June 23, 1964 C. E. ANDERSON ETAL 3,138,370

MAGNETIC STIRRING DEVICE

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FIG. 1

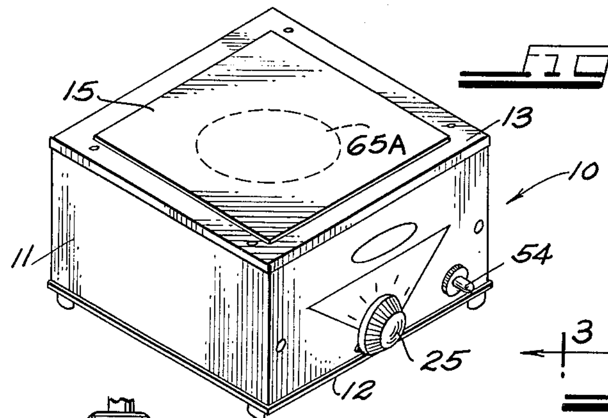

FIG. 2

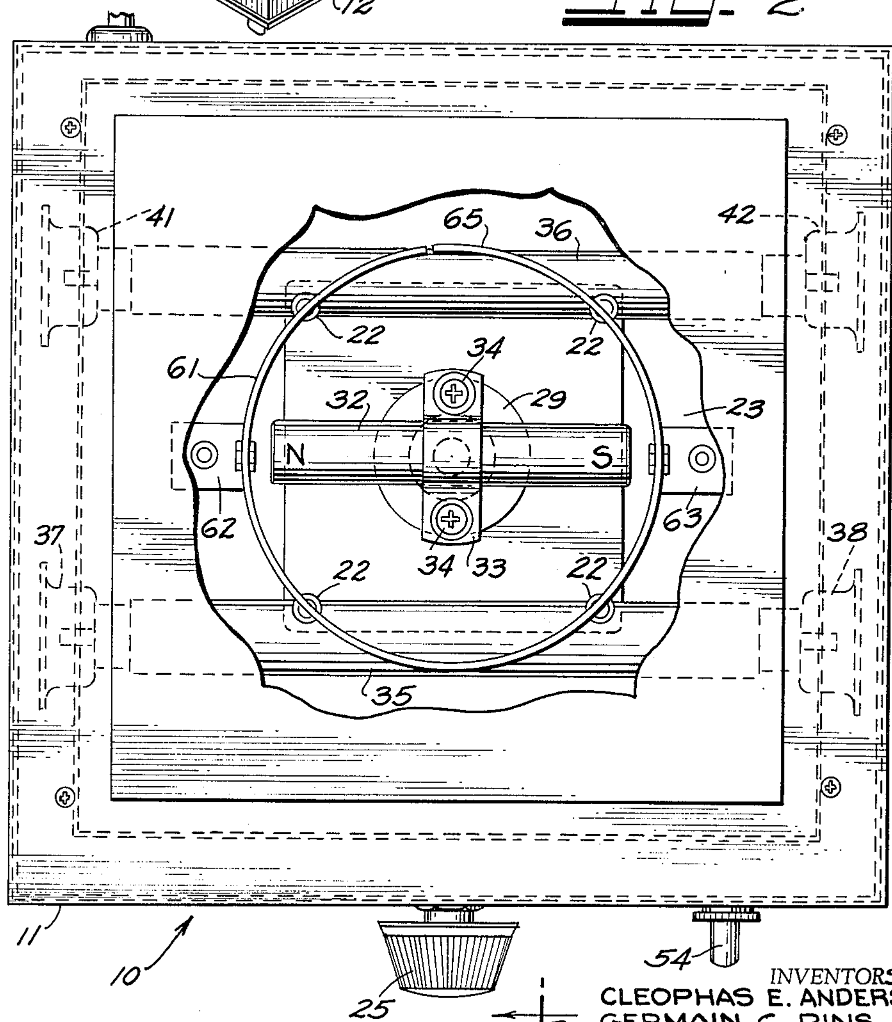

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FIG. 3

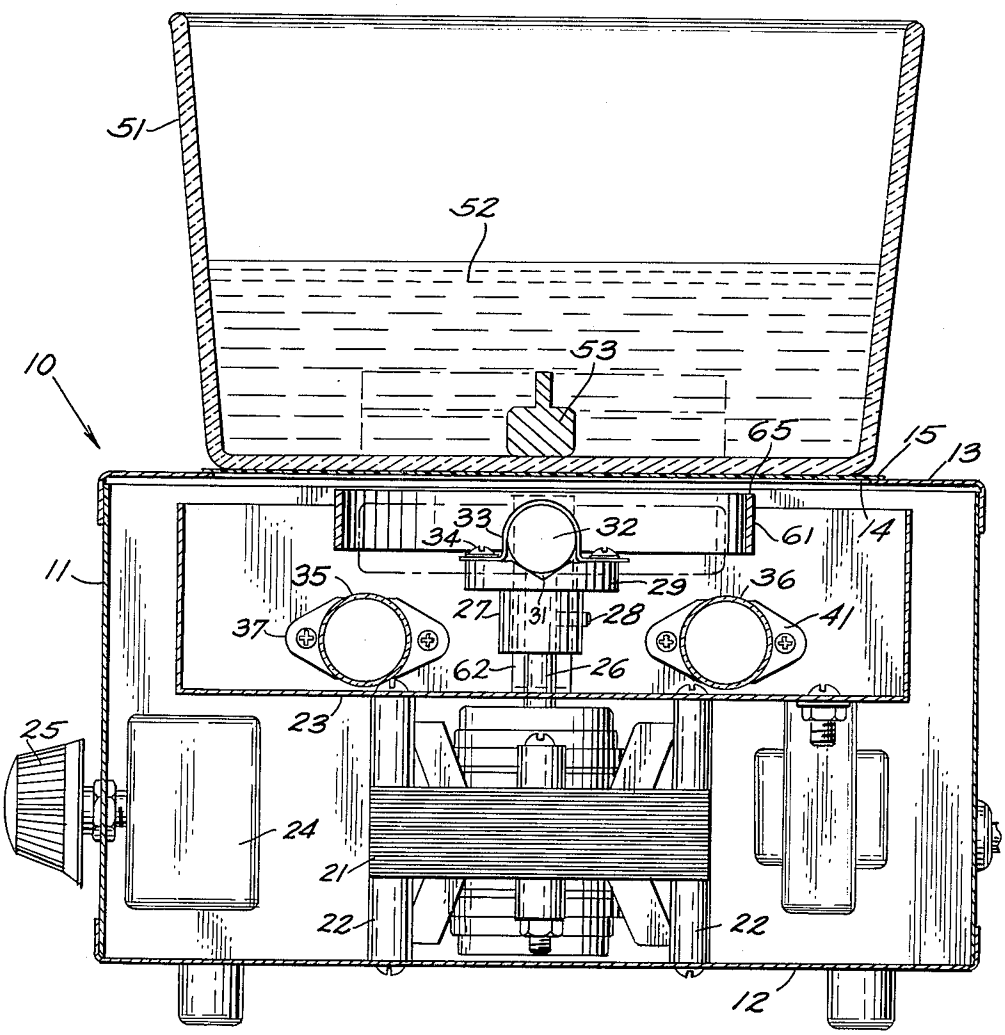
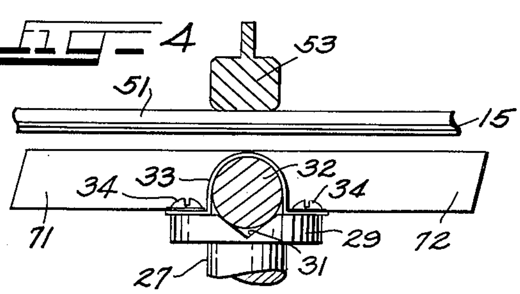


FIG. 4



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MAGNETIC STIRRING DEVICE

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3 Claims. (Cl. 259—108)

This invention relates to a new and improved magnetic stirring device and more specifically to a self-illuminated magnetic stirring device for agitating and illuminating the contents of a transparent vessel.

There are a number of laboratory operations in which changes in appearance of the material under study are of substantial or even critical importance. Thus, in chemical titration operations, close observation of the contents of a vessel may be required; at the same time, it is frequently necessary to agitate the contents of the vessel continuously. Ordinarily, the vessel in which the titration or like operation is carried out is illuminated from the side or from behind while the vessel is disposed upon a stirring apparatus. This arrangement, however, does not give optimum illumination of the contents of the vessel.

In apparatus of this kind, the stirring operation may be carried out by means of a stirring magnet disposed in the bottom of the vessel. This stirring magnet is rotated in response to the rotation of a drive magnet to which the stirring magnet is magnetically coupled. In operations of this kind, it is undesirable to spill the liquid that is being subjected to agitation, as might occur if the speed of the drive magnet is inadvertently increased beyond a safe level. Moreover, it is desirable to have some means for limiting the rotational speed of the drive magnet if the vessel is removed from the stirring device, thereby removing the major part of the load on the drive appartaus of the stirring mechanism.

It is an object of the present invention, therefore, to provide optimum illumination, during titrations or similar operations, in a magnetic stirring device of the kind in which a stirring magnet is disposed in a vessel containing the fluid to be agitated and is driven by magnetic coupling to a drive magnet located externally of the vessel and constituting a part of the stirring device.

Another object of the invention is to control and limit the operating speed of a magnetic stirring device, holding the speed relatively constant under variable load conditions.

A specific object of the invention is to afford an effective governor for a self-illuminated magnetic stirring device that also serves as a centering indicator for locating a vessel on the stirring device in centered alignment with respect to the drive magnet of the device.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments of the present invention and the principles thereof and what is now considered to be the best mode contemplated for applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

FIG. 1 is a perspective view of a self-illuminated magnetic stirring device constructed in accordance with one embodiment of the present invention;

FIG. 2 is a plan view of the stirring device of FIG. 1 with a part of the cover plate cut away to show internal construction;

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FIG. 3 is a sectional view taken approximately along line 3—3 in FIG. 2 and illustrating a vessel mounted on the stirring device; and

FIG. 4 is a detail view, similar to a portion of FIG. 3, showing an alternative construction for a part of the stirring device.

FIGS. 1–3 illustrate a self-illuminated magnetic stirring device **10** comprising an enclosed base **11**, preferably constructed from sheet metal. The lower portion of base **11** is enclosed by a bottom plate **12**. The upper portion of base **11** is provided with a rectangular rim member **13** having a relatively large central opening **14**. A thin, rigid, translucent cover plate **15** is mounted on the top rim member **13** of base **11** and covers the opening **14** in the top of the base. Cover plate **15** could be fabricated from glass, but is preferably formed from a translucent plastic, for example, an acrylic resin such as methyl methacrylate is quite suitable.

A variable speed drive motor **21**, in this instance a shaded-pole motor, is mounted upon the bottom plate **12** of base **11** by means of suitable support posts **22**. The support posts **22** extend above the motor and are also utilized to support a pan-shaped reflector **23** that is located immediately below cover plate **15**. Motor **21** is connected to a rheostat or other variable impedance device **24** by means of a suitable electrical circuit (not shown). Rheostat **24** is operated by an external manually controlled knob **25** to adjust the operating speed of the motor.

The shaft **26** of motor **21** extends upwardly through a central opening in reflector pan **23** as best shown in FIG. 3. The upper end of the motor shaft carries a coupling **27**. Coupling **27** is affixed to shaft **26** by suitable means such as a set screw **28**. The top portion **29** of coupling **27** is of enlarged disc-like configuration and is provided with a transverse V-shaped slot **31**. Coupling **27** is fabricated from brass or other suitable non-magnetic material.

A permanent magnet **32** is mounted in slot **31** of coupling **27** as best shown in FIGS. 2 and 3. Permanent magnet **32** may be fabricated from any suitable magnetic alloy of high remanence, such as the several Alnico alloys, or a ceramic permanent magnet material may be employed if desired. Magnet **32** is magnetized in an axial direction producing, for example, north and south poles as marked in FIG. 2. The permanent magnet is held in place on coupling **27** by a clamp **33** secured to the top portion **29** of the coupling by suitable means such as the screws **34**.

Magnetic stirring device **10** further includes a pair of lamps **35** and **36**; in the illustrated construction, the two lamps are small fluorescent tubes. Lamp **35** is mounted in suitable electric sockets **37** and **38**, the sockets for lamp **36** being designated by reference numerals **41** and **42** (see FIG. 2). The lamp sockets are mounted on the sides of the reflector pan **23**. Lamps **35** and **36** are located immediately above reflector pan **23** and are disposed on opposite sides of motor shaft **26** in position to illuminate the entire surface of the translucent cover plate **15**.

In the operation of magnetic stirring device **10**, a suitable transparent vessel **51** partially filled with a liquid **52** is disposed upon transparent cover plate **15**. A stirring magnet **53**, which can be of conventional construction, is located in the bottom of vessel **51**. The magnetic field between members **32** and **53** causes magnet **53** to align itself with the permanent magnet in the base of the stirring device.

Stirring device **10** may then be started in operation by actuation of a suitable switch **54** (see FIG. 1) connected in the operating circuit of lamps **35** and **36** and by actuation of rheostat 24 in the motor circuit. Energization of the motor rotates coupling 27 and permanent magnet 32. Rotation of magnet 32 causes a corresponding rotation of the stirring magnet in vessel 51, agitating the contents of the vessel.

Lamps 35 and 36 and translucent cover plate 15 afford an evenly illuminated background for vessel 51, providing convenient and effective observation of the contents of the vessel throughout the time during which it is agitated. Consequently, maximum accuracy and control can be achieved with respect to titrations and other procedures in which changes of color, opacity, or other visual characteristics of the contents of the vessel are critical.

The agitation of the contents of vessel 51 presents a variable load to motor 21. For example, the load on the motor is greater at the time that stirring is initiated than subsequently, when all that is required is to maintain rotation of driven magnet 53 and liquid 52 in the vessel. Thus, the stirring speed is relatively slow when operation is initiated but tends to increase thereafter. This is particularly true where a shaded pole motor or similar motor is used as the drive member 21, since motors of this kind are approximately constant-torque devices.

An eddy current brake or governor comprising a conductive metal ring 61 is disposed in encompassing relation to permanent magnet 32. The conductive ring 61 may be fabricated from aluminum or other suitable conductive material. It is mounted upon a pair of brackets 62 and 63 which, in turn, are supported upon the reflector pan 23 in the base 11 of the stirring device.

As permanent magnet 32 rotates, its magnetic field induces electrical currents in conductive ring 61. These currents are proportional in amplitude to the rotational speed of the magnet and the power dissipated in the ring is, of course, proportional to the square of the current. Hence, ring 61 represents a load for the motor that varies in proportion to the square of the rotational speed of the drive magnet 32.

The eddy current brake 61 tends to maintain a constant speed for the device, since it applies an increased load on the motor as the motor speed increases. Conversely, less power is dissipated by the eddy current brake or governor with decreasing speed. As a result, the overall effect of the eddy current ring is to maintain a relatively constant speed for the stirring operation, under conditions of variable loading, for a given setting of the control rheostat 24. Because good speed control, even at low speeds, is highly desirable for titrations and similar operations, the eddy current ring affords a material improvement in operation of the stirring apparatus. In addition, and as a result of the same basic braking action, the eddy current brake protects the stirring device against over-speed operation in the event that the load represented by the stirring magnet 53 in vessel 51 is removed without shutting the stirring device down.

Ring 61 does not interfere materially with illumination of the contents of the vessel. On the other hand, the upper rim 65 of the eddy current ring may be made dark in color so that the circular outline of the ring can be seen through translucent cover plate 15, as indicated by the dash outline 65A in FIG. 1. By making the rim of the eddy current brake ring visible through the translucent cover plate of the stirring device, the ring is made to serve a dual purpose, affording a convenient and relatively accurate means for centering vessel 51, and particularly stirring magnet 53, in relation to permanent magnet 32, in addition to the governor action of the ring.

FIG. 4 illustrates a modification of the present device in which a different form of brake structure is employed. In the arrangement shown in FIG. 4, the permanent magnet 32 is again mounted upon the disc-like upper portion 29 of coupling 27, in slot 31, by means of the clamp 33. Clamp 33, however, is provided with at least a pair of outwardly projecting vanes 71 and 72. In this embodiment the eddy current brake ring 61 is not employed.

The operation of the modification of FIG. 4 is essentially similar to that of the construction shown in FIGS. 2 and 3 except that the braking or governing effect for preventing over-speed operation of the motor is developed by virtue of the air resistance encountered by vanes 71 and 72. In this instance, the braking action increases as the third power of the speed of rotation, again effectively protecting the stirring device against excessive operating speeds in the event that the load on the motor is removed. However, this arrangement is less desirable than the eddy current brake afforded by ring 61, with respect to introduction of some flicker in the illumination of the contents of the vessel, particularly when the stirring device is operated at relatively low speeds.

Hence, while preferred embodiments of the invention have been described and illustrated, it is to be understood that they are capable of variation and modification, and we therefore do not wish to be limited to the precise details set forth, but desire to avail ourselves of such changes and alterations as fall within the purview of the following claims.

We claim:

1. A self-illuminated magnetic stirring device for supporting, agitating, and illuminating the contents of a transparent vessel containing a magnetic stirring magnet, during titrations and like operations, said device comprising:
- an enclosed base having a large opening in the top surface thereof;
- a thin, rigid, translucent plastic cover plate, covering said opening in the top of the base, for supporting a vessel on said base;
- a drive magnet mounted immediately below said cover plate for magnetic coupling to a stirring magnet in said vessel, said drive magnet being rotatable about a vertical axis;
- drive means, including a motor mounted within said base, for rotating said drive magnet to effect corresponding rotation of said stirring magnet and thereby agitate the contents of the vessel;
- an eddy current governor comprising an electrically conductive ring mounted in approximate vertical alignment with said drive magnet and in encompassing relation thereto, for maintaining the speed of rotation of said drive magnet relatively constant under varying load conditions;
- and at least one electrical lamp, mounted within said base, for illuminating the contents of the vessel, from below, through said cover plate.

2. A self-illuminated magnetic stirring device for supporting, agitating, and illuminating the contents of a transparent vessel containing a magnetic stirring magnet, during titrations and like operations, said device comprising:
- an enclosed base having a large opening in the top surface thereof;
- a thin, rigid, translucent cover plate, covering said opening in the top of the base, for supporting a vessel on said base;
- a drive magnet mounted immediately below said cover plate, at the center thereof, for magnetic coupling to a stirring magnet in said vessel, said drive magnet being rotatable about a vertical axis;
- drive means, including a motor mounted within said base, for rotating said drive magnet to effect corresponding rotation of said stirring magnet and thereby agitate the contents of the vessel;
- an eddy current governor comprising an electrically conductive aluminum ring mounted in coaxial alignment with and in approximate vertical alignment with said drive magnet, and in encompassing relation thereto, for maintaining the speed of rotation of said drive magnet relatively constant under varying load conditions;

the upper edge of said ring being of a dark color to afford a centering indicator for said vessel;

and a pair of electrical lamps, mounted within said base below said drive magnet and brake member ring on opposite sides of said axis, for illuminating the contents of the vessel, from below, through said cover plate.

3. A self-illuminated magnetic stirring device for supporting, agitating, and illuminating the contents of a transparent vessel containing a magnetic stirring magnet, during titrations and like operations, said device comprising:

an enclosed base having an enlarged opening in the top surface thereof;

a thin, rigid, translucent plastic cover plate, covering said opening in the top of the base, for supporting a vessel on said base;

a drive magnet mounted immediately below said cover plate for magnetic coupling to a stirring magnet in said vessel, said drive magnet being rotatable about a vertical axis;

variable speed drive means, including a motor mounted within said base, for rotating said drive magnet to effect corresponding rotation of said stirring magnet and thereby agitate the contents of the vessel;

governor means for applying an increasingly greater drag to said drive means with increasing speed of rotation of said drive magnet to maintain the speed of rotation thereof relatively constant under varying load conditions;

and at least one electrical lamp, mounted within said base, for illuminating the contents of the vessel, from below, through said cover plate.

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