged from chamber 2 into chamber 3 through a duct 33 at the end of the chamber opposite its plug 14. A fourth liquid is admitted to the chamber 3 through pipe 7 and duct 29 and the finished mixture is discharged through the nozzle 8 of the chamber 3.

It is to be understood that any number of liquids may be mixed in the manner described in any number of mixing chambers, to which they are supplied by any number of inlet feeds and tangential ducts.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

In the claims affixed to this specification no selection of any particular modification of the invention is intended to the exclusion of other modifications thereof, and the right to subsequently make claim to any modification not covered by these claims is expressly reserved.

I claim:—

1. A mixing apparatus for liquids comprising a casing with an initial mixing chamber adapted to have a preliminary mixing operation performed therein, a final mixing chamber adapted to receive the mixture from said initial chamber and to discharge it from the apparatus, intermediate mixing chambers the first of which is adapted to receive the mixture from the initial chamber and the last of which is adapted to deliver the mixture to the final chamber, each chamber being adapted to receive mixture from a preceding chamber and to deliver it to a succeeding chamber, and means for supplying a medium to each of said intermediate chambers.

2. A device adapted to thoroughly mix liquids including the formation of dispersions, comprising a casing, a plurality of mixing chambers of substantially circular cross-section, ducts tangentially disposed with respect to the said mixing chambers, and liquids supply passages, the combination of supply passages, tangential ducts and mixing chambers being so arranged that each mixing chamber is provided with at least two tangential ducts communicating with at least two different supply sources, the diameters of the several mixing chambers being such as to permit efficient centrifugal force to operate on the liquids in the several mixing chambers, and the number of the chambers being such as to insure high output capacity of the said device.

3. A device adapted to thoroughly mix liquids including the formation of dispersions, comprising a casing, a plurality of mixing chambers of substantially circular cross-section, ducts tangentially disposed with respect to the said mixing chambers and liquid supply passages, the combination of supply passages, tangential ducts and mixing chambers being so arranged as to permit liquid in the supply passages to flow simultaneously into several mixing chambers, the diameters of the mixing chambers being such as to permit efficient centrifugal force to operate on the liquids in the several mixing chambers, and the number of the chambers being such as to insure high output capacity of the said device.

4. A device adapted to thoroughly mix liquids including the formation of dispersions, comprising a casing, at least three mixing chambers of substantially circular cross-section, ducts tangentially disposed with respect to the said mixing chambers, the said mixing chambers being so arranged with respect to each other as to permit liquid mixture in two of them to be discharged into a third mixing chamber and the diameters of the several mixing chambers being such as to permit efficient centrifugal force to operate on the liquids in the several mixing chambers.

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