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AGITATOR DEVICE

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FIG. 1

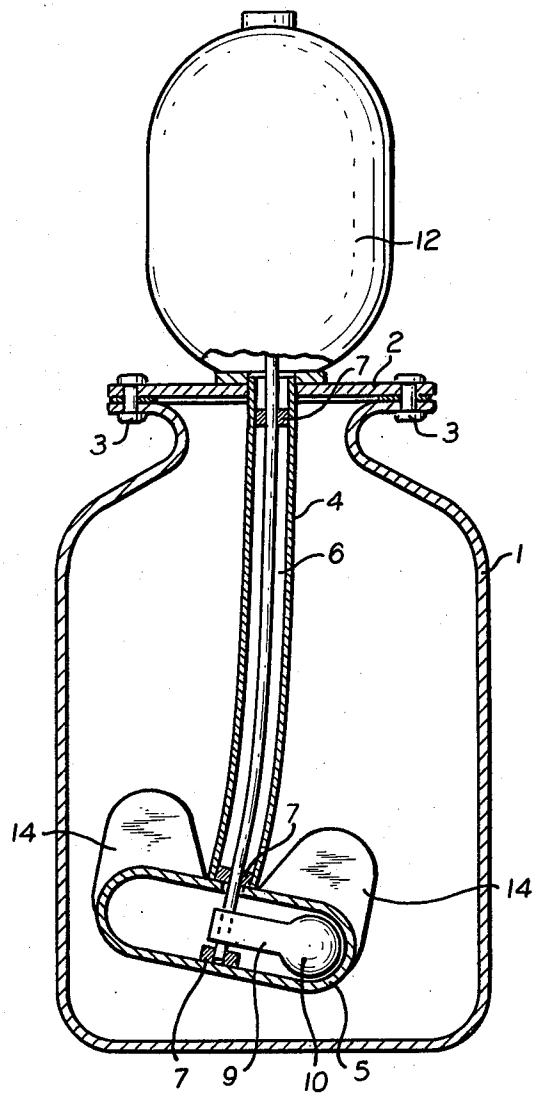


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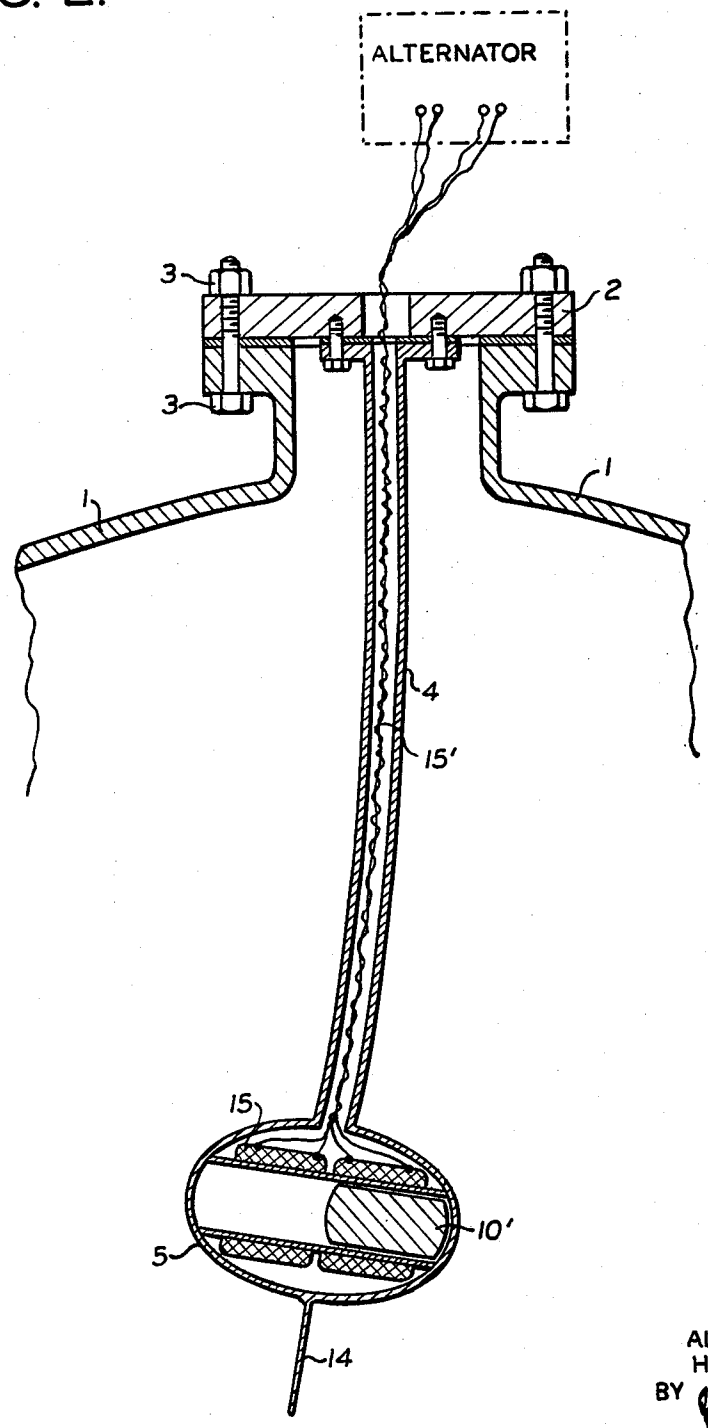
FIG. 2.

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3,384,354

# AGITATOR DEVICE

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## ABSTRACT OF THE DISCLOSURE

An agitator for liquids especially in closed containers, which liquids are preferably maintained at pressure or vacuum conditions, having a flexible hollow shaft extending through and sealed to the closed container and including an agitator vessel having vanes and a hollow interior, the latter communicating with the hollow shaft. A weight is movably disposed in the interior of the vessel and is adapted for circular or reciprocating movement by electrical or mechanical means passing through the hollow shaft. The movement of the weight causes an imbalance in the vessel causing it to move through the liquid for mixing the liquid.

The invention relates to an agitator device, in general and to such device or the mechanical mixing or agitation of liquids, mixtures of liquids, suspensions, dispersions and similar substances or mixtures of substances, in particular.

The agitator device, according to the present invention is more particularly suited to closed agitator tanks, for instance tanks in which an internal pressure has to be maintained which differs from atmospheric pressure. The agitator device according to the present invention can very advantageously be used in cases, in which a very high pressure or a high vacuum must be maintained.

In all mechanical mixing and agitating processes kinetic energy is transmitted to the material for agitation by means of an actuated agitator member. The agitator member generally rotates, but in many instances it also performs linear reciprocations.

In all these known agitator devices the moving agitator member must be connected by an arrangement of forces to a drive device disposed outside the agitator tank. In open agitator vessels and in such vessels operating at atmospheric pressure, it is possible to connect the movable agitator member to the drive device by a drive shaft, which is inserted into the agitator vessel, if necessary with the use of a packing or a stuffing box. However, difficulties arise, if a positive or negative pressure must be maintained within the vessel or if the vessel contains substances, the vapors of which are not permitted to escape even in small quantities from the vessel to prevent unpleasantness of odors, or due to their poison characteristics or due to any other danger. The known packings break down in high vacuum and at excess pressures, which exceed about 5 atmospheres. Even with lower excess pressures slight leakages can occur, by which vapors emerge and may cause dangers. At high operating pressures of the order of the magnitude of 100 atmospheres or more, packings by means of stuffing boxes can no more be employed. Moreover, stuffing boxes have still the further disadvantage that by lubrication means or removal of the packing means, soiling can enter the substances in the agitator.

It is one object of the invention to provide an agitator device which obviates the necessity of inserting a mobile drive shaft through an opening in the cover or in the wall of the agitator container.

It is another object of the present invention to provide an agitator device, wherein the agitator member is suspended in a container for oscillation or for an elastic movement and either given a circular oscillatory movement by an unbalanced mass rotating inside the agitator or displaced in a linear pendulous movement by a reciprocating mass inside the agitator. The drive motor for the rotating unbalanced mass or the moved mass, respectively, can be disposed inside the agitator member or, very advantageously, outside the agitator container and be connected to the rotating or pendulously moving mass by means of an articulated or cardan shaft or a resiliently bendable shaft.



In order to obtain movement of the agitator member with as low an expenditure of power as possible, the frequency of resilient oscillations of the agitator member can be chosen in resonance with the frequency of rotation of the unbalanced mass. However, since during agitation a relatively large amount of energy is released to the material being agitated, and, thereby, the oscillations of the agitator member are considerably dampened, it has been found more advantageous, to apply to the agitator member a much higher frequency of rotation than the specific frequency of the agitator member, so that the same does not perform spontaneous oscillations, rather enforced oscillations.

Conveniently the agitator member itself comprises suitably a tube which is made of a material resilient as to bending, such as metal or plastics, and which is rigidly connected, for instance by welding to the cover or wall of the agitator container. At its free end, i.e. the end not connected to the cover or wall of the container, which end is sealed off from the container contents, the agitator member is conveniently widened to form a hollow chamber, which has the shape of a rotary member having the necessary volume for the rotation of the unbalanced mass. Suitably curved vanes are disposed on the outside of the agitator member, to transmit as satisfactorily as possible the motion of the agitator member to the material to be agitated.

With these and other objects in view which will become apparent in the following detailed description, the present invention will be clearly understood in connection with the accompanying drawings, in which:

FIGURE 1 discloses an agitator device, designed in accordance with the present invention, for circular movement; and

FIG. 2 discloses an agitator device, designed in accordance with the present invention, for reciprocating movement.

Referring now to the drawing and in particular to FIG. 1, an embodiment of an agitator device is disclosed in the drawing, which comprises an agitator vessel **1**, for instance an autoclave for high internal pressure or a vacuum vessel, which is hermetically sealed by a cover **2** secured to the vessel by screws **3**. A tube **4** made of resilient material, for instance a steel tube, is inserted in sealing-tight relationship, for instance welded into the cover **2**. Disposed at the bottom of the tube **4** is an agitator member **5** connected in sealing-tight relationship to the tube **4** and sealed off on all sides, except at the place of entry of the tube **4**. A shaft **6** is guided, by a number of roller or plain bearings **7** in the tube **4**. An imbalance **10** is attached by an arm **9** to the bottom of the shaft **6**. When the shaft **6** rotates, the imbalance **10** moves over a circular path inside the member **5**. A drive motor **12** (shown diagrammatically) is disposed above the cover **2** to drive the shaft **6**. Disposed on the outside of the member **5** are vanes **14** which transmit the motion of the member **5** to the substance to be agitated or mixed. Clearly, forces of reaction make the member **5** and, therefore, the whole agitator member performs a circular oscillation when the imbalance **10** rotates inside the member **5**. The drawing shows only one of the positions

through which the agitator device passes when the imbalance **10** is rotating, the resilient tube **4** and the resilient shaft **6** being flexed, whereas, when the imbalance **10** is not rotating, the agitator device is in the central position in which the tube **4** and the shaft **6** are substantially straight.

Referring now again to the drawings, and more particularly to FIG. 2, instead of having the imbalance rotating in the member, it is also possible to subject a mass to a reciprocating movement, for instance a soft iron member **10'** reciprocated by magnetic coils **15**, or a piston reciprocated in a cylinder by a hydraulic fluid operative alternately at either end (the latter not shown). In this case, the agitator device would, therefore, perform not a circular, but a linear pendulum movement. With this device could also be obtained an agitating effect which would, however, not mix the material as thoroughly as the device performing a circular oscillation. The advantage, that the agitator container can be hermetically sealed from atmosphere, would be likewise obtained in this case.

Of course, the present invention is not limited to the embodiment thereof illustrated and described, since the shapes of the agitator vessel, agitator device, imbalance and agitator vanes can vary. Nor is the invention limited to the agitator device being suspended in the vessel from the top, since it can alternatively be introduced from the sides or from below.

While we have disclosed several embodiments of the present invention, it is to be understood that these embodiments are given by example only and not in a limiting sense, the scope of the present invention being determined by the objects and the claims.

We claim:

**1.** An agitator device, more particularly for closed agitator vessels, comprising

a closely sealed container,

a flexible tube passing into said container and sealed thereto,

an agitator member sealingly connected to and suspended by said flexible tube for vibratory movement in said container, and including therein an unbalanced mass,

said unbalanced mass movably disposed inside of said agitator member to impart a vibratory movement to the latter when said unbalanced mass is moved, and

means partly disposed outside of and extending into said flexible tube and operatively connected to said unbalanced mass for actuating from the free end of said flexible tube said unbalanced mass for movement.



**2.** The agitator device, as set forth in claim **1**, wherein said unbalanced mass is subjected to a circular oscillatory movement, thereby displacing said agitator member in a circular movement.

**3.** The agitator device, as set forth in claim **1**, wherein said unbalanced mass is subjected to a linear oscillatory movement, thereby displacing said agitator member in a linear pendulum movement.

**4.** The agitator device, as set forth in claim **1**, wherein said means actuating said mass is disposed outside of and in part inside of said agitator member.

**5.** An agitator device particularly for closed vessels comprising,

a flexible tube,

an agitator member defining an interior and suspended by and sealingly connected to said flexible tube for vibratory movement,

an unbalanced mass movably disposed in said interior of said agitator member to impart a vibratory movement to the latter when said unbalanced mass is moved, and

means disposed outside of and partly in said flexible tube and operatively connected to said unbalanced mass for actuating, from the free end of said flexible tube, said unbalanced mass for vibratory movement.

**6.** The agitator device, as set forth in claim **1**, further comprising,

at least one vane disposed externally on said agitator member for transmitting the vibratory movement of said agitator member to a fluid material in said container.


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