

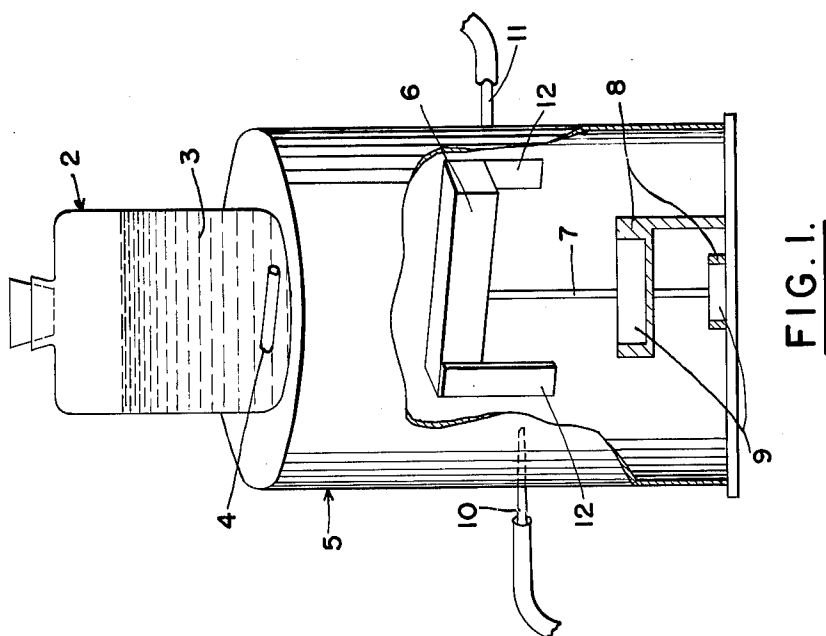
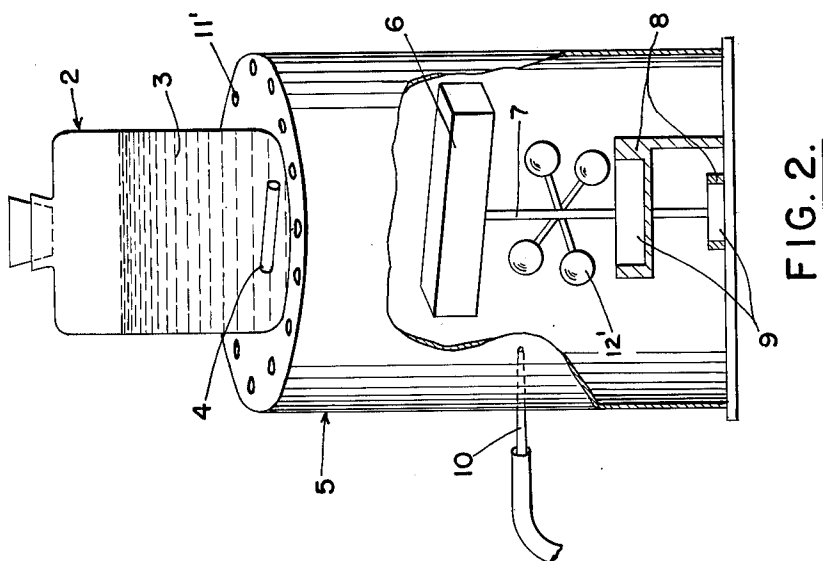
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MAGNETIC STIRRING APPARATUS

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3,211,433

MAGNETIC STIRRING APPARATUS

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(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment to us of any royalty thereon.

This invention relates to the stirring of liquids under hazardous environmental conditions. More particularly, the invention relates to an apparatus for safely stirring liquids of a flammable, explosive, or highly volatile nature in an enclosed system.

In the course of many scientific investigations, particularly in the chemical and allied fields, the use of a device for stirring or otherwise agitating liquid mixtures is often required. Ordinarily, no problem exists in view of the multitude of satisfactory mixing and stirring devices which are commercially available at present. However, depending upon the nature of the liquid employed and the environmental conditions existent, situations may present themselves which endanger personnel and equipment and/or render the mixing operation nugatory. For example, when it is contemplated to mix liquids which in themselves are flammable or explosive or which react during mixing to produce flammable or explosive products, the use of existing ordinary electrically operated magnetic stirrers cannot be tolerated because of the hazards attendant the generation of sparks. Even where modifications are made to seal and explosion-proof the electrical motors employed, environmental conditions necessarily encountered in certain investigations, e.g., high radiation intensity in radiation chemistry experiments, often result in deterioration of elastomers and insulation material exposing electrical components to failure and possible fire and explosion. In the latter example, additional hazards include damage to irradiators employed causing contamination of the apparatus and surrounding area, possibly rendering the entire building housing the apparatus hazardous for occupancy. Aside from the sparking aspect of electrically operated magnetic stirrers, a further disadvantage of the commercially available models is their large size and cumbersomeness which greatly restricts the use which can be made of them. In lieu of employing electrically operated stirrers, agitation by means of bubbling gases has been proposed. However, when inert gases were used to agitate mixtures of organic solvents in aqueous systems contained in specialized glass reactors with an inlet tube at the bottom and an outlet tube at the top of the vessel, there was a complete loss of the most volatile component of the system.

Accordingly, principal objects of the present invention are to provide an apparatus for stirring liquids under hazardous environmental conditions which are not attended by the disadvantages of the prior art.

Other objects of the invention are to provide an apparatus for safely stirring liquids of a flammable, explosive, or highly volatile nature.

Further objects and advantages of the invention will in part be obvious and in part appear hereinafter in the following detailed description of the principle of the invention and several of its embodiments.

In general, the present invention concerns the stirring of mixtures of flammable, explosive, or highly volatile liquids by placing a magnetized impeller in a contained quantity of the liquid mixtures, and spinning the impeller by means of a rotating magnetic coupling element. Ordinarily, the liquid mixtures may be placed in a glass

stoppered bottled thus providing an enclosed system insuring against loss of components by volatilization or against the possibility of ignition or explosion of issuing vapors or fumes by a chance spark. The magnetized impeller may be a permanent bar magnet or a bar of ferromagnetic material, and is preferably coated with glass or other sealant to avoid reaction with the liquids being mixed. The magnetized impeller or driven element is rotated by the application of an adequate torque thereto by means of a magnetic coupling element or driving element. There is no physical connection between the driven element and the driving element, as the latter is situated within a vertically positioned, cylindrical housing upon which the bottle or container rests. The magnetic coupling element or driving element comprises a permanent bar magnet horizontally positioned within the housing and in spaced-apart parallel relation with respect to the magnetized impeller or driven element within the container seated on the housing. A rotary control shaft is rigidly affixed to the driving element and is coaxial with a vertical axis passing through the center of gravity thereof, the driving element together with the rotary control shaft comprising the driving assembly. The driving assembly is freely rotatable within the housing which contains mounts for bearings which contact and support the rotary control shaft. The housing is provided with an inlet port and one or more outlet ports, for entry and exit, respectively, of drive gas. A nozzle connected to a source of compressed gas extends through the inlet port and permits a stream of said gas to be directed on vanes or fins attached to the driving assembly, either on the driving element or emanating radially from the rotary control shaft. The vanes or fins are so constructed and arranged that the stream of compressed gas issuing from the nozzle and impinging thereon imparts a torque to the driving assembly. The speed of stirring may be controlled by the size of the nozzle orifice and the gas pressure applied.

Referring more particularly to the drawings accompanying and forming a part of this specification, wherein like reference characters designate like parts,

FIG. 1 is a schematic depicting an embodiment of the inventive apparatus wherein the vanes or fins are affixed to the magnetic coupling or driving element, and

FIG. 2 is a schematic depicting an embodiment of the inventive apparatus wherein the vanes or fins are affixed to the rotary control shaft.

In both FIGS. 1 and 2 a glass stoppered bottle 2 constituting a closed system contains the liquid mixture 3 to be stirred. A magnetized impeller or driven element 4 comprising a glass-coated magnet is immersed in a liquid mixture 3. The bottle 2 is seated on the upper end of the driving assembly housing 5 which comprises a vertically positioned, aluminum canister. The driving assembly consists of a permanent bar magnet or driving element 6 which is horizontally positioned and a rotary control shaft 7 which is coaxial with a vertical axis passing through the center of gravity of driving element 6. Housing 5 contains mounts 8 for bearings 9 which support and permit free rotation of rotary control shaft 7. A nozzle 10 connected to a source of compressed inert gas extends through a port in the side of housing 5. FIG. 1 depicts a gas outlet port 11 in the cylindrical side of housing 5 and vanes or fins 12 attached directly to driving element 6. FIGS. 2 depicts gas outlet ports 11¹ arranged in the upper end of housing 5 about the perimeter of the seated bottle 2 for the purpose of exerting a cooling effect to compensate for heat of solution and exothermic reactions, and vanes or fins 12¹ emanating radially from rotary control shaft 7. The nozzle 10 and vanes or fins 12 and 12¹ are so constructed and arranged that the stream of compressed gas issuing from nozzle

10 will impinge on the respective vanes or fins imparting a torque to shaft 7.

It is to be understood that the specific embodiments set forth hereinbefore are presented for purposes of explanation and illustration and that various modifications thereof without departing from the spirit and scope of the invention may be otherwise embodied or practiced.

We claim:

1. A gas driven magnetic stirring apparatus for flammable, explosive, or highly volatile liquids comprising in combination,

a driving assembly consisting of a driving element and a rotary control shaft, said driving element having a longitudinal axis which is horizontally positioned and said rotary control shaft being rigidly affixed to said driving element and coaxial with a vertical axis passing through the center of gravity of said driving element,

a non-magnetic housing for said driving assembly comprising a vertically positioned, cylindrical canister having a plurality of gas outlet ports in the upper end thereof, said housing containing mounts for bearings which support and permit free rotation of said rotary control shaft,

a source of compressed inert gas connected to an inlet port in the cylindrical side of said housing,

a plurality of vanes affixed to said driving assembly, said nozzle and said plurality of vanes being so constructed and arranged that the stream of compressed inert gas issuing from said nozzle will impinge on said vanes imparting a torque to said shaft,

a container for said liquids adapted to be seated on the upper end of said housing canister, and

a magnetized stirring bar adapted to be immersed in said liquids within said container and to form a magnetic couple with said driving element.

2. A magnetic stirring apparatus for flammable, explosive, or highly volatile liquids comprising

a magnetized stirring bar adapted to be placed in a quantity of said liquids within a container, magnetic coupling means for spinning said bar by imparting a torque thereto,

said magnetic coupling means being housed in a canister so arranged and constructed as to provide a support for said container, and

said canister being provided with a plurality of gas outlet ports at its supporting surface, whereby said container may be bathed in a controlled atmosphere of inert gas when a source thereof is connected to said canister.

3. A magnetic stirring apparatus for flammable, explosive, or highly volatile liquids comprising a magnetic coupling circuit containing a driven element and a driving element in spaced-apart parallel relation,

said driven element being immersed in a quantity of said liquids within a container and said driving element being outside said container and rigidly attached to a rotary control shaft,

said driving element and said rotary control shaft being housed in a canister so arranged and constructed as to provide a support for said container, and

said canister being provided with a plurality of gas outlet ports at its supporting surface, whereby said container may be bathed in a controlled atmosphere of inert gas when a source thereof is connected to said canister.

4. An apparatus according to claim 3 wherein a plurality of vanes are attached to said driving element, said plurality of vanes being so constructed and arranged as to permit a fixed stream of said gas impinging on said vanes to impart a torque to said driving element.

5. An apparatus according to claim 3 wherein a plurality of fins are attached to said rotary control shaft and emanate radially therefrom, thereby permitting a torque to be applied to said shaft when a stream of said gas impinges on said fins.

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