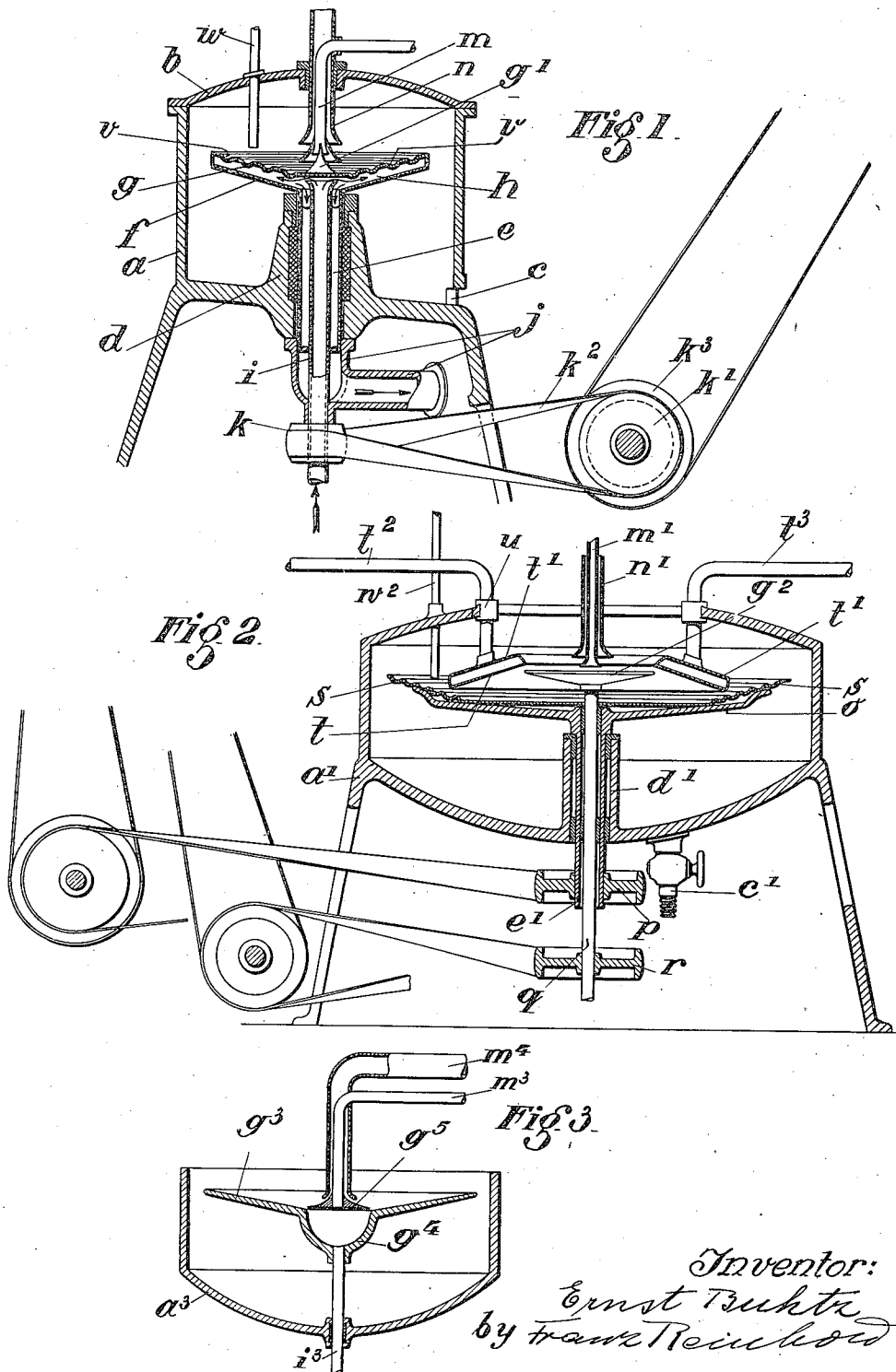


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METHOD OF AND APPARATUS FOR CARRYING OUT
CHEMICAL REACTIONS OR PHYSICAL PROCESSES
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METHOD OF AND APPARATUS FOR CARRYING OUT CHEMICAL REACTIONS OR PHYSICAL PROCESSES.

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My invention relates to improvements in the method of and apparatus for carrying out chemical reactions or physical processes, and the object of the improvements is to provide a method in which a plurality of substances are brought into contact with each other in such proportion that the proper reaction without by-reactions is insured. With this object in view my invention consists in causing the said substances to move in contact with each other and in the form of a thin film over a surface. In the preferred embodiment the substances are made to flow from the center towards the margin of a surface rotating about a substantially vertical axis at a velocity so that the time of the movement of the substances over the said surface is sufficient to complete the mixture and to introduce the reaction. Another object of the improvements is to provide a method in which the temperature of the reaction is regulated, and with this object in view my invention consists in heating or cooling the body on which the substances are made to move, so that the substances are indirectly heated or cooled.

For the purpose of explaining the invention several apparatus suitable for carrying out the method have been shown in the accompanying drawing. In said drawing,

Fig. 1 is a sectional elevation showing the apparatus.

Fig. 2 is a similar elevation showing a modification, and

Fig. 3 is a similar elevation showing another modification.

In the example shown in Fig. 1 the apparatus consists of a cylindrical casing *a* having a lid *b* and a discharge *c*. The bottom of the said casing is formed with an axial hub *d* providing a rotary bearing for a tubular member *e* carrying at its top a pair of conical plates *f* and *g* connected at their outer margins to provide a chamber *h*. Within the tubular member *e* there is a concentric pipe *i* which is rigidly connected with the tubular member *e* and which is passed downwardly through a tubular member *j* secured to the bottom of the casing *a*. The pipe *i* carries suitable driving means such as a pulley *k* adapted to be rotated from a pulley *k*¹ by means of a belt *k*². The pulley *k*¹ is adapted to be rotated at different velocities, for example by means of a stepped

pulley *k*³. Through the lid *b* two concentric pipes *m* and *n* are passed downwardly which open above the center of the upper plate *g*, both pipes being formed at their delivery ends with outwardly flaring walls. To the plate *g* a substantially conical guide member *g*¹ is secured.

In the operation of the apparatus the liquids to be entered into reaction are supplied through the pipes *m* and *n*, and the pipe *i* and the plates *f* and *g* connected therewith are made to rotate. The liquid admitted through the pipe *m* is deflected outwardly by the guide cone *g*¹, and it is spread by centrifugal action on the top face of the plate *g* so as to move from the center of the said plate towards the margin thereof. The liquid supplied through the pipe *n* is deflected by the flaring portion of the inner pipe *m*, and it falls on the film of liquid admitted through the pipe *m* and moving over the top face of the plate *g*. The liquids are supplied to the pipes *m* and *n* in measured amounts, so that they meet in the correct proportion on the plate *g*, thus insuring exact reaction and avoiding by-reactions. From the plate *g* the mixed liquids are thrown into the casing *a*, from which they are removed through the outlet *c*.

According to the character of the reaction a heating or cooling medium is admitted through the pipe *i* to the chamber *h*, which liquid is thrown against the bottom face of the plate *g*, moves outwardly by centrifugal action and is discharged through the annular passage provided between the tubular member *e* and the pipe *i*, and through the outlet *j*.

The velocity of the rotation of the plate *g* is regulated so that the time of the movement of the liquids over the plate *g* is sufficient to complete the reaction or a substantial part thereof. If the reaction of the substances is too slow I pass the liquids a second time through the apparatus, or I allow the mixed liquids to stand within the reaction receptacle, in which case the main object of the rotary plate *g* is the production of a uniform mixture of measured amounts of liquids.

While moving over the surface of the plate *g* the liquids are thoroughly mixed with each other. But in some cases the mixing of the liquids is assisted by providing

the surface of the plate g with suitable obstructing members such as projections or depressions v .

I have found that the best results are obtained if the plate g is rotated at comparatively low velocity. Generally speaking, the said velocity depends on the character of the liquids, and I have found that the velocity should be high, if the substances are not readily mixed with each other. To give an example of the operation of the apparatus, I have mixed toluol and chlorosulphonic acid (HSO_3Cl), in which case the diameter of the plate g was 30 centimeters, and the plate was rotated at a velocity of 60 per minute.

In such cases in which the reaction is completed very rapidly I may add a third substance, admitted to the disk g through a pipe w disposed eccentrically of the pipes m and n , in which case the diameter of the plate g is increased and the velocity of the rotation decreased.

In Fig. 2 I have shown a modification, in which the liquids are successively passed over concentric surfaces rotating in opposite directions. As shown the apparatus comprises a receptacle a^1 having an outlet c^1 and formed with an axial hub d^1 providing a bearing for a tubular shaft e^1 made integral at its top with a disk o and adapted to be rotated by suitable means such as a belt gearing including a pulley p . Within the said tubular shaft a solid shaft q is rotatable which carries at its top a disk g^2 , and which is adapted to be rotated in a direction opposite to that of the pulley p by suitable means such for example as a belt gearing including a pulley r . The disk o provides a support for a conical annular disk s . Above the margin of the disk g^2 there is a conical annular disk t fixed to brackets u . Above the said disk there is a jacket t^1 connected by inlet and delivery pipes t^2 and t^3 for circulating a heating or cooling liquid therethrough. Above the disk g^2 there are two concentric pipes m^1 and n^1 for supplying the liquids to the disk g^2 .

In the operation of the apparatus the disks g^2 and s are made to rotate in opposite directions, and measured amounts of the substances to be subject to the reaction are gradually admitted through the pipes m^1 and n^1 , which liquids are spread into a thin film moving over the surface of the disk g^2 and flowing against the stationary disk t . From the latter the mixture falls on the annular disk s and it moves thereon outwardly by centrifugal action. By circulating a heating or cooling medium through the jacket t^1 the temperature of the reaction may be regulated. For adding a third liquid an eccentric pipe w^2 may be provided.

In Fig. 3 I have shown a modification in

which the rotary disk g^3 comprises a semi-spherical cavity g^4 receiving the liquid admitted through the inner pipe m^3 , the outer pipe m^4 delivering the liquid on a distributing disk g^5 . The disk g^3 , g^4 is mounted on a rotary shaft i^3 passed through the bottom of the casing a^3 .

The apparatus may be used for carrying out chemical reactions such as condensation, oxidation and reduction, for the preparation of emulsions, for shaking out albuminous substances for the salting out of soap and the like. By regulating the speed of rotation and of the supply, the thickness of the layers or films and thereby the conditions of the reaction can be altered as desired so as to meet any requirements of the process.

While in describing the invention reference has been made to particular examples embodying the same I wish it to be understood that my invention is not limited to the constructions shown in the drawing, and that various changes may be made in the general arrangement of the apparatus and the construction of its parts without departing from the invention.

I claim:

1. The herein described method of causing chemical or physico-chemical reactions of substances which consists in simultaneously supplying the said substances in the form of superposed films in amounts corresponding to the chemical composition of the components to be formed by the reaction to a disk near the center thereof, and rotating the said disk.

2. The herein described method of causing chemical or physico-chemical reactions of substances, which consists in separately supplying the said substances in amounts corresponding to the chemical composition of the compounds formed by the reaction to a disk near the center thereof, heating the said substances during the reaction, and rotating the said disk.

3. An apparatus for causing a plurality of substances to react on each other, comprising a disk having its surface rising from its center towards its margin, means to rotate said disk about a vertical axis, and means to supply the substances to the surface of said disk near the center thereof.

4. An apparatus for causing a plurality of substances to react on each other, comprising a body having a substantially vertical axis of rotation and having its top surface formed with depressions, means to supply said substances to the top surface of said body near the axis of rotation thereof, and means to rotate said body at a velocity so as to cause gradual movement of the said substances towards the margin of said body.

5. An apparatus for causing a plurality

of substances to react on each other, comprising a body having a substantially vertical axis of rotation, concentric pipes for supplying said substances to the top surface of said body near the axis of rotation thereof, and means to rotate said body at a velocity so as to cause gradual movement of the said substances towards the margin of said body.

6. An apparatus for causing a plurality of substances to react on each other, comprising a body having a substantially vertical axis of rotation and having its top surface formed with annular depressions, means to supply said substances to the top surface of said body near the axis of rotation thereof, and means to rotate said body at a velocity so as to cause gradual movement of the said substances towards the margin of said body.

7. An apparatus for causing a plurality of substances to react on each other, comprising a body having a substantially vertical axis of rotation, means to supply two of said substances to the top surface of said body near the axis of rotation thereof, means to supply a third substance to said body at a part a substantial distance away from the center thereof, and means to rotate said body at a velocity so as to cause gradual movement of the said substances towards the margin of said body.

8. An apparatus for causing a plurality of substances to act on each other, comprising

ing a plurality of rotary bodies having inner and outer concentric surfaces, means to rotate said bodies in opposite directions, and means to supply the substances to the inner surface near the axis of rotation, said outer surface being disposed in position for taking up the substances delivered from the inner surface.

9. An apparatus for causing a plurality of substances to act on each other, comprising a plurality of rotary bodies having inner and outer concentric surfaces, means to rotate said bodies in opposite directions, means to supply the substances to the inner surface near the axis of rotation, and a member intermediate said surfaces in position for taking up the substances delivered from the inner surface and to direct the same on the outer surface.

10. An apparatus for causing a plurality of substances to act on each other, comprising a plurality of rotary bodies having inner and outer concentric surfaces, means to rotate said bodies in opposite directions, means to supply the substances to the inner surface near the axis of rotation, a member intermediate said surfaces in position for taking up the substances delivered from the inner surface and to direct the same on the outer surface, and means to regulate the temperature of the intermediate member.

In testimony whereof I hereunto affix my signature.

ERNST BUHTZ.