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H. L. ASP ET AL
MAGNETIC STIRRING BAR
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2,951,689

FIG. 1

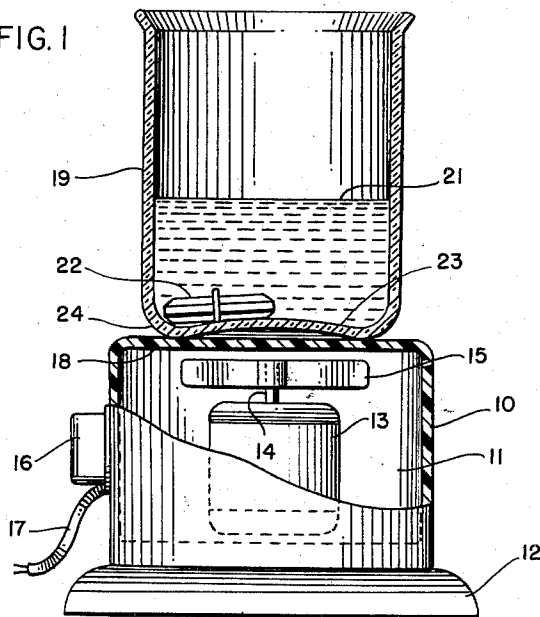


FIG. 2

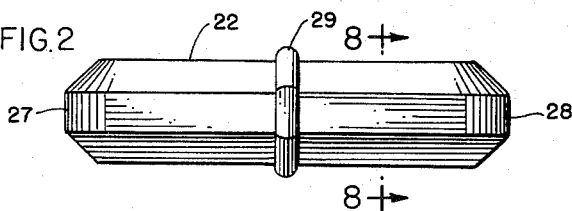


FIG. 3

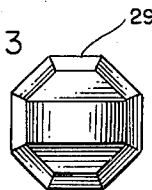


FIG. 4

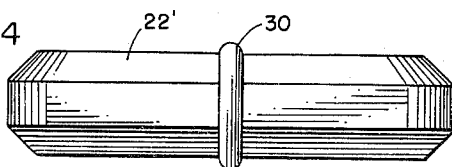


FIG. 5

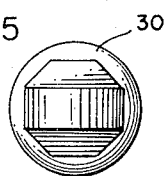


FIG. 6

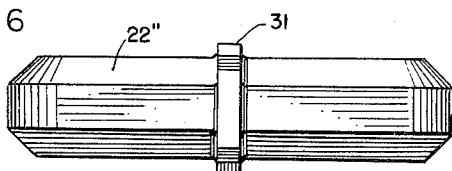


FIG. 7

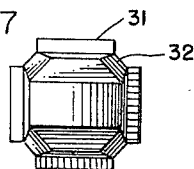
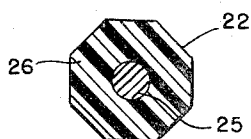


FIG. 8



INVENTORS:
HOWARD L. ASP
JOHN W. ROFFE

BY

Watson D. Harbaugh

ATT'Y

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MAGNETIC STIRRING BAR

Howard L. Asp, Evanston, and John W. Roffe, Itasca, Ill., assignors to Halogen Insulator and Seal Corporation, Franklin Park, Ill., a corporation of Illinois

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2 Claims. (Cl. 259—144)

This invention relates to fluid stirring apparatus, and more particularly to the stirring bar used in connection with magnetic stirring devices.

In magnetic stirring apparatus, a vessel containing the liquid or other fluid material to be agitated is placed above a rotatably driven magnet, and a magnetized stirring bar is placed in the vessel. As the magnet is rotated, the stirring bar is intended to rotate about its own axis, and if the vessel is sufficiently large the bar will revolve thereabout while it rotates. In order to effect proper agitation, both the rotational and revolving motions of the stirring bar should be present; but one of the difficulties encountered is that in beakers or vessels having a contoured bottom (concave, for example), a straight stirring bar tends to hang up on such bottom, especially if the fluid is viscous or when the magnet is rotated at slow velocities, whereupon rotation of the stirring bar is prevented.

One of the objects of the present invention is to provide a stirring bar structure that will overcome this troublesome characteristic. Another object of the invention is in providing a magnetic stirring bar that will rotate about its own axis irrespective of the contour of the bottom wall of the containing vessel. Still another object is in the provision of a magnetic stirring bar equipped centrally with a pivot ridge that permits the bar to be rotated under all conditions of speed, position thereof in the vessel, or the contour of the bottom wall of the latter.

Yet another object is to provide a stirring bar of the character described, in which the pivot ridge is configured so that as it revolves about the bottom wall of a vessel, it sweeps the same and thereby assures agitation of any solids or heavy material tending to collect thereon. Additional objects and advantages of the invention will become apparent as the specification develops.

Embodiments of the invention will become apparent, and are illustrated in the accompanying drawings, in which—

Figure 1 is a vertical sectional view, partly in elevation, of magnetic stirring apparatus having a vessel positioned thereon and containing a stirring bar therein;

Figure 2 is an enlarged, side view in elevation of the stirring bar shown in Figure 1;

Figure 3 is an end view in elevation of the bar illustrated in Figure 2;

Figure 4 is a side view in elevation of a modified stirring bar embodying the invention;

Figure 5 is an end view in elevation of the modified bar of Figure 4;

Figure 6 is a side view in elevation of still another modified bar embodying the invention;

Figure 7 is an end view in elevation of the bar shown in Figure 6; and

Figure 8 is a vertical sectional view taken along the line 8—8 of Figure 2.

The mixing device comprises a casing 10, defining a

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motor compartment 11 therein and equipped at its bottom with a base 12. Mounted within the compartment 11 is a motor 13 having a shaft 14 equipped adjacent the end thereof with a magnet 15. The magnet 15 will ordinarily comprise a permanent bar magnet and may be secured to the shaft 14 by any suitable means as, for example, a set screw. Preferably, the motor circuit will include a speed control 16 which may be a rheostat connected in the lead line 17 which will be equipped at its outer end with a plug (not shown) adapted to be connected in a convenience outlet.

In the specific structure shown, the casing 10 at the upper end thereof is provided with a top wall 18 adapted to support a beaker or vessel 19 thereon. The platform or support wall 18 is preferably planar to accommodate vessels of various diameters, although other configurations could be used. The vessel is shown to contain a liquid 21, and disposed within the liquid is a stirring bar 22 resting on the bottom wall 23 of the vessel.

Preferably, the vessel 19 is formed of plastic or glass or other non-magnetic material, as is the casing 10, so that the magnetic flux developed by the magnet 15 will not be dissipated in either the casing or vessel and will be available to act only on the stirring bar 22. It is noted that the bottom wall 23 of the vessel has a generally concave contour, and that the merger thereof with the side walls of the vessel is defined by a slightly rounded or arcuate section 24.

The stirring bar 22, as shown most clearly in Figure 8, comprises a magnetized core 25 within a cross-sectionally round sheath or encapsulating body 26. Consequently, when the motor 13 is energized to rotate the bar magnet 15, the magnetic field revolving about the axis of the shaft 14 causes the mixing bar 22 to sweep along the bottom wall 23 of the vessel (that is, revolve about an axis defined by the motor shaft 14), and at the same time, the revolving magnetic field causes the bar 22 to rotate about its transverse axis (that is, the vertical axis thereof with reference to the disposition of the bar in each of the figures of the drawing).

The encapsulating body 26 is preferably of a non-magnetic material which is impervious to the materials normally encountered in mixing operations, and able to withstand whatever temperatures are present in the vessel. Examples of such a material are Teflon, polytetrafluoroethylene, fluorinated ethylene polymer, polyethylene, or monochloro tri fluoro ethylene, and the encapsulating body may be molded about the core 25 so that it will be integral therewith. Subsequent to such molding and the curing of the material, the core is magnetized.

The encapsulating body 26 has a polygonal configuration, and as is most apparent from Figures 3 and 8, has an octagonal cross section. However, the ends of the body are rounded as shown at 27 and 28. Intermediate the ends of the bar and at substantially the mid-portion thereof is a laterally projecting rib or pivot ridge 29. As Figure 3 makes evident, the rib 29 follows the octagonal contour of the encapsulating body, and thus is an eight-sided element. The modified bar illustrated in Figures 4 and 5 differs from that of Figures 2 and 3 only with respect to the pivot ridge. Therefore, the bar is denoted with the numeral 22'. Similarly, the modified bar shown in Figures 6 and 7 is identical to the bar 22 except for the pivot ridge thereof, and is denoted with the numeral 22''.

The rib or pivot ridge 30 of the bar 22' is circular or ring-shaped (as is apparent from Figure 5), but like the rib 29 is a continuous element. However, the rib 31 of the bar 22'' is an interrupted element comprising four flat-sided segments arranged in diametrically opposed pairs. Figure 7 makes this evident, and shows that a total of four such segments are provided, equally spaced

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about the bar 22". The segments, however, are interconnected by inset stringers 32. The forms shown in Figures 3 and 7 are preferred over the ring-shaped ridge illustrated in Figure 5 because they provide flat surfaces that engage the bottom wall 23 of the vessel throughout an extended area thereof, in contrast to the point engagement which occurs between the ring-shaped rib 30 and bottom wall 23. Thus, as the bars 22 and 22" are carried about the bottom wall 23, they sweep a substantial area thereof and thereby agitate sediment tending to separate from the liquid body, and thus assure a more uniform intermix.

At the same time, however (as shown in Figure 1), the rib acts as a pivot preventing the stirring bar from hanging up on the contoured bottom wall of the vessel so that it will freely rotate about a vertical axis defined through the rib even when the motor 13 and magnet 15 are turning at slow speeds.

In the method of making the stirring bar, the core 25 is magnetized after the plastic sheath or coating is molded thereon. The reason for this is that the molds are made of ferrous metals; and if the core is magnetized when placed within such mold, it is difficult to maintain the core in a centered relation therein. This difficulty could be avoided if non-magnetic molds were employed (stainless steel, for example), but superior molds are made of ordinary steel for the surfaces thereof can be harder, they are more durable, etc.

The polygonal configuration of the stirring bar is important in that it serves a useful function in the removal of the bar from the mold. It has been found that if the bar is cylindrical, removal thereof from a mold of such shape is difficult, and often such a bar will be destroyed in attempting to pry the same from the mold. We have found that where the mold has flat surfaces, the bar after its formation pops from the mold thereby eliminating, through this self-ejection procedure, the time and difficulties encountered in manually removing the bar therefrom. It is believed that this result occurs because of the restoration forces that appear along the flattened surfaces of the mold during a molding operation, and which then exert an outward push against the bar when the mold is released.

That is, the mold is sectioned, and the lower section is filled with powder and the core placed in position thereon. The top section is also filled with powder through the provisions of a special jig, and the sections are then

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placed together and are held in such position by the application of a required force thereto. Heat is applied to change the powder to a molten state, and thereafter the material is chilled to solidify the same about the core. During this compression operation, the mold cavity is believed to be distorted slightly, and when the mold is opened the cavity restores itself, and as a consequence the bar is popped therefrom. This result is attained only when the mold surfaces have a flattened or planar contour as illustrated by the end product—namely, the stirring bar shown in the drawing.

While in the foregoing specification embodiments of the invention have been set forth in considerable detail both as to the structure and method of forming, for purposes of making an adequate disclosure thereof, it will be apparent to those skilled in the art that numerous changes may be made in those details without departing from the principles and spirit of the invention.

We claim:

1. A mixing bar for use with magnetic mixers, comprising a magnetized core and a cross-sectionally rotund encapsulating body enclosing the same, said body having flat faces on its sides and being equipped intermediate the ends thereof with a laterally projecting continuous pivot rib encircling the body and having a polygonal configuration defining a plurality of flat-sided segments upon which the body pivots.

2. A mixing bar for use with magnetic mixers, comprising a magnetized core and a cross-sectionally rotund encapsulating body enclosing the same, said body having flat faces on its sides and being equipped intermediate the ends thereof with a laterally projecting pivot ridge comprising a plurality of radially extending segments equally spaced circumferentially about the encapsulating body and having outwardly presenting straight edges upon which the body pivots.

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