

April 5, 1960

K. E. RUMBEL ET AL

2,931,633

MIXING APPARATUS

Filed Feb. 27, 1958

3 Sheets-Sheet 1

Fig. 1.

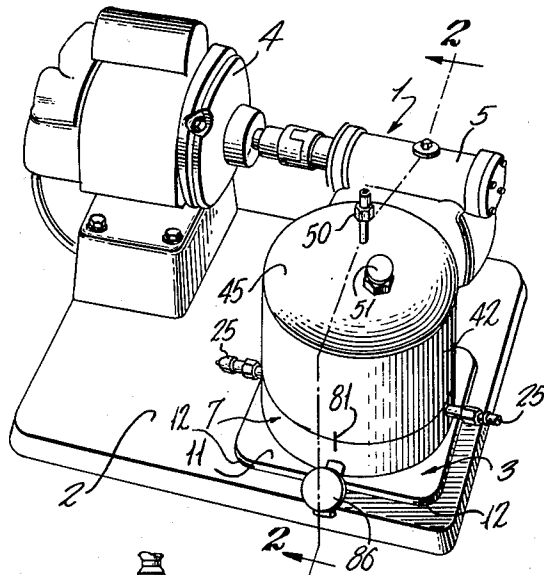
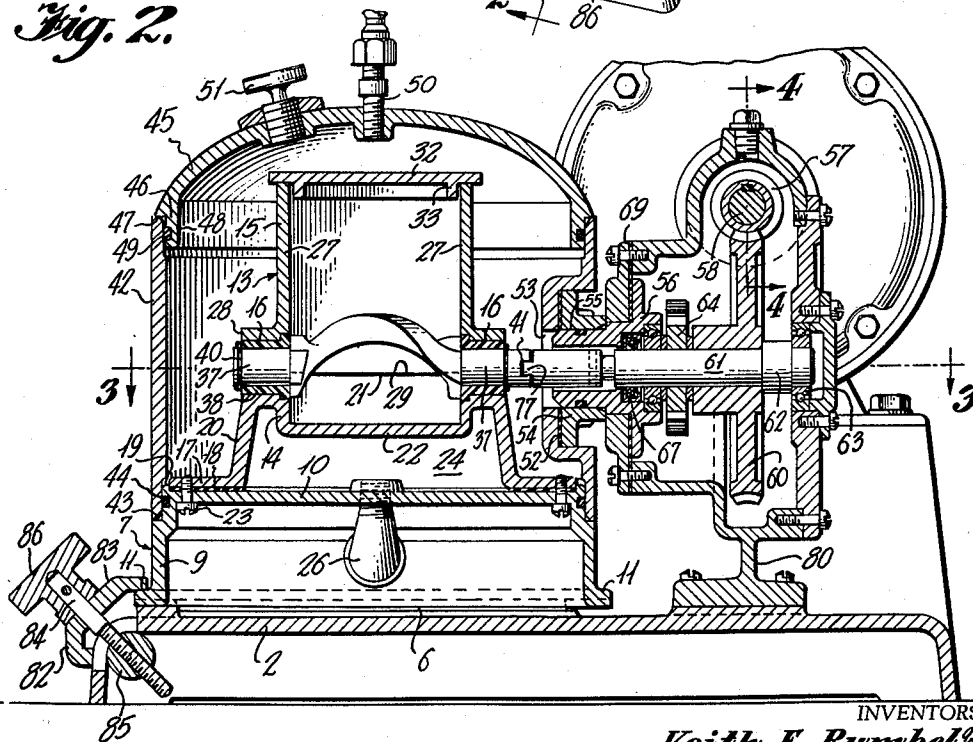


Fig. 2.



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3 Sheets-Sheet 2

Fig. 3.

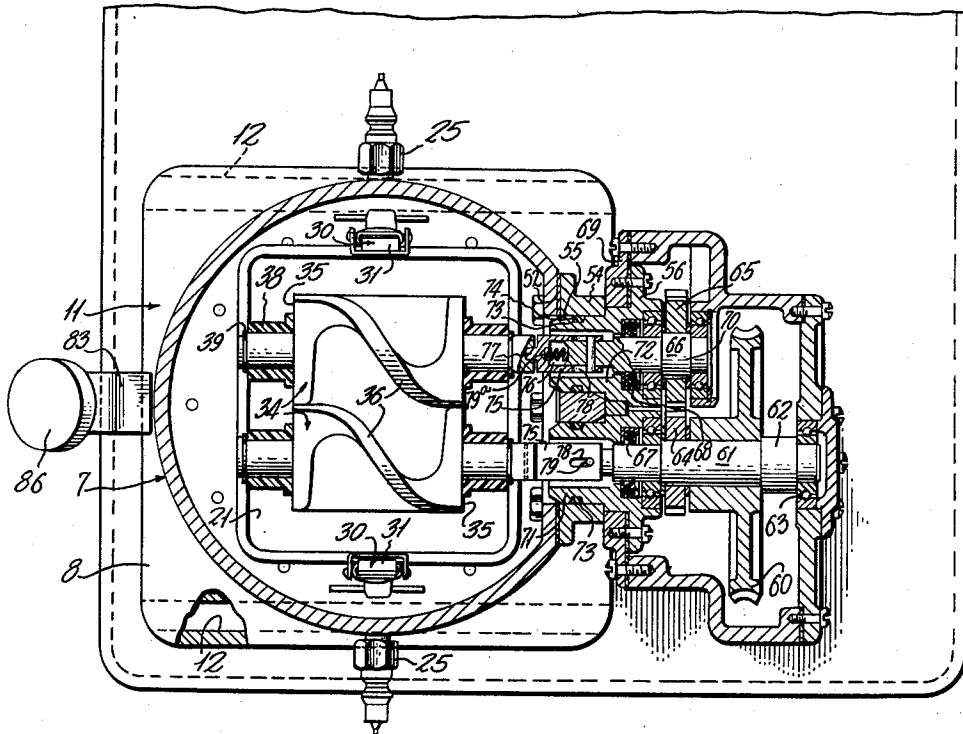
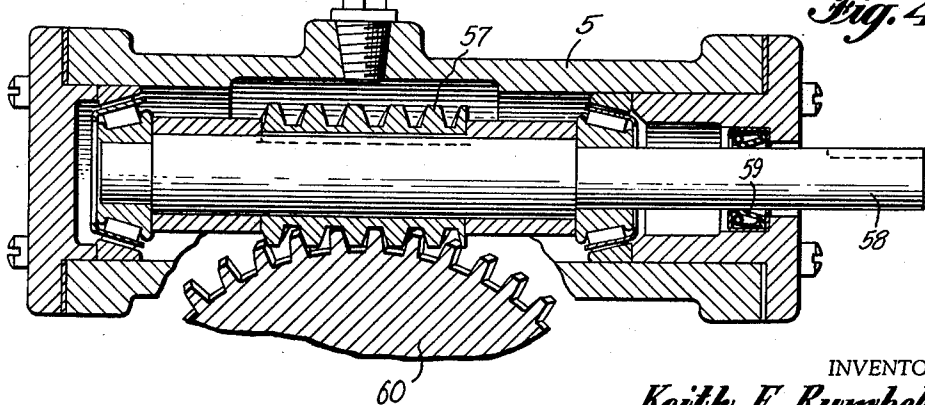


Fig. 4.



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3 Sheets-Sheet 3

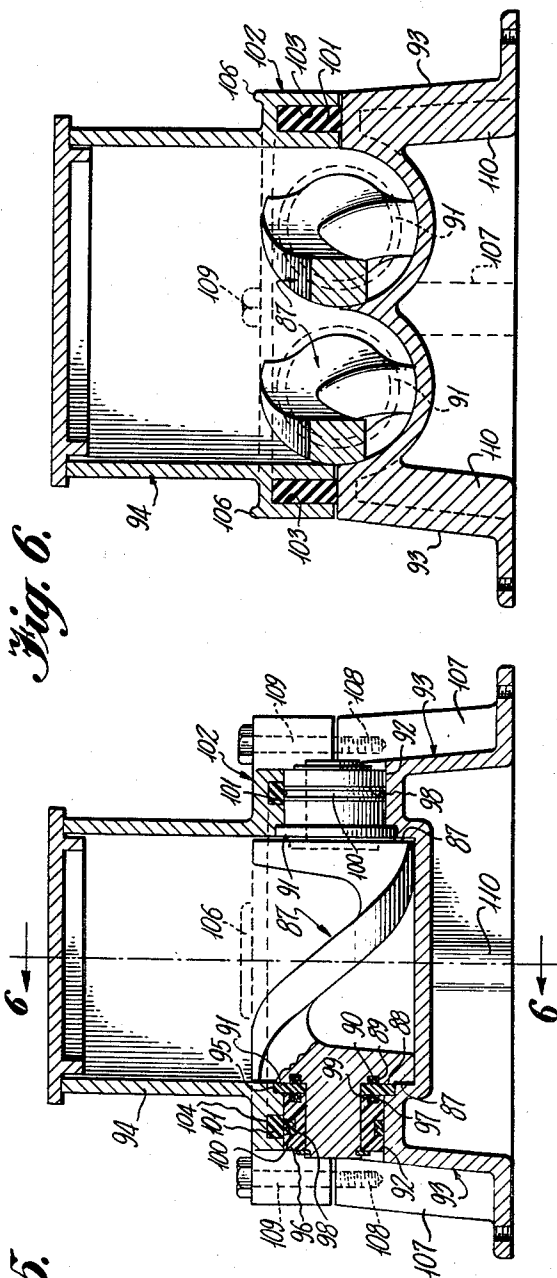
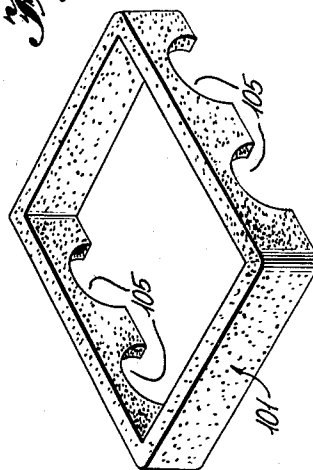


Fig. 5.

Fig. 7.



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2,931,633

MIXING APPARATUS

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16 Claims. (Cl. 259—104)

This invention relates to a laboratory mixer particularly designed to provide versatility in experimental mixing and for efficiency in mixing small batches.

One of the objects of the invention is to provide a mixer of the general type described including means providing controllable thermal and atmospheric environment for the mixing receptacle.

Another object of the invention is the provision of a laboratory mixer in which the mixing receptacle is surrounded by a vacuum chamber thereby establishing a balanced sub-atmospheric pressure both inside and outside the mixing receptacle, preventing air from being drawn in and entrained with the batch, and having other advantages which will be developed as the description proceeds.

A further object of the invention is the provision of a mixer as described in which the mixing blades are journaled in bearings made of a material which has been found to be non-wettable by most substances, seepage or creeping of liquid films through the bearings, being thus inhibited through the absence of capillarity.

Still another object of the invention is to provide a laboratory mixer in which the mixer can be completely disassembled or reassembled in the laboratory without tools or special skills in a matter of seconds, permitting simple and thorough cleaning, saving time between batches and avoiding batch to batch contamination.

Other objects of the invention will appear as the description of a practical embodiment thereof proceeds, it being understood that while the practical application of the invention in immediate contemplation is its use as laboratory apparatus, the scope of the invention is to be regarded as sufficiently comprehensive to include the construction and use of larger units for the mixing of batches of production magnitude.

In the drawings which accompany and form a part of the following specification and throughout the figures of which the same reference characters have been employed to denote identical parts.

Figure 1 is a perspective view of a power plant in which the mixer forms a component.

Figure 2 is a section in a vertical plane taken along the line 2—2 of Figure 1.

Figure 3 is a horizontal section taken along the line 3—3 of Figure 2.

Figure 4 is a fragmentary view in vertical section taken along the line 4—4 of Figure 2.

Figure 5 is a vertical section of a slightly modified form of the invention.

Figure 6 is a section taken along the line 6—6 of Figure 5.

Figure 7 is a perspective view of a molded gasket employed in sealing the body components of the mixing receptacle shown in Figure 5.

Referring now in detail to the drawing, the numeral 1 designates a mixing unit embodying the principles of the invention. This unit which is in effect a power plant includes a base 2 upon which is mounted the mixer 3,

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motor 4, and gear box 5, the latter containing the gear assemblage by means of which the mixer is driven from the motor. The motor and gear box are permanently fixed to the base, but the mixer is slidably mounted upon tracks 6, which are secured to the base, so that it can be slidably moved into or out of coupled relation to the gear assembly. When in uncoupled position the mixer 3 can be lifted bodily from the base, for the purpose of various manipulations, including tipping it for pouring out its contents.

Adverting now to the structural details of the mixer per se as shown, it comprises a pedestal 7 consisting of a flat base plate 8, which in the exemplary form shown is of square dimensions, having rounded corners and formed with a large circular opening centrally located from the circumference of which an integral cylindrical sidewall 9 extends upwardly, said pedestal terminating in a flat top 10 integrally meeting the upper circumferential edge of the wall 9. The base plate 8 projects beyond the circumference of the sidewall 9, forming a flange which is narrowest at the points 11, at which points the sides of the base plate comes closest to be tangent to the circumference of the sidewall. The top 10 is parallel to the base plate. Said base plate on its underface, at opposite sides, is formed with the channels 12 which interfit with the tracks 6.

The mixing receptacle 13 is made with a lower body member 14 and an upper body member 15. These, together, are formed at their opposite sides with cylindrical bearing seats 16, and the horizontal plane of separation between the two body members passes through the axes of said seats. The lower body member 14 begins with an annular base flange 17 which rests upon the topwall 10 of the pedestal, an annular gasket 18 intervening. Said topwall has an upstanding peripheral flange 19 within which the flange 17 is centered. The lower body member 14 is chambered, having a rectangular sidewall 20 extending upwardly from the inner circumference of the annular flange 17, said sidewall merging into an upper wall which extends inwardly at the level of said axial plane, forming a flat face 21. Said lower body member is formed with a reentrant rectangular recess, the bottom wall 22 of which has upturned marginal portions which merge integrally with the inner edge of said flat face. The reentrant recess constitutes the trough of the mixing receptacle.

The lower body member 14 is secured to the top wall 10 of the pedestal by studs 23 which pass through registering holes in the top wall 10 and in the base flange 17. The chamber 24 defined between the top wall 10 and the wall structure of the lower body member 14 is for the reception or circulation of a coolant or heating medium for controlling the temperature of the batch. The temperature control medium is carried to and from the chamber 24 by hoses, not shown, which connect to inlet and discharge nipples 25, emanating from the sidewall 9 of the pedestal at opposite sides and being connected to conduits within said pedestal which have elbowed ends 26, the latter being connected to the top wall 10 at opposite sides. The nipples are preferably of the self-closing type so that the temperature control medium can be retained when the hoses are disconnected to enable the mixer to be moved away from the base 2 for pouring out the batch.

The upper body member 15 which is in effect an upper extension of the trough of the mixing receptacle, comprises a surrounding sidewall 27 of rectangular cross-section, having an outwardly extending flange 28 at the bottom, the under face 29 of which is coextensive with the mating face 21 of the lower body member. These faces are precisely machined and come together to form a joint without the use of a gasket. At opposite sides

of the mixing receptacle the faces 21 and 29 of the respective body members are indented to form pairs of semi-cylindrical recesses, which together form the bearing seats previously referred to. The upper body member is kept in place by oppositely disposed quickly detachable latches 30, hingedly secured to the sidewall of the lower body member and each having a retractable keeper 31 adapted to grip the flange 28 of the upper body member, with stiffly yielding means for retracting it. The latches are not part of the present invention and need not be more specifically described. A rigid cover 32 is provided for the mixing receptacle, which rests freely upon the upper edge of the upper body member, and has an internal flange 33 for holding it in place. Said cover is unattached and freely removable.

The mixing receptacle is furnished with a pair of co-operating rotary mixing blades 34, commonly known as Z-blades, from the appearance of their mixing portions, viewed in elevation. Each of these blades is provided with circular end faces 35, in planes perpendicular to the axes of rotation of the blades, the latter having each a helically twisted portion 36 in between, and having integral journals 37 at their ends. Bearing bushings 38 are fitted upon the journals and have flanged inner ends, the flanges of which fit in circumferential rabbets in the body members which extend about the bearing apertures. The bushings are retained upon the journals by means of snap rings 39 which interlock with grooves 40 in the outer portions of said journals so that the blades with bushings may be removed as a unit. The length of the blades between said end faces is such that there is substantially no end play between the blades and bushings. The flanges and blade unit or means is provided for inhibiting axial slippage of the bushings in the bearing apertures. Each blade at one end has the journal extended and provided with an end slot 41 which cooperates, as will appear, with a tongue formed on the complementary coupling element of the gear assembly. The bearing bushings 38 are snugly retained in their seats or bearing apertures 16 by the weight of the upper body member 15 and the additional clamping pressure exerted by the latches 30, so that the snap rings play no part in holding the bushings in place while the mixing receptacle is assembled, their sole function being to hold the bushings on the journals when the blades are freed from the assemblage. Said bushings are made of a plastic characterized by its resistance to wear and high temperatures, its non-abrasive behavior toward the journals, by its non-wettability by most liquids. The utility of this last mentioned property will be referred to in due course. Specifically, a plastic is employed having a tradename "Teflon," the chemical nomenclature being polytetrafluoroethylene, which has the above properties in a satisfactory degree.

The versatility of the laboratory mixer is enhanced by the provision of means for maintaining, when desired, an ambient vacuum about the mixing receptacle, which means may be readily installed within a moments time, without tools, or laid aside if not to be used.

In prior batch mixers vacuum has generally been drawn directly on the mixing chamber itself. Among other disadvantages this arrangement has the objectionable feature of causing air to be drawn into the batch through the bearings thereby defeating the exclusion of oxygen from the mix, which exclusion in the case of certain mixtures, may be the very object of mixing them under vacuum. The entrainment of air during the mixing may also, with batches of certain viscosity, convert the batch into a froth or lather and impair the efficiency of the mixing operation.

Packing glands are normally required to keep the mixing chamber air-tight if the vacuum were drawn directly therein. Such glands would deteriorate rapidly in contact with corrosive and solvent chemicals seeping from the mixing chamber and would require frequent replace-

ment. Packing glands, furthermore, cannot readily be disassembled for cleaning and reassembled.

Another drawback encountered in mixers of the type in which the air is evacuated directly from the mixing chamber, is that the batch necessarily comes into contact with some of the surfaces which must be sealed to maintain the vacuum. For example, the cover of the mixing chamber would have to make an air-tight fit with the top edge of the mixing receptacle that it overlies. But the batch must be poured out over this very edge. If the batch were corrosive, deterioration would eventually beset the sealing surface and the joint could no longer be maintained air tight.

The present invention, on the contrary, does not employ means for imposing the vacuum directly upon the mixing receptacle, but surrounds it with a plenum in which sub-atmospheric pressure may be maintained. Since there is no pretense of sealing the mixing chamber from said plenum, there will be a balanced sub-atmospheric pressure both within and without the mixing chamber. For establishing this plenum, the mixer 3 includes a cylindrical shell 42 which surrounds the mixing receptacle in spaced relation thereto, functioning as a jacket, and has its lower end fitted into an external rabbet extending peripherally about the upper end of the pedestal 7. The upright wall of said rabbet has a circumferential groove in which an O-ring 44 or equivalent packing is mounted, which presses against the shell forming a seal. The upper end of the shell is closed by a cover 45, also formed with a peripheral rabbet 46, at its outer end, forming a shoulder 47 which rests upon the upper end of the shell, and a circumferential flange 48 that slidably fits within said shell, said flange having a surrounding groove containing an O-ring 49 which provides a seal between said shell and cover. The cover is provided with a nipple 50 for the attachment of the hose of the evacuating means, and with a relief valve 51, which can be of any conventional structure.

Since the cover 32 is a loose fit upon the mixing chamber and neither secured nor sealed, it follows that the air will be equally depleted both within and without the mixing chamber when a vacuum is drawn so that the possibility of air being drawn into the batch is eliminated. It also becomes immaterial whether the surfaces of the mixing chamber over which a corrosive batch might be poured, become rough or otherwise marred, for such surfaces are not relied upon for a sealing function.

It will be noted that in the present invention the motor and gear box have been excluded from the chamber of the plenum. Obviously the motor could not be practically operated in a vacuum, due to need for ventilation, also in some instances because of fire hazard. From the practical standpoint, in order to obtain maximum convenience and mobility in assembling and disassembling the shell and cover components of the plenum chamber, these are made as small and as simple as practicable, therefore, the gear box as well as the motor are excluded from the plenum. This necessitates the provision of sealing means between the shell and gear box.

It will be noted in the drawings that the shell 42, on one side, at an intermediate position between its upper and lower ends, is provided with a flat depressed area 52, the outer surface of which is in a chordal plane with respect to the adjacent cylindrical surface of said shell. The shell in this area is provided with an opening 53 of such length and width as to amply surround the geometrical axial projections of the blade journals carrying the coupling elements, when the shell is in its normal position with said journals confronting said opening. This opening is overlain by a flanged connecting plate 54 fitted to the shell in said flat area and peripherally bolted to said shell in air-tight contact therewith. The plate 54 is provided with cylindrical passages 55 there-through spaced side by side an axial distance apart equal to the distance between the axes of said blades, and

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which are axially aligned with said blades when the shell is in proper position. Said passages make a slip-joint connection with complementary extensions on the shaft housing 56 of the gear box 5.

Said gear box comprises a casing which houses a worm 57 receiving power transmitted from the motor through a shaft 58, entering the casing at one end and having an oil seal 59. The worm meshes with a worm gear 60 mounted upon a shaft 61, having a collar 62 which thrusts against a bearing 63. A spur gear 64 is also carried by this shaft which meshes with a spur gear 65 on a parallel lay shaft 66. The shafts 61 and 66 are carried in suitable bearings, the forward bearings being seated in the shaft housing 56. In front of said forward bearings are the oil seals 67 and 68 for the respective shafts. Like the shaft 61, the shaft 66 has a collar 70 thrusting against a bearing at its rear end. The shaft housing 56 is bolted to the oblong cover plate 69 and the latter bolted to the body of the casing.

The shaft housing 56 is formed with the extensions 71 and 72 which make a sliding fit within the corresponding passages 55. Said extensions are formed with interior annular grooves 73 in which O-rings 74 are seated, sealing the joints between said extensions and the walls of said passages. The forward ends of the shafts 61 and 66 are formed with reduced outer ends, furnished with coupling elements each comprising a cylindrical cap 75 with a deep cylindrical bore 76 into which the reduced end of the shaft slidably fits. The outer ends of said cap have transverse tongues 77 adapted to interdigitate with the end slots 41 of the adjacent coupling elements of the blade journals. The caps 75 are slotted as shown at 78 and pins 79 project radially from the reduced ends of the shafts through said slots, by which means the caps and springs 79a are retained and the extent of yield of the caps determined.

It is to be noted that in the embodiment of the invention selected for purpose of illustration the gears 64 and 65 are of different diameter, therefore, the mixing blades will be driven at different speeds. This makes it essential that the paths of rotation of the blades do not intersect in order to avoid collision of the blades. It is contemplated, however, that the gears 64 and 65 be freely splined to their respective shafts so that by removing the forward end plate 69 together with the shaft housing 56, the gears may be freed so that they may be slipped off and substituted by gears of equal size, imparting equal speed to the blades. With gears of equal diameter the type of blades shown may be used, or substituted by other known types of blade, each of which in the course of its rotation may invade the cylinder of revolution of the other without colliding if the mixing receptacle is made sufficiently large to provide for mixing blades of larger overall diameter. Thus, various types of mixing are available to the subject apparatus, and by reversing the motor the direction of mixing can also be reversed so that the material of a batch can be worked toward or away from the center of the mixing receptacle, as desired.

The gear box includes a foot portion 80 which is secured to the base 2 in such a position that the axes of the shafts 61 and 66 are parallel to the tracks 6. Therefore, when the mixer is placed upon the tracks the axes of the blades will be coaxial with said shafts. In order to orientate the shell 42 so that passages 55 also will be coaxial with said shafts an index may be provided in the form of a vertical score mark 81, for example, on the outer surface of the shell and the adjacent side wall of the pedestal, intersecting the circumferential line of junction between said parts.

In operating the mixer, if mixing under vacuum is not desired, the shell cover may be left off. The mixer containing the batch to be mixed is placed upon the tracks, the shell is slipped into place over the O-ring 44, and the assembly is pushed toward the gear box as far as it will

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go. Since the coupling tongues 77 will probably not be in the same phase of displacement as the coupling slot 41, the coupling caps 75 will be depressed. The clamp 82 will now be tightened to press the keeper 83 against the flange 11 of the pedestal. The keeper is free on the shank 84, the latter being threaded into an anchor pin 85 on the under side of the pedestal, bridging a slot through which the shank extends. The knob 86, fixed to the shank presses against the keeper. It is to be observed that there is no component of the pressure of the keeper tending to force the mixer toward the gear box. When the position of the mixer has been fixed by the keeper, the motor is started, the coupling caps turn into the same displacement phase as the blade shafts so that the tongues spring into the slots and the mixing proceeds. This feature, which obviates the necessity for preliminary mating by hand of the blade and gear shaft coupling slot and tongue, is a great convenience. If vacuum is to be employed, the cover is then put on with the O-ring 49 bearing against the inside of the shell. The shell can also be left off if no vacuum is drawn.

One of the outstanding features of the invention is the celerity and completeness with which the mixer can be disassembled for thorough cleaning and reassembled. The vacuum shell and its cover are not fastened, so that in a moment of time they can be put in place or removed. To disassemble the mixer proper it is necessary merely to release the latches 30 and lift off the upper body member. Each blade together with its bushings and snap rings may now be lifted out as a unit. Upon withdrawing the snap rings the bushings may be slipped off of the journals. All parts of the mixer that may be touched by the batch have now been separated into their ultimate elements in seconds of time and are in an optimum state of disassociation to permit thorough cleaning. This is particularly important both as to the time element and the ability to obtain thorough cleanliness in the mixing of successful experimental batches of different substances, without contamination.

While ordinarily there is no creeping or seeping of the batch or ingredients thereof, through the bearings or through the joint between the upper and lower body members, there are conditions under which such seepage may take place, as for example, when the batch includes a fluent volatile solvent, or one of low density, in which case the loss of an appreciable amount of solvent may interfere with the proper mixing or materially alter the constituency of the batch.

Figures 5, 6 and 7 show a modified form of the invention in which a novel sealing system is interposed between the upper and lower body members and between said body members and the journals of the blades for positively preventing seepage at those points where it might occur. It is to be understood that the end position between body members of such positive sealing means suggests that the upper body member be bolted to the lower body member rather than secured merely by yielding latches, in order to obtain the requisite pressure upon the sealing instrumentalities. Said figures show only those members of the mixer as previously described, which it has been considered necessary to alter in order to incorporate the said sealing system, it being understood that these members can be substituted for their counterparts in the originally described structure. Therefore, only those parts which have been modified will now be described.

Referring first to the blade unit 87, the outer faces 88 of the blades are provided with annular channels 89 forming seats for quad-rings 90, these being rings of rubber or like material, a rectangular cross-section, having medial grooves extending circumferentially about all four faces, affording displacement spaces. The rings are somewhat larger than the channels in which they are squeezed, the ensuing distortion displacing some of the

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mass of said rings into said spaces causing a reaction pressure of the ring against the sides of the channel and the adjacent face of the "Teflon" washer 91. The circular bearing aperture 92 formed between the upper and lower body members 94 and 93 are each provided on the sides adjacent to faces 88 of the blade with the circumferential rabbet 95 forming a seat for the said "Teflon" washer. At the outer side of the "Teflon" washer the journals of the blade are furnished with cylindrical bearing bushings 96, preferably made of nylon or its equivalent, being inflexible. Said bushings are formed each with a circumferential channel 97 in its inner end wall and a similar channel 98, circumferentially about its exterior cylindrical wall. Quad-rings 99 and 100 are seated in said channels, the one to press the "Teflon" washer on the side opposite the quad-ring 90 and the other to press the walls of the lower halves of the bearing aperture 92 and also that part of an extensive molded gasket 101 which is exposed at the face of said bearing aperture through a slot communicating with a chamber in which said gasket is confined and which will now be described.

This leads to a description of the modified upper body member 94, the lower part of which has an outward extension about all sides. Said extension is formed with a deep recess 103 continuing uninterruptedly about said extension, opening in the lower face of said upper body member and intersecting the semi-circular walls of said bearing apertures carried by said upper body member. Said recess extends depthwise to a level above the apices of the upper arcs of said bearing apertures, as indicated by the numeral 104. The intersection of said recess with the walls of the bearing apertures forms slots above referred to through which the gasket 101 is exposed.

Said gasket, per se is illustrated in Figure 7 and is rectangular in shape, having a general depth just a little greater than the depth of the recess 103 so that when it is snugly seated in said recess it projects slightly beyond the under face of the upper body member. Said gasket is formed on opposite sides with semi-circular indents 105 of slightly smaller diameter than the bearing apertures so that it extends slightly beyond walls of the bearing apertures. Said gasket is preferably made of a rubber-like material such as neoprene.

The upper body member is formed at opposite sides of the outward extension with integral lugs between the bearing apertures to receive studs for securing the body members together with the gasket 101 pressed into sealing contact with the contiguous face of the lower body member and with the upper half of the quad-ring 100, and pressing said quad-ring into sealing contact with the lower half of the bearing aperture. In order to minimize the number of studs, in the interest of ease and quickness of assembly, the upper body member is provided on the unbolted sides with upstanding ledges 106 permitting the supplementary employment of latches such as those hereinbefore described, or in the event that the substances to be mixed are non-seepable, the studs may be left out and sole reliance placed on the latches.

Referring to that part of the sealing system which affects the bearings, the bearing bushings 96 are held on the journals by snap rings 39 seated in grooves 40. Since the blades will be pushed back manually in order to expose the grooves 40 for the insertion of the snap rings, there will be only light frictional pressure transmitted through the bushings and "Teflon" washers to the quad-ring 90 so that the rotary movement will be restricted to the quad-ring 90 against the "Teflon" washer, and the snap-ring against the outer end of the bearing bushing, all other parts of the sealing system remaining fixed. The "Teflon" washer being non-wettable by most substances acts as a normal barrier against seepage, the quad-ring 100 forming a positive circumferential stop

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against leakage along the exterior face of the bearing bushing, while the quad-rings 90 and 99 supplement the natural seepage repellent property of the "Teflon" washer in positively sealing the leakage path about said washer.

Referring now to the modified lower body member 93, this is formed at opposite sides with the integral ribs 107, providing sufficient thickness of material to coat the threaded bores 108 for the studs 109, and also being for purpose of reinforcement. Said lower body member is also cast with reinforcement ribs 110 on the interior of the alternate pair of opposite sides.

It will be understood that by the removal of the studs, the upper body member 94 may be lifted off, together with the molded gasket 101, thereby releasing the blade unit, including the bearing bushings, the "Teflon" washers and the quad-rings. These may be separately disassembled after removing the snap rings. It is thus apparent that the mixer with the modified components may be disassembled and reassembled with practically the same facility as the originally described mixer.

It is to be understood by those skilled in the art that the arrangement of parts and the specific details of construction are by way of example and not to be construed as necessarily limiting the scope of the pending claims.

We claim:

1. Mixing apparatus comprising a mixing receptacle including lower and upper body members, each being formed on opposite sides with the matching halves of coaxial cylindrical bearing apertures, said body members being separable in a horizontal plane embracing the axis of said bearing apertures, a blade unit comprising a blade having end faces perpendicular to its axis of rotation, and having coaxial journals extending outwardly from its end faces, bearing bushings mounted upon said journals, fitting said apertures, said journals projecting slightly beyond the outer ends of said apertures, said bushings having flanged inner ends fitting in circumferential rabbets in said body members surrounding said apertures, means for inhibiting axial slippage of said bushings in said apertures, in the assembled apparatus, releasable means co-acting with the projecting portions of said journals for retaining said bushings upon said journals when said blade unit is freed from said body members, and means for clamping said body members together.

2. Mixing apparatus as claimed in claim 1, said bushings being made of polytetrafluoroethylene, a plastic characterized by being non-wettable by most substances, whereby with respect to the mixing of such substances, seepage through the joints of said bushings with said journals and bearing apertures, is suppressed.

3. Mixing apparatus comprising a mixing receptacle including lower and upper body members, each formed on opposite sides with the matching halves of a pair of coaxial cylindrical bearing apertures, said body members being separable in a horizontal plane embracing the axes of said bearing apertures, cooperating blade units, each comprising a mixing blade having end faces perpendicular to its axis of rotation, and having coaxial journals extending outwardly from said end faces, bearing bushings mounted upon said journals fitting said bearing apertures, said journals projecting slightly beyond the outer ends of said apertures, said bushings having flanged inner ends, the flanges of which fit in circumferential rabbets in the body member surrounding said apertures, means for inhibiting axial slippage of said bushings in said apertures, in the assembled apparatus, the projecting portions of said journals being grooved circumferentially, and snap rings removably seated in said grooves, for retaining said bushings upon said journals so that said blade with bushings may be removed as a unit, and means for clamping said body members together.

4. Mixing apparatus comprising a mixing receptacle

including lower and upper body members, each formed on opposite sides with the matching halves of coaxial circular bearing apertures, mixing blades journaled in bearings positioned in said apertures, the plane of separation of said body members being horizontal and embracing the axes of rotation of said blades, said lower body member having its upper portion reentrantly dished to form a recess in which said blades operate, and being formed with a planiform face in said plane about the upper end of said recess, constituting a surface of the joint between said body members, said lower body member below said plane being formed with a side wall integral with said planiform face, surrounding the dished portion of said lower body member in spaced relation thereto and extending below it, forming a chamber, and means for admitting a heating medium to said chamber beneath said reentrant portion being chambered and fitted for circulation of a heat exchanging medium, said chamber being extended to surround the sides of said reentrant recess.

5. Mixing apparatus comprising a base having a circumferential rabbet thereabout defining a horizontal supporting shoulder and a cylindrical face, said face being formed with circumferential groove, a mixing receptacle comprising a lower and an upper body member, each being formed at opposite sides with the matching halves of coaxial circular bearing apertures, said body members being separable in a horizontal plane embracing the axes of said bearing apertures, a driven blade unit within said mixing receptacle having end journals, bearing bushings removably retained upon said journals and seated in said bearing apertures, means for clamping said body members in sealing relation with one another and with said bearing bushings, a jacket including a shell about said mixing receptacle removably seated in said rabbet in sealed contact with said packing ring, and a closure sealingly engaging the upper end of said shell, and coupling means for connection to vacuum drawing apparatus, carried by said jacket, opening into the space between said jacket and mixing receptacle.

6. Mixing apparatus as claimed in claim 5, the lower part of said lower body member being externally chambered to form a heating chamber, and a heating medium conduit communicating with said chamber.

7. Mixing apparatus comprising a hollow pedestal having a planiform face at the top, and being provided with a circumferential rabbet about the top defining a horizontal supporting shoulder and a circumferential wall upstanding therefrom, a mixing receptacle mounted on said pedestal in secured relation thereto, comprising upper and lower body members resting one upon the other, each formed on opposite sides with the matching halves of bearing apertures, said lower body member having a transverse wall dished between said bearing apertures to form the lower part of the chamber of said mixing receptacle, said lower body member being hollow below said wall defining a chamber for a heat exchanging medium, conduits extending through said pedestal below the level of said rabbet and communicating with said heat exchanging medium chamber, a blade unit including a blade with journals and bearings on said journals seated in said bearing apertures retained by the interengagement of said body members and freed for removal by their separation, a tubular shell surrounding said mixing receptacle having its lower end slidably telescoped over the upstanding wall of said rabbet, forming a slip-joint, one of the joint-forming faces being grooved, and an O-ring seated in said groove, a removable cover for said shell having a peripheral shoulder adapted to rest on said shell, and a depending flange adapted to telescope relative to said shell and make a slip-joint therewith, one of the slip-joint faces being grooved and an O-ring seated in said groove, said cover being provided with fittings adapting it to be connected to vacuum drawing apparatus.

8. Mixing apparatus comprising a base, a mixing re-

ceptacle mounted on said base, comprising upper and lower body members each formed on opposite sides with the matching halves of bearing apertures, bearing bushings within said apertures and a blade unit within said mixing receptacle journaled in said bearing bushings, the adjacent faces of said body members making a butt joint with one another and with said bearing bushings, means for securing said body members together, a shell adapted to be slipped over said mixing receptacle with its lower end lapped over the upper end of said base, forming a joint, sealing means between the lapped portions of said joint, a cover for said shell forming therewith an enclosure for said mixing receptacle, said cover having a flange in lapped relation to the upper end of said shell, forming therewith a slip-joint, and sealing means between the faces of said joint, said cover being provided with fittings adapting it to be connected with a vacuum pump, and to relieve the vacuum.

9. Mixing apparatus as claimed in claim 8, the upper body member having a peripheral slot extending all around and of such depth as to extend above the upper arcs of the bearing apertures, and a molded gasket of flexible, elastically deformable material shaped to fill said slot, to conform to the shape of the joint surface of said upper body member and to extend slightly outward with respect to said surface, and means for clamping said upper and lower body members together to press said gasket in sealing relation to the entire joint interface.

10. Mixing apparatus comprising a mixing receptacle including upper and lower body members each formed on opposite sides with the matching halves of bearing apertures, said body members being separable in a horizontal plane embracing the axes of said apertures, bearing bushings within said apertures, and a blade unit within said mixing receptacle journaled in said bushings, the adjacent faces of said body members making a butt joint with each other and with said bearing bushings, the upper body member having a peripheral slot extending all around and of such depth as to extend above the upper arcs of the bearing apertures, a perimetrical continuous molded gasket of flexible, elastically deformable material, shaped to fill said slot, to conform to the shape of the joint surface of said upper body member including said bearing apertures and to extend slightly outward with respect to said surface, and means for clamping said upper and lower body members together to press said gasket in sealing relation to the entire joint interface, including the contiguous arcs of said bushings.

11. In combination, a mixer including a mixer receptacle, a mixing blade therein journaled on a horizontal axis, a shaft extending horizontally therefrom having a coupling element at its end, a gear assembly for driving said blade, said gear assembly including a shaft having a complementary coupling element at its adjacent end, one of said coupling elements being yieldable, means for a common support for said gear assembly and mixer, a casing for said gear assembly secured to said support, linear guided means secured to said support parallel to said shaft of the gear assembly, slide means at the bottom of said mixer parallel to the blade shaft, said mixer being adapted to be guidedly moved upon said support to bring said coupling elements into yielding interengagement, a shell adapted to be placed in enveloping relation to said mixing receptacle, means between the lower end of said shell and the adjacent part of said mixer for forming a sealed circumferential joint about said mixer, a fitting secured to a side of said shell having a cylindrical opening communicating with the interior of said shell and extending outwardly therefrom, said shell being freely circumferentially adjustable to bring said opening into axial alignment with the blade shaft, and an extension projecting from the casing of said gear assembly surrounding the coupling element of the shaft of said gear assembly adapted to interdigitate with the opening through said fitting when said mixer is approached to said gear assem-

bly sufficient to depress said yieldable couplings, an O-ring seated in a circumferential groove in one of the adjacent faces of said interdigitated members, a cover for said shell having a circumferential flange in lapped relation to the upper end of said shell and an O-ring seated in a circumferential groove in one of the adjacent lapped faces, and a coupling connection carried by said cover communicating with the space between said shell and receptacle, adapted for connection to vacuum drawing apparatus.

12. Mixing apparatus including a mixing receptacle, a mixing blade journaled therein on a horizontal axis, a shaft extending horizontally therefrom having a coupling element at its end, a gear assembly for driving said blade including a shaft for a complementary coupling element, one of said coupling elements being yieldable, a casing including a shell and cover removably and sealingly enveloping said mixing receptacle, a fitting on said shell at one side thereof having a passage therethrough coaxially with said blade shaft, a casing about said gear assembly including a hollow extension surrounding said gear assembly shaft, through which said gear assembly shaft extends with said complementary coupling element projecting therefrom, said extension making a slip-joint with the wall of the passage through said fitting, and having means for sealing said joint, and a coupling connection carried by said casing communicating with the space between said casing and receptacle adapted for connection to vacuum drawing apparatus.

13. Mixing apparatus as claimed in claim 12, there being two blades journaled in said mixer on parallel shafts, each having a coupling element, and two parallel gear assembly shafts having coupling elements complementary to the respective blade shaft coupling elements, the fitting on said shell having passages therethrough coaxial with the respective blade shafts, the gear assembly casing having an extension for each passage forming a sealed slip-joint with the walls thereof, and separate gears for driving said gear assembly shafts, said gears being freely removable for replacement by other gears, for adjusting speed ratio of said blades.

14. Mixing apparatus comprising a base having a circumferential rabbet thereabout, defining a horizontal supporting shoulder and a cylindrical face, a mixing receptacle seated on said base comprising upper and lower body members separable in a horizontal plane, and a

driven blade unit journaled in said receptacle on an axis in said plane of separation, and retained through the normal juxtaposition of said members, means for securing said body members together, removable jacket means enveloping said mixing receptacle in airtight manner including a shell seated in said rabbet in sealed relation to said cylindrical face, and coupling means for connection to vacuum drawing apparatus carried by said jacket means.

15. In combination, mixing apparatus as claimed in claim 14, and a driving unit therefor, said blade unit being formed with a coupling element at one end, said driving unit being provided with a complementary coupling element, said shell having an opening in one side giving coupling access to said coupling elements, and interengaging sealing means between said driving unit and shell, about said opening.

16. Mixing apparatus comprising a base, a mixing receptacle mounted on said base comprising upper and lower body members, each formed on opposite sides, with the matching halves of bearing seats, bearing bushings within said seats and a blade unit within said receptacle journaled in said bushings, the adjacent faces of said body members making a butt joint with one another and with said bushings, means securing said body members together, jacket means enveloping said receptacle in airtight manner, including a shell lapped over the upper end of said base forming a sealed slip joint, said jacket means being provided with fittings adapting it to be connected with a vacuum pump, and to relieve the vacuum.

References Cited in the file of this patent

UNITED STATES PATENTS

615,683	Day	Dec. 13, 1898
1,490,617	McKillican	Apr. 15, 1924
1,584,562	Kulenkampff	May 11, 1926
2,017,116	Bonell	Oct. 15, 1935
2,376,593	Hellen	May 22, 1945
2,411,006	Sharp	Nov. 12, 1946
2,552,166	Gardiner	May 8, 1951
2,702,730	Ivanoff et al.	Feb. 22, 1955

FOREIGN PATENTS

1,030,617	France	Mar. 18, 1953
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