

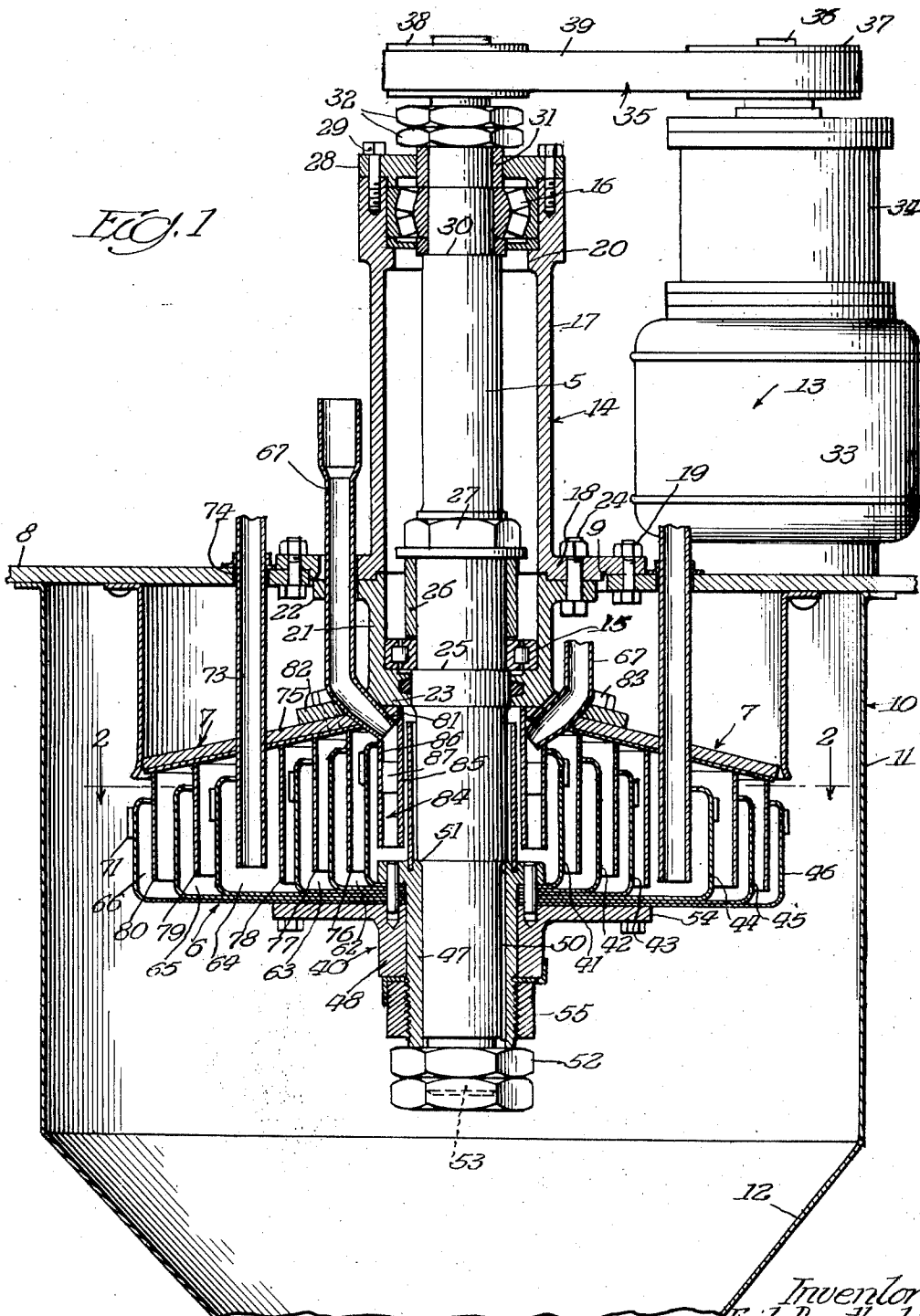
June 5, 1951

F. PERNTHALER
CENTRIFUGAL VARIETY APPARATUS FOR MIXING
AND REACTING LIQUID MATERIALS

2,555,899

Filed Aug. 19, 1949

2 Sheets-Sheet 1



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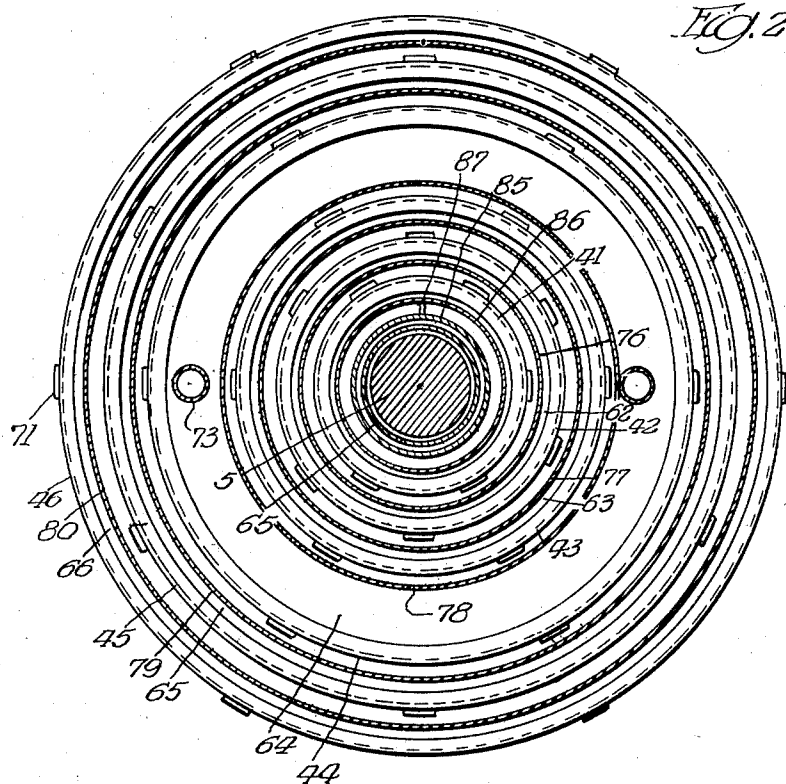
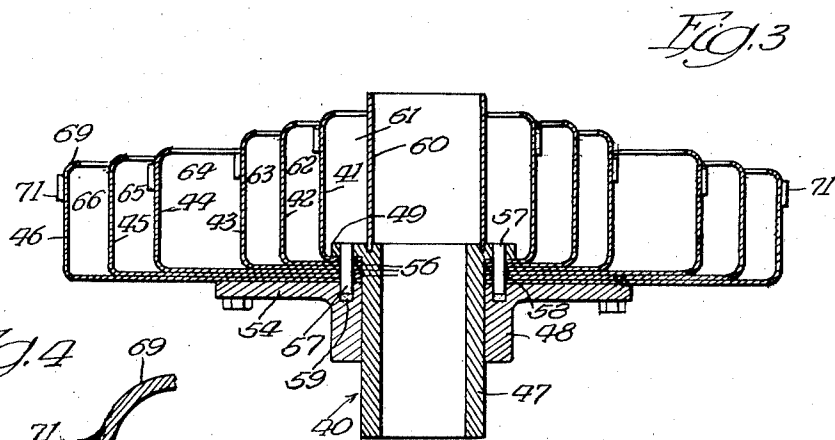
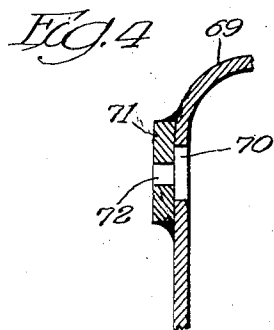
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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CENTRIFUGAL VARIETY APPARATUS FOR
MIXING AND REACTING LIQUID MATERIALS

Fritz Pernthaler, Dusseldorf, Germany

Application August 19, 1949, Serial No. 111,104

5 Claims. (Cl. 259-96)

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The present invention relates generally to mixing apparatus. More particularly the invention relates to that type of apparatus which serves as a medium or instrumentality for mixing materials in liquid form for reaction purposes and as its principal components or parts comprises (1) a power driven rotor which is mounted to revolve about a vertical axis and consists of a bottom structure and a plurality of upwardly extending, spaced apart, concentric, annular, chamber-forming walls; (2) a stationary cover which overlies the rotor and consists of a top structure and a plurality of downwardly extending, spaced apart, concentric annular partitions between and in spaced relation with the upwardly extending annular walls of the rotor; and (3) a plurality of conduits which lead downwards through the central portion of the top structure of the cover and serve to introduce the materials to be mixed together for reaction purposes into the rotor's innermost chamber from whence, in connection with drive of the rotor, they flow outwards successively through the other chambers which are formed or defined by the upwardly extending walls of the rotor.

One object of the invention is to provide a mixing apparatus of this type which is an improvement upon, and has certain inherent advantages over, previously designed apparatus and is characterized by extremely high efficiency and simplicity of design.

Another object of the invention is to provide a mixing apparatus of the type under consideration in which the upwardly extending annular walls of the rotor have the upper margins thereof inclined inwards, i. e., in the direction of the axis of the rotor, and embody beneath such margins radially extending nozzles which during operation of the apparatus jet the materials outwards so that they flow successively through the chambers that are formed or defined by the annular walls of the rotor.

Another object of the invention is to provide a mixing apparatus of the type and character under consideration in which the upwardly extending annular walls of the rotor progressively decrease in height from the innermost wall to the outermost wall and the top structure of the cover is conical.

Another object of the invention is to provide a mixing apparatus of the aforementioned type in which the rotor is formed of a plurality of stamped metal cup shaped members which are arranged in nested relation.

A further object of the invention is to provide

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a mixing apparatus of the type under consideration in which the central portion of the cover is provided with a depending baffle arrangement which is disposed in the innermost chamber of the rotor and serves intimately to mix the liquid materials as they enter such chamber from the conduits.

A still further object of the invention is to provide a mixing apparatus which is generally of new and improved construction, effectively and efficiently fulfills its intended purpose and is so designed and constructed that it may be produced and operated at a comparatively low cost.

Other objects of the invention and the various advantages and characteristics of the present mixing apparatus will be apparent from a consideration of the following detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawings which accompany and form a part of this specification or disclosure and in which like numerals of reference denote corresponding parts throughout the several views:

Figure 1 is a vertical section of a mixing apparatus embodying the invention;

Figure 2 is a horizontal section taken on the line 2-2 of Figure 1 and illustrating in detail the arrangement of the downwardly extending concentric annular partitions of the cover with respect to the upwardly extending concentric annular chamber-forming walls of the rotor;

Figure 3 is a vertical section of the rotor showing in detail the manner in which it is formed or constructed; and

Figure 4 is an enlarged vertical section of one of the radially extending nozzles.

The apparatus which is shown in the drawings constitutes the preferred form or embodiment of the invention. It is adapted in connection with use thereof and as described hereafter more in detail, to mix together liquid materials for reaction purposes. As its principal components the apparatus comprises a vertically extending shaft 5, a rotor 6 on the lower end of the shaft, and a stationary cover 7 above the rotor. As shown in Figure 1, the apparatus is supported by a horizontally extending plate 8. The latter is supported in an elevated position by any suitable means (not shown) embodies a circular opening 9, and has depending therefrom a container 10. Such container surrounds the rotor and cover of the apparatus and embodies a cylindrical side wall 11 and an infundibular or funnel shaped

bottom wall 12. The side wall 11 of the container is disposed concentrically with respect to the circular opening 9 and has its upper margin connected to the bottom face of the plate 8 in any suitable manner. The bottom wall 12 is connected to the lower margin of the container side wall 11 and embodies at its lower or apex portion a valve controlled outlet (not shown).

The vertically extending shaft 5 of the mixing apparatus is driven by an electric motor 13 and extends through the circular opening 9 in the supporting plate 8. The central and upper portions of the shaft are disposed within an elongated, vertically extending, sectional journal box 14. They are supported rotatably by a lower roller bearing 15 and an upper roller bearing 16. The journal box 14 consists of an upper section and a lower section. The upper section embodies a cylindrical side wall 17 and this embodies at its lower end an outwardly extending annular flange 18. Such flange rests on the opening defining portion of the supporting plate 8 and is fixedly secured thereto by way of an annular series of bolts 19. At a point beneath its upper end the cylindrical side wall 17 of the upper section of the journal box is provided with an inwardly extending annular flange 20. The lower section of the journal box consists of a cylindrical side wall 21 and this is the same in diameter as, and in longitudinal alignment with, the cylindrical side wall 17 of the upper section of the journal box. The upper end of the side wall 21 of the lower section of the journal box is provided with an outwardly extending annular flange 22 and the lower end is provided with an inwardly extending annular flange 23. The flange 22 abuts against, and is secured by vertically extending bolts 24 to, the inner marginal portion of the outwardly extending annular flange 18 on the lower end of the cylindrical side wall 17 of the upper section of the journal box. The lower roller bearing 15 surrounds the central portion of the shaft 5 and consists of outer and inner races and an annular series of rollers between the races. The outer race of the bearing 15 rests on the inwardly extending flange 23 and the inner race rests on an upwardly extending shoulder 25 on the central portion of the shaft 5 and is held in place by way of a clamp sleeve 26 which is urged downwards by way of a nut 27. The latter surrounds the central portion of the shaft 5 and is connected thereto by way of a screw thread connection (not shown). The upper roller bearing 16 surrounds the upper portion of the shaft 5 and consists of outer and inner races and an annular series of rollers between the two races. The outer race of the upper bearing overlies the inwardly extending annular flange 20 and is held in place by way of a ring shaped cap 28 which is secured to the upper end of the cylindrical side wall 17 of the upper section of the journal box by cap screws 29. The inner race of the bearing 16 overlies an annular upwardly facing shoulder 30 on the upper portion of the shaft 5 and is held in place by way of a clamp sleeve 31 which is urged downwards by nuts 32 on the upper end of the shaft 5. Said upper end of the shaft 5 projects through and terminates above the ring shaped cap 28.

The electric motor 13 for driving the shaft 5 of the mixing apparatus is located at one side of the upper section of the journal box 14 and consists of a housing 33 and a vertically extending armature shaft (not shown). The motor housing 33 rests on, and is suitably fixedly connected to, the supporting plate 8. The motor 13 is con-

nected to drive the shaft by way of a gear variety speed reducing unit 34 and a pulley and belt connection 35. The speed reducing unit 34 is mounted on the upper end of the motor housing 33 as shown in Figure 1. It is connected to be driven by the armature shaft of the motor 13 and embodies an upwardly extending driven shaft 36. The pulley and belt connection 35 consists of a pulley 37 on the upper end of the driven shaft 36, a pulley 38 on the upper end of the shaft 5, and an endless belt 39 around the two pulleys. Whereas the shaft 5 may be driven at any desired speed by the motor 13 it has been found that in connection with the mixing and reacting of certain liquid materials a speed of 500 R. P. M. produces desirable results.

The rotor 6 of the apparatus is disposed within the container 10 and surrounds, and is connected for drive by, the lower portion of the vertically extending shaft 5. It is of composite character and consists of a two-piece hub 40 and a plurality of cup shaped members 41, 42, 43, 44, 45 and 46. The hub 40 surrounds the lower end of the shaft 5 and consists of a cylindrical inner piece 47 and a cylindrical outer piece 48. The inner piece is provided at its upper end with an outwardly extending annular flange 49 and is fixedly or drivably connected to the lower end of the shaft 5 by a longitudinally extending key 50. The inner portion of the key fits within an outwardly facing key-way in the lower end of the shaft 5 and the outer portion of the key fits within an inwardly facing key-way in the inner periphery of the inner piece 47 of the hub. The upper end of the inner piece 47 is clamped against a downwardly facing shoulder 51 on the lower portion of the shaft 5 by a pair of nuts 52. The latter are mounted on a screw threaded stem 53 on the lower end of the shaft 5. The cylindrical outer piece 48 of the hub 40 surrounds the central portion of the inner piece 47 of the hub and is provided at its upper end with a comparatively wide outwardly extending annular flange 54. It is held against downward displacement by way of a nut 55 which surrounds the lower end of the cylindrical inner piece 47 of the hub and is mounted on an external screw thread. The cup shaped members 41, 42, 43, 44, 45 and 46 are preferably in the form of stainless steel stampings and each consists of a flat bottom wall and an upwardly extending annular or cylindrical side wall. They are arranged in nested relation and have the side walls thereof concentrically disposed and spaced apart. The bottom walls of the cup shaped members rest on one another and are supported on the annular outwardly extending flange 54 of the cylindrical outer piece 48 of the hub 40. The central portions of the bottom walls of the cup shaped members have circular openings 56 through which the upper end of the cylindrical inner piece 47 of the hub 40 extends. The opening defining portions of the bottom walls of the cup shaped members are clamped between the outwardly extending flange 49 and the inner portion of the flange 54 in order that the cup shaped members are connected to rotate with the hub 40 in connection with drive of the shaft 5. Vertically extending pins 57 depend from the flange 49, extend through holes 58 in the inner marginal portions of the bottom walls of the cup shaped members and into sockets 59 in the cylindrical outer piece 48 of the hub and serve to connect the cup shaped members together for conjoint rotation with the hub. Preferably there are six cup shaped members, al-

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though it is to be understood that more or less may be employed if desired. The side wall of the cup shaped member 41 defines with a cylindrical sleeve 60 a ring shaped chamber 61. The sleeve 60 surrounds the lower portion of the shaft 5 at a point above the downwardly facing shoulder 51 and has its lower end suitably secured to the upper end of the cylindrical inner piece 47 of the hub 40. The side wall of the cup shaped members 41 and 42 define between them a ring shaped chamber 62 directly outwards of the chamber 61; the side walls of the members 42 and 43 define between them a ring shaped chamber 63 directly outwards of the chamber 62; the side walls of the members 43 and 44 define between them a ring shaped chamber 64 directly outwards of the chamber 63; the side walls of the members 44 and 45 define between them a ring shaped chamber 65 directly outwards of the chamber 64; and the side walls of the members 45 and 46 define between them a ring shaped chamber 66 directly outwards of the chamber 65. The side walls of the cup shaped members are of progressively decreasing height from the innermost side wall to the outermost side wall and as a result the ring shaped chambers progressively decrease in height from innermost to outermost. Two vertically extending conduits 67 serve to introduce into the innermost chamber 61 the liquid materials that are to be mixed together for reaction purposes. One of the conduits 67 extends downwards through registering openings in the flanges 18 and 22 and is adapted to have one of the liquid materials to be mixed introduced into its upper end. The lower end of the one conduit 67 constitutes a discharge and terminates at the upper inner portion of the chamber 61. The other conduit 67 is disposed diametrically opposite the one conduit and is adapted to have another of the liquid materials to be mixed introduced into its upper end. Its lower end constitutes a discharge and leads to and terminates adjacent the upper inner portion of the chamber 61. The upper margins of the side walls of the cup shaped members are bent inwards at substantially a 45° angle in order to form inwardly extending lips 69 for restraining up-flow of the liquid materials in the various ring shaped chambers. Directly beneath the lips 69 the side walls of the cup shaped members are provided with radially extending holes 70 and these have associated therewith nozzles 71. The latter have orifices 72 therein and are arranged so that the orifices are in alignment and communicating relation with the holes 70. Preferably the nozzles 71 are welded to the outer surfaces of the side walls of the cup shaped members. In connection with operation of the apparatus the liquid materials which are introduced into the chamber 61 by the conduits 67 and 68 become mixed in the chamber and the mixture, in response to centrifugal force, swirls around the side wall of the cup shaped member 41 and then is jetted outwards through the nozzles on the side wall of the cup shaped member 41 into the next outer chamber 62. After being jetted into the chamber 62 the mixture swirls around the side wall of the cup shaped member 42 and is then jetted into the chamber 63 through the nozzles on the side wall of the cup shaped member 42. After being jetted into the chamber 62 the mixture swirls around the side wall of the cup shaped member 43 and is then jetted into the chamber 64. From such chamber the mixture is successively jetted into the chambers

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65 and 66. From the chamber 66 the mixture is jetted outwards through the nozzles on the side wall of the cup shaped member 46 into the interior of the container 10 which, as heretofore pointed out, surrounds the rotor of the apparatus. The materials of which the mixture is composed are thoroughly mixed for reaction purposes in connection with swirling and jetting. The upwardly and inwardly inclined lips 69 at the upper marginal portions of the side walls of the cup shaped members tend to restrain the mixture so that it flows through the nozzles 71. If desired a third material in liquid form may be introduced into the chamber 64 for mixing with the liquid mixture in such chamber. A vertically extending conduit 73 serves this purpose. It extends downwards through a hole 74 in the supporting plate 8 and has the lower discharge end thereof disposed in the lower portion of the chamber 64.

The cover 7 of the mixing apparatus is disposed between the rotor 6 and the supporting plate 8 and consists of a top structure 75, and downwardly extending, spaced apart, concentric, annular partitions 76, 77, 78, 79 and 80. The top structure 75 is conical and overlies and is spaced a small distance above the annular side walls of the cup shaped members 41, 42, 43, 44, 45 and 46 of the rotor 6. It is formed of any suitable comparatively thick plate metal and has a circular, centrally disposed opening 81 through which extends the lower portion of the shaft 5. The inner marginal portion of the top structure 75 fits against the bottom face of an outwardly and downwardly extending annular flange 82 on the lower end of the cylindrical lower section of the journal box 14. Bolts 83 extend through aligned holes in the flange 82 and the inner marginal portion of the top structure 75 and serve rigidly to hold in place the cover 7. The annular partitions 76, 77, 78, 79 and 80 depend from the top structure 75 and have the outer margins thereof welded or otherwise fixedly secured to the bottom face of said top structure. The partition 76 is disposed substantially midway between the side walls of the cup shaped members 41 and 42 and is of such height that the lower edge thereof is disposed a small distance above the bottom of the ring shaped chamber 62. The partition 77 is disposed substantially midway between the side walls of the cup shaped members 42 and 43 and is arranged so that its lower edge terminates a small distance above the bottom of the chamber 63. The partition 78 is located between the upwardly extending side walls of the cup shaped members 43 and 44 and has its lower edge disposed a small distance above the bottom of the chamber 64. The partition 79 is positioned substantially midway between the upwardly extending side walls of the cup shaped members 44 and 45 and has its lower edge disposed a small distance above the bottom of the chamber 65. The partition 80 is positioned substantially midway between the upwardly extending side walls of the cup shaped members 45 and 46 and is of such height that its lower edge is spaced a small distance above the bottom of the ring shaped chamber 66. The partitions are imperforate and each operates to cause the mixture which is jetted into its particular chamber to flow first downwards and then upwards in order to assist in intimately mixing for reaction purposes the liquid materials of which the liquid mixture is composed. Because of the construction and design of the annular

partitions they, together with the top structure 75, prevent escape of vapor in connection with operation of the apparatus. In addition to the parts heretofore mentioned the stationary cover 7 comprises a baffle arrangement 84. The latter is disposed for the most part within the innermost chamber 61 and consists of spaced apart inner and outer cylindrical concentrically arranged sleeves 85 and 86 and vertically extending baffles 87 between the two sleeves. The inner sleeve closely surrounds the sleeves 60 and is connected to, and depends from, the portion of the cover top structure 75 that defines the circular opening 81. The outer sleeve 86 is spaced beneath the top structure 75 and is disposed wholly within the ring shaped chamber 61. It is held in spaced relation to the inner sleeve 85 by the vertically extending baffles 87. The latter are positioned radially so far as the axis of the shaft 5 is concerned and serve to reduce or diminish the speed of flow of the liquid materials in the ring shaped chamber 61. The lower or discharge ends of the conduits 67 and 68 are preferably arranged so that they feed or supply the liquid materials into the space between the inner and outer sleeves 85 and 86.

Assuming that the rotor 6 is being driven by the electric motor 13 and liquid materials to be mixed are being introduced by way of the conduits 67, 68 and 73 the operation of the apparatus is as follows:

The liquid materials which are introduced into the chamber 61 by the conduits 67 and 68 are subjected to the baffle arrangement 84 and are mixed together in a preliminary manner. After being subjected to the action of the baffle arrangement the mixture, in response to the action of centrifugal force, swirls around the upwardly extending annular side wall of the cup shaped member 41 and then, as previously pointed out, is jetted outwards through the nozzles at the upper margin of said side wall. The mixture, after being jetted through such nozzles, flows downwards across the inner face or periphery of the annular partition 75 and then flows upwards between said partition and the side wall of the cup shaped member 42. After up-flow of the mixture it is jetted outwards into the chamber 63 through the nozzles at the upper margin of the side wall of the cup shaped member 42. In a similar manner the mixture flows through the chambers 63, 64, 65 and 66 and is then jetted outwards against the inner periphery of the cylindrical side wall 11 of the container 10. In connection with successive flow of the mixture through the chambers the desired reaction takes place.

The herein described mixing apparatus is comparatively simple so far as design and construction are concerned and effectively and efficiently fulfills its intended purpose. It has various capabilities of use and occupies but a small amount of space.

The invention is not to be understood as restricted to the details set forth since these may be modified within the scope of the appended claims without departing from the spirit and scope of the invention.

Having described my invention, what I claim as new and wish to secure by Letters Patent is:

1. A centrifugal variety apparatus adapted to mix liquid materials for purposes of reaction and comprising a rotor mounted to revolve about a vertical axis, provided with power means for driving it, and embodying a bottom

structure and a plurality of spaced apart concentric annular walls connected fixedly to, and extending upwards from, the bottom structure, defining between them a series of ring shaped combined mixing and reacting chambers, adapted during drive of the rotor to have the liquid materials swirl therearound, having their upper margins inclined inwards to form material restraining lips, and provided directly beneath said lips with circumferentially spaced apart orifice defining means whereby communication is established between the chambers and the liquid materials are caused, after swirling upwards around the annular walls and being restrained by said lips, to be jetted outwards in small sized streams from one chamber into the next, a stationary cover positioned over the rotor and embodying a top structure and a plurality of spaced apart concentric annular partitions connected to, and extending downwards from, the top structure, projecting into, and terminating a small distance above the bottoms of, certain of the chambers, and serving to cause the liquid materials to flow through said certain chambers in a U-shaped course, and conduit means for introducing into the innermost chamber the liquid materials to be mixed and reacted.

2. A centrifugal variety apparatus adapted to mix liquid materials for purposes of reaction and comprising a rotor mounted to revolve about a vertical axis, provided with power means for driving it, and embodying a bottom structure and a plurality of spaced apart concentric annular walls connected fixedly to, and extending upwards from, the bottom structure, defining between them a series of ring shaped combined mixing and reacting chambers, adapted during drive of the rotor to have the liquid materials swirl therearound, having their upper margins inclined inwards at substantially a 45° angle to form material restraining lips, and provided directly beneath the lips with circumferentially spaced apart radially extending nozzles whereby communication is established between the chambers and the liquid materials are caused, after swirling upwards around the annular walls and being restrained by said lips, to be jetted outwards in small sized streams from one chamber into the next, a cover positioned over the rotor and embodying a top structure and a plurality of imperforate spaced apart concentric annular partitions connected to, and extending downwards from, the top structure, projecting into, and terminating a small distance above the bottoms of, certain of the chambers, and serving to cause the liquid materials to flow through said certain chambers in a U-shaped course, and conduit means for introducing into the innermost chamber the liquid materials to be mixed and reacted.

3. A centrifugal variety apparatus adapted to mix liquid materials for purposes of reaction and comprising a rotor mounted to revolve about a vertical axis, provided with power means for driving it, and embodying a substantially flat bottom structure and a plurality of spaced apart concentric annular walls connected fixedly to, and extending upwards from, the bottom structure, progressively decreasing in height from the innermost to the outermost, defining between them a series of ring shaped combined mixing and reacting chambers, adapted during drive of the rotor to have the liquid materials swirl therearound, having their upper margins inclined in-

wards to form material restraining lips, and provided directly beneath the lips with radially extending nozzles whereby communication is established between the chambers and the liquid materials are caused, after swirling around the annular walls, to be jetted outwards from one chamber into the next, a stationary cover positioned over the rotor and embodying a conical top structure, a plurality of substantially imperforate spaced apart concentric annular partitions connected to, and extending downwardly from, the top structure, projecting into, and terminating a small distance above the bottoms of, the chambers, and serving to cause the liquid materials to flow through said chambers in a U-shaped course, conduit means extending downwards through the central portion of the top structure of the stationary cover and adapted to introduce into the innermost chamber the liquid materials to be mixed and reacted, and a stationary baffle arrangement disposed in said innermost chamber and consisting of a pair of spaced apart concentric sleeves suspended from the central portion of said top structure disposed on opposite sides of the conduit means and having the lower ends thereof spaced above the bottom of the innermost chamber, and in addition vertically and radially extending baffles between the sleeves.

4. A centrifugal variety apparatus adapted to mix liquid materials for purposes of reaction and comprising a rotor mounted to revolve about a vertical axis, provided with power means for driving it and embodying a plurality of separately formed cup-shaped members connected together in nested relation and having the side walls thereof spaced apart and concentrically arranged, defining between them a series of ring shaped combined mixing and reacting chambers, adapted during drive of the rotor to have the liquid materials swirl therearound, and provided beneath their upper edges with orifice defining means whereby communication is established between the chambers and the liquid materials are caused, after swirling around the side walls, to be jetted outwards from one chamber into the next, and a stationary cover positioned over the rotor and embodying a top structure and a plurality of spaced apart concentric annular partitions connected to, and extending downwardly from, the top structure, projecting into, and terminating a small distance above the bottoms of, certain of

the chambers and serving to cause the liquid materials to flow through said certain chambers in a U-shaped course, and conduit means for introducing into the innermost chamber the liquid materials to be mixed and reacted.

5. A centrifugal variety apparatus adapted to mix liquid materials for purposes of reaction and comprising a rotor mounted to revolve about a vertical axis, provided with power means for driving it, and embodying a plurality of separately formed one-piece cup-shaped members connected together in nested relation and having the side walls thereof spaced apart and concentrically arranged, defining between them a series of ring shaped combined mixing and reaction chambers, adapted during drive of the rotor to have the liquid materials swirl therearound, provided with inwardly inclined upper margins to form material restraining lips, and provided directly beneath said lips with circumferentially spaced orifice defining means whereby communication is established between the chambers and the liquid materials are caused, after swirling upwards around the side walls and being restrained by said lips, to be jetted outwards in small sized streams from one chamber into the next, and a cover positioned over the rotor and embodying a top structure and a plurality of spaced apart concentric annular partitions connected to, and extending downwardly from, the top structure, projecting into, and terminating a small distance above the bottom of, certain of the chambers and serving to cause the liquid materials to flow through said certain chambers in a U-shaped course, and conduit means for introducing into the innermost chamber the liquid materials to be mixed and reacted.

FRITZ PERNTHALER.

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