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STIRRING AND MIXING DEVICE

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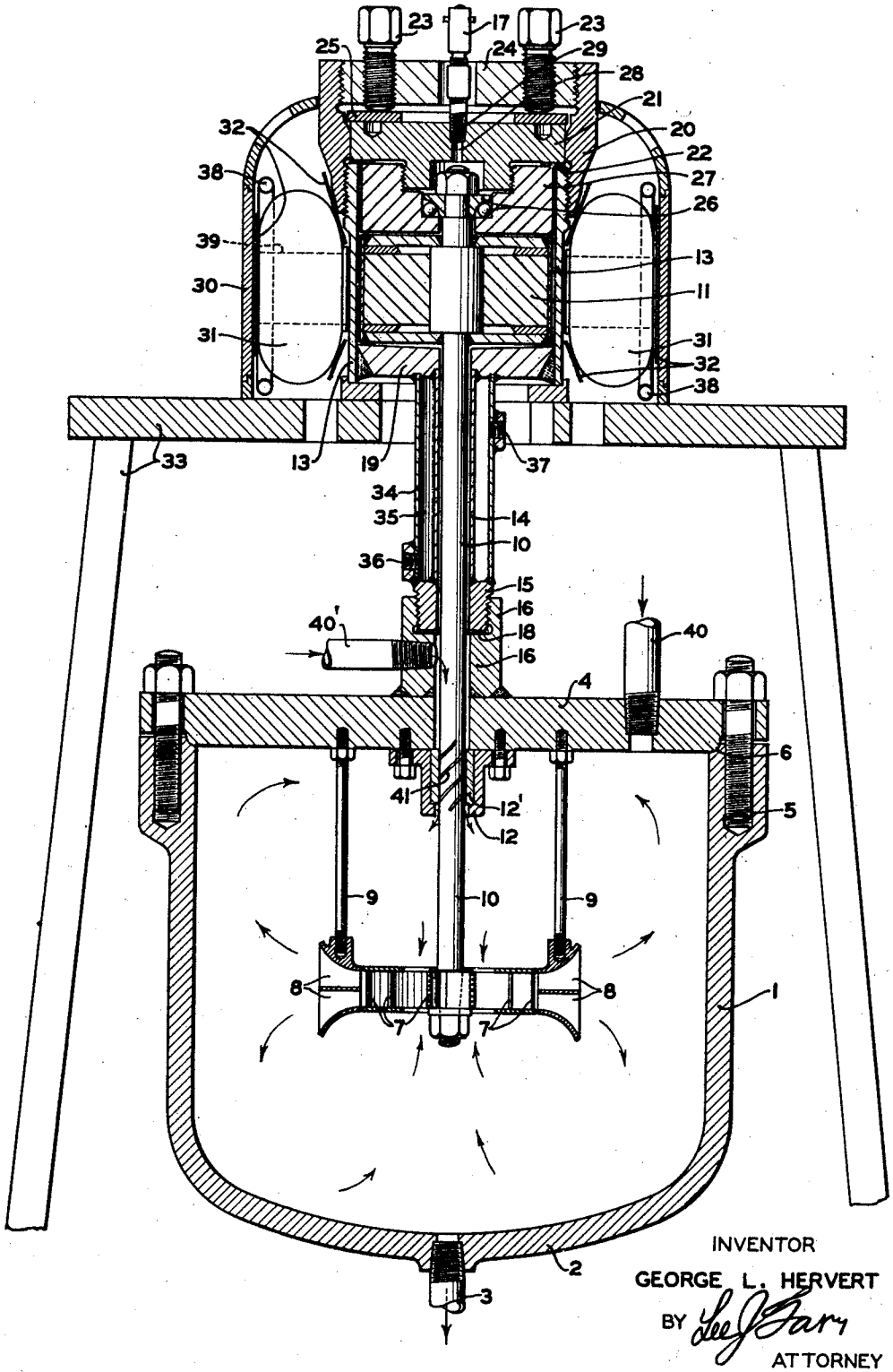

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STIRRING AND MIXING DEVICE

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This invention relates to an improved form of apparatus of the class of mixing and stirring devices and the like, driven by electrical means such as an induction motor.

One of the primary objects of the invention is to provide an apparatus of this general class wherein the contacting or mixing zone may be operated at sub-atmospheric or superatmospheric pressure and in which packing means for preventing leakage past moving parts of the apparatus to or from the mixing zone are obviated.

Another object of the invention is to provide such an apparatus wherein the transfer of heat between the motor and the mixing zone is minimized.

The features of the invention are particularly advantageous as applied to apparatus for conducting contact conversion reactions at superatmospheric or sub-atmospheric pressure and at controlled temperature in a confined zone wherein agitation or mixing of the reactants with each other and also, when desired, with a catalytic agent for promoting the reaction is accomplished by mechanical agitation or stirring of the reacting mass maintained in said confined zone.

The catalytically promoted alkylation between saturated and unsaturated hydrocarbons is an example of an operation of the class above mentioned to which the features of the invention have been advantageously applied. In this particular process an alkylating agent, such as sulfuric acid, aluminum chloride, hydrogen fluoride or the like, is employed and is thoroughly mixed in the reaction zone with the reactive unsaturated and saturated hydrocarbons, such as, for example, butylenes and isobutane. The reaction, being endothermic, results in a considerable evolution of heat and the temperature at which the reaction can be most advantageously conducted is rather critical. It is also desirable, if not essential, to keep the reacting mixture in liquid state or in a dense phase resembling liquid state and this necessitates the use of relatively high pressure in the reaction zone.

The invention, as embodied in an apparatus for conducting the alkylating reaction and other reactions of this general class, provides an impeller within the confined reaction and mixing zone for agitating and obtaining intimate contact between the reactants and the catalyst, said impeller being mounted on a rotatable shaft connected with the armature of an induction motor. The armature is separated from the field of the motor by a sheath or pressure-tight housing of suitable non-magnetic metal, alloy or the like, capable of withstanding the pressure employed in the reaction zone and communicating with the latter through a pressure-tight sheath or housing provided about the shaft. This eliminates the necessity for packing about the rotating shaft and, in the preferred embodiment of the invention, a second housing is provided about the shaft with a zone between the same and the other shaft housing through which suitable cooling fluid is circulated to prevent substantial transmission of heat between the motor and the reaction zone. The invention also provides, when desired, for keeping the temperature rise in the motor within reasonable limits by providing a suitable cooling coil or the like through which cooling fluid may be circulated adjacent the field of the motor.

The features and advantages of the invention will be more readily apparent from an inspection of the accompanying diagrammatic drawing and the following description thereof.

The drawing is an elevational view shown principally in section of one specific form of apparatus embodying the features of the invention.

Referring to the drawing, reference numeral 1 designates the shell of a suitable reaction or mixing vessel which is provided with a closed bottom 2 having a suitable outlet and drain connection 3 and having a removable upper head or closure member 4 bolted to the shell, as indicated at 5, with a ground joint 6, or other suitable means of retaining pressure within the reaction and mixing zone, between the removable closure member and the shell. A suitable inlet connection 40 is provided on head 4, for admitting fluid to the mixing vessel as will be later described.

An impeller or other stirring or mixing device of any desired form, indicated at 7, is provided within the mixing zone and, in this particular instance, the impeller is circumscribed by a series of deflecting vanes 8 secured to and suspended from the removable head 4 by bolts 9. The impeller 7 is mounted on a rotatable shaft 10 extending through the closure member 4 to the armature 11 of the motor. Shaft 10 is journalled within the mixing vessel in a suitable bearing 12 disposed within housing 12' secured to the detachable head 4.

In accordance with the features of the invention, the shaft 10 and the armature 11 are enclosed in a pressure-tight housing which comprises the cylindrical member 13 of suitable non-magnetic metal or alloy such as the chromium-nickel-steel alloy known as "stainless" steel, disposed about the rotor and the tubular or sleeve-like member 14 disposed about shaft 10. Mem-

ber 14 is secured at its lower end by welding or in any other convenient manner to a threaded connector 15 which is threaded to connection 16 provided on head 4, a suitable gasket 18 being provided between the abutting surfaces of members 15 and 16.

It will, of course, be understood that, when desired, member 14 may be extended to and welded or otherwise attached to head 4 to eliminate the coupling arrangement and the necessity for gasket 18, the coupling arrangement being provided in the case illustrated for convenience in detaching the mixing or reaction vessel from the motivating means for the impeller.

The upper end of member 14 is secured by welding or in any other convenient manner to a suitable closure member 19 at the bottom of the armature casing, member 19 being integral with member 13 or suitably secured thereto by welding or in any other convenient manner.

A suitable threaded collar 20 or the like is secured to the upper end of member 13, although these two members may be formed integral or otherwise suitably attached, when desired, and a top closure plate 21 fits within member 20 and is detachably held in place against a suitable gasket 22, provided between member 20 and the upper end of member 13, by cap screws 23 extending through a bolt plate 24 which is detachably threaded to collar 20. A case-hardened ring 25 is provided, in the case illustrated, between the cap screws 23 and the closure member 21.

Shaft 10 is supported at its upper end above the armature by a self-alignment bearing, indicated at 26, disposed in a suitable bearing housing 27 which is threaded, in the case illustrated, or may be attached in any other suitable manner to the closure plate 21. The bearing is made accessible for lubrication through a threaded port 28 provided in closure plate 21 and connected, as shown at 29, to a suitable pressure-tight lubrication fitting, such as indicated, for example, at 17, which projects through an opening provided in member 24.

The motor is provided with an outer case 30 and suitable field coils, indicated diagrammatically at 31 and connected by well known means, not illustrated, with a suitable source of electric power, are disposed within the space defined between the outer case 30 and the armature housing. Suitable electrical insulation, such as the mica sheets, indicated at 32, are provided between the field coils and the inner and outer housings except that the cores 33 of the field coils bear against member 13.

A suitable supporting structure of any convenient form, such as indicated for example at 33, is provided for the entire assembly.

As a special feature of the invention, a tubular jacket 34, or the like, secured at its upper end to member 19 and at its lower end to member 15 is provided about member 14, with a space 35 therebetween through which suitable cooling fluid may be circulated, ports 36 and 37 being provided through the wall of jacket 34 for the admission of the cooling fluid to space 35 and for its discharge therefrom. By virtue of this provision, the substantial flow of heat through shaft 10 and member 14 between the motor and the mixing or reaction zone is prevented.

It is, of course, also within the scope of the invention to provide a suitable jacket through which convective fluid may be circulated about the reaction or mixing vessel to control the temperature within the reaction or mixing zone, although this well known provision is not illustrated in the drawing.

A motor of the type herein provided and illustrated will develop considerable heat due to distortion of the magnetic field or impedance offered to the flow of magnetic force between the field coils and the armature by member 13. In view of this the invention provides for dissipating a large portion of this heat, when required, to keep the operating temperature of the motor within the required limits. This is accomplished, in the case illustrated, by means of a cooling coil, indicated at 38, through which cooling fluid may be circulated. The coil 38 is disposed adjacent the field coils within the space between the outer shell 30 of the motor and the armature housing, although it may, when desired, be replaced or augmented by a cooling coil wound about the outer case 30 or by providing a hollow outer case through which cooling fluid may be circulated.

In operation of the device fluids to be mixed may be continuously or intermittently supplied to vessel 1 through conduit 40 and the resulting mixture may be continuously or intermittently removed from the vessel through conduit 3. This arrangement, may, of course, be reversed when desired, the incoming fluid being admitted through conduit 3 and the outgoing fluid discharged through conduit 40. Alternatively, and in accordance with the preferred mode of operating the device, one or more of the fluids to be mixed may be supplied through conduit 40' into the annular space provided about shaft 10 above bearing 12'. The fluid thus supplied in the apparatus is introduced under sufficient pressure to force the same between the bearing 12' and shaft 10 into the mixing zone. When desired, the shaft 10 may be rifled adjacent bearing 12' as indicated at 41, to assist the flow of fluid into the mixing zone, or a sufficiently loose fit may be provided between the bearing and the shaft to permit passage of the desired quantity of fluid therebetween from conduit 40' into the mixing zone.

The provision for introducing incoming fluid into the mixing zone between the bearing 12' and the shaft, as above described, permits protection of the bearing from contact with excessively hot or corrosive ingredients of the mixture by introducing a non-corrosive or relatively cool component of the fluids to be mixed through conduit 40', while introducing relatively hot and/or corrosive components thereof through conduit 3 or conduit 40. For example, when the apparatus is employed in the catalytic alkylation of isobutane with butylenes employing a corrosive alkylating agent or catalyst such as phosphoric or sulfuric acid, a portion or all of the butylenes or a portion or all of the isobutane to be reacted may be introduced in relatively cool state through conduit 40' while the remaining reactants and all of the corrosive catalyst is introduced through conduit 3 or conduit 40.

I claim as my invention:

1. An apparatus of the class described comprising a closed pressure tight mixing vessel, an impeller disposed within said vessel, an electric motor above and spaced from said vessel, a pressure tight casing around the rotor of said motor and having a bottom closure member and a top closure member, a vertical shaft extending from the impeller through an opening in the top of said vessel and through an opening in said bottom closure member and connected with said rotor, a bearing for the shaft within said vessel

adjacent the first-mentioned opening, and a tubular member depending from said bottom closure member and surrounding and spaced from the portion of said shaft outside said vessel, the annular space between said tubular member and shaft being in communication with the interior of said casing through the opening in said bottom closure member, said casing and tubular member forming a closed pressure tight chamber housing the rotor and said portion of the shaft and communicating with the interior of the vessel through said opening in the top of the vessel, the field coils of the motor being disposed outside said pressure tight chamber.

2. An apparatus of the class described comprising a closed pressure tight mixing vessel, an impeller disposed within said vessel, an electric motor above and spaced from said vessel, a pressure tight casing around the rotor of said motor and having a bottom closure member and a top closure structure, a thrust bearing enclosed within said top closure structure, a vertical shaft extending from the impeller through an opening in the top of said vessel and through an opening in said bottom closure member, said shaft being connected with said rotor and being supported at its upper end above the rotor by said thrust bearing in the top closure structure, a bearing for the shaft within said vessel adjacent the first-mentioned opening, and a tubular member depending from said bottom closure member and surrounding and spaced from the portion of said shaft outside said vessel, the annular space between said tubular member and shaft being in communication with the interior of said casing through the opening in said bottom closure member, said casing and tubular member forming a closed pressure tight chamber housing the rotor and said portion of the shaft and communicating with the interior of the vessel through said opening in the top of the vessel, the field coils of the motor being disposed outside said pressure tight chamber.

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