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BARIUM DISPENSING SYSTEM

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Fig. 1

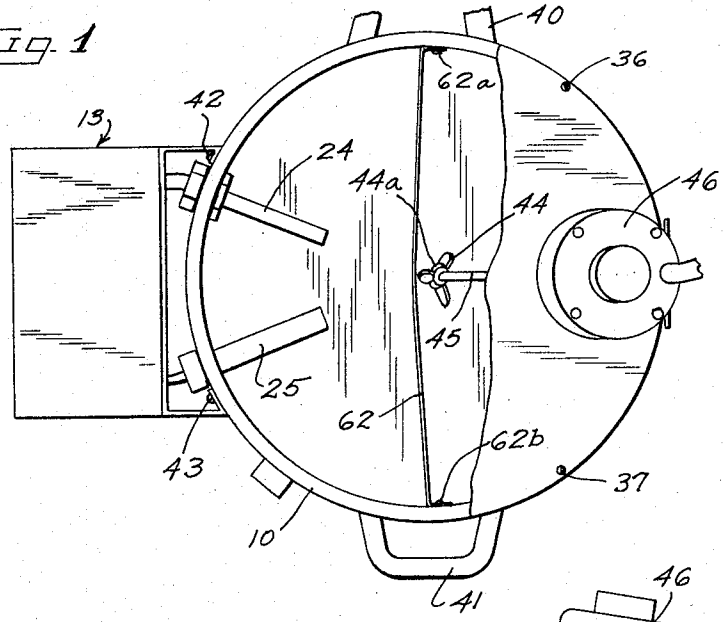
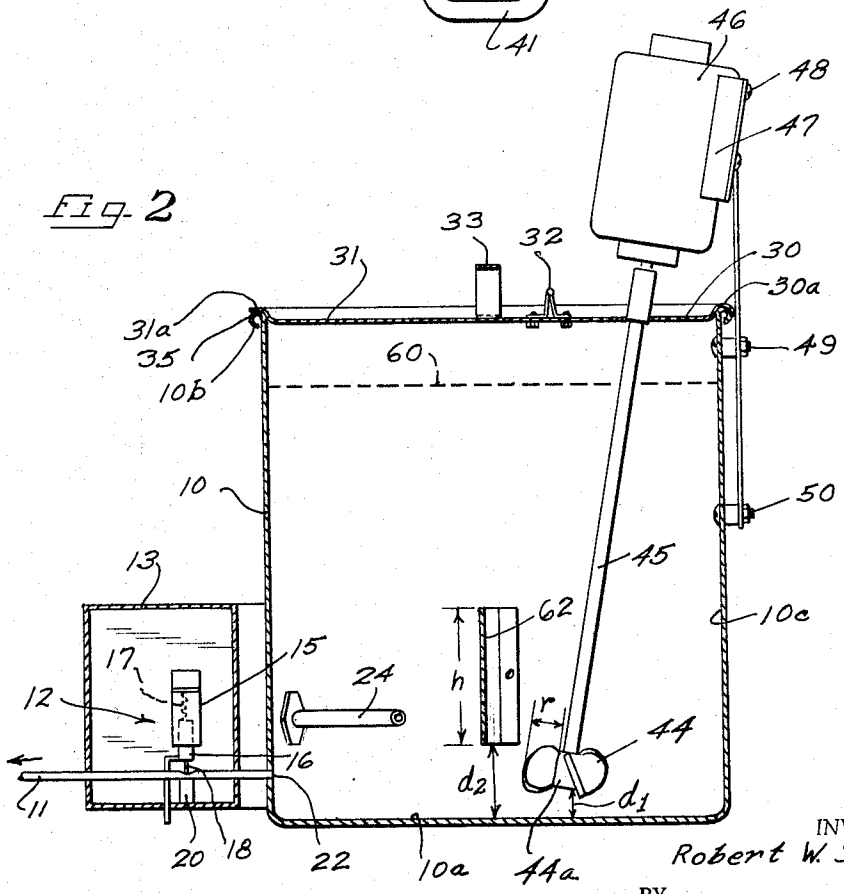


Fig. 2



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BARIUM DISPENSING SYSTEM

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The present invention relates generally to a system and method for handling solutions of the type which tend to settle out when left standing, even when the standing time is relatively short.

The present invention is applicable generally to the handling of solutions of any composition provided that the solution is sufficiently liquid to flow through a discharge tube. The present invention is particularly applicable to the handling of barium sulfate solution for use in colon fluoroscopies. Heretofore, considerable difficulty has been encountered in providing an apparatus and method for maintaining a barium solution in a properly dispersed condition within a tank so that it can be used at any given time after the solution has been prepared because of the tendency of the solid material in the solution to settle out in the tank.

An object of this invention is to provide an improved method and apparatus for maintaining a barium solution for use in colon fluoroscopies in condition for use at any time after the solution has been prepared.

Another object of the invention is to provide an improved method and apparatus in which a heated solution such as barium sulfate is kept in a state of constant agitation even though such solution is to be dispensed only periodically.

Other objects and features of the present invention will more fully become apparent in view of the following detailed description illustrating a single embodiment and in which:

FIGURE 1 is a fragmentary top plan view of a barium dispensing apparatus; and

FIGURE 2 is a vertical section of the apparatus shown in FIGURE 1 only with certain components illustrated in elevation.

As shown on the drawings:

The tank **10** is utilized to contain a barium sulfate solution for use in colon fluoroscopies. The barium sulfate solution may comprise eight pounds of barium sulfate powder to two gallons of water, and the capacity of the tank **10** may be forty quarts.

Prior to the present invention, there has been no satisfactory way of maintaining the barium sulfate in a properly dispersed condition within the tank.

The dispensing of the barium solution from the tank is via a flexible tube **11** having a solenoid shut-off valve generally indicated at **12**. The solenoid valve is located in a housing **13** directly secured to the tank **10**. The housing may, for example, contain all of the electrical wiring for the dispensing system including a relay controlled from a remote station and in turn controlling energization of the solenoid **12**, a suitable transformer for supply of secondary voltage of appropriate value, indicator lights, fuses and the like. The solenoid valve **12** may include a solenoid **15** having an armature member **16** which is urged downwardly into closing relation to the tube **11** by means of a suitable compression spring **17**. The armature **16** may carry a relatively thin plate **18** which has a straight relatively thin edge extending transverse to the tube **11** for constricting the tube and preventing flow therethrough. A supporting plate **20** underlies the tube **17** and cooperates with the edge of plate **18** in pinching off the tube. When the remote control switch is actuated, (not shown), the relay (not shown) in housing **13** is actuated to cause energization of the solenoid **15** and retraction of the armature **16** against

the action of spring **17** to open the tube **11** and allow the flow of the barium solution along the tube **11** under the action of gravity.

The tube **11** communicates with the interior of the tank **10** by means of an aperture in the tank wall as indicated at **22** which is near the bottom wall **10***a* of the tank.

The element indicated by the reference numeral **24** in FIGURES 1 and 2 is a suitable heating element for maintaining the barium solution at a predetermined desired temperature corresponding approximately to body temperature. A thermostatic element indicated at **25** and located at approximately the same height as the element **24** in the tank is effective in connection with the control circuitry in the housing **13** to maintain the desired temperature. That is, if the temperature falls below a predetermined value, electric current is supplied to the heating element **24** until the temperature is raised to a predetermined upper limit temperature after which current flow may be interrupted, for example, until the temperature of the solution again falls to the lower predetermined limit. Any suitable automatic temperature control of this type may be utilized. The level of the heating element **24** in the tank is related to the volume of the tank lying below the level of the heating element so that the heating element **24** is incapable of heating the barium solution above 100° F. even in the event of a failure of the thermostat **25**. That is, given a volume of barium solution such that the surface of the solution is in contact with the heating element **24**, the volume of the liquid is such that the heating element would be incapable of raising the temperature of the volume of liquid above 100° F. Of course, if the level of liquid falls below the level of the heating element **24**, the heating element **24** even if continuously energized would transfer relatively little heat to the volume of liquid.

The tank **10** is provided with a cover assembly including a fixed cover part **30** and a movable cover part **31** hinged to the fixed part as indicated at **32** in FIGURE 2. A suitable handle **33** is secured to the hinged cover part **31** to facilitate opening of the cover part **31** for inserting the elements of the barium solution and other purposes. The cover assembly may be provided with a grooved margin as indicated at **30***a* and **31***a* in FIGURE 2 and a suitable seal may be provided secured to the underside of the cover **31***a* as indicated at **35** in FIGURE 2 which seal seats upon a bead **10***b* at the top of the tank in closed position of the movable cover section **31**. The fixed cover section **30** may be secured to the top of the tank by means of screws or the like such as indicated at **36** and **37** so as to be readily removable.

The tank **10** may have suitable carrying handles as indicated at **40** and **41** in FIGURE 1. The housing **13** may be secured to the tank by suitable fastening means such as indicated at **42** and **43** in FIGURE 1.

In order to maintain the barium sulfate properly dispersed in the volume of the tank, an impeller device indicated at **44** is provided carried on an elongated shaft **45** and driven from an electric motor **46**. The motor is secured to the tank by means of a bracket **47** secured to the motor casing as indicated at **48** and secured to the side wall **10***b* of the tank by fastening means which may comprise bolts and nuts, such as indicated at **49** and **50**. Of course, suitable seals are utilized at all points where there are apertures in the tank **10** below the liquid level therein which may be generally as indicated by the reference numeral **60** in FIGURE 2.

As an example of a very successful embodiment in accordance with the present invention, the impeller blade has a radial dimension beyond the harp portion **44***a* thereof of about ½". The distance d_1 between the center of the

impeller **44** and the upper surface of the bottom wall **10***a* of the tank is slightly more than ½" and the motor **46** operates at a speed of about 1725 revolutions per minute. A baffle wall **62** extends across the central part of the tank and has end flanges **62***a* and **62***b* secured to the side wall of the tank by suitable fastening means. The baffle wall has a spacing above the bottom of the tank d_2 of slightly more than 2" and has a height dimension h of about 4". Effectively, each successive blade of the impeller **44** during rotation thereof has its radially outer tip move in close relation to the plane of the baffle wall **62** at a height above the bottom wall **10***a* of approximately 1", that is approximately mid-way between the bottom wall **10***a* and the lower edge of the baffle wall **62**. An axial projection of the shaft **45** and the axis of the impeller **44** would intersect the bottom wall **10***a* within a half-inch or so of the center of the bottom wall **10***a*. The impeller **44** has its blades tilted at an angle of approximately 30° to the horizontal and rotates in such a direction as to impel the liquid downwardly and generally toward the center of the bottom wall **10***a* substantially directly below the partition wall **62**. It is found that the positioning of the impeller **44** and the location and dimensions of the partition wall **62** are relatively critical for adequate dispersion of the barium sulfate in the volume of the tank. The impeller **44** should be relatively near to the center of the tank as illustrated and a one-half inch blade should be within ½" to 2" from the bottom wall **10***a*, that is the distance d_1 should be between ½" and 2". The radial dimension r of the blade **44** can be increased to about 1" and the distance d_1 correspondingly slightly increased as to its upper limit but in effect, the impeller **44** must be relatively close to the bottom wall **10***a* in relation to its effective radial dimension r. It is considered preferable to drive the impeller **44** at a speed betwen 1400 and 1900 revolutions per minute. The baffle wall **62** has been found to be essential in conjunction with the impeller **44** so as to prevent undesired movements of the liquid and to insure the desired motion of the liquid which is downwardly toward the bottom wall **10** and then upwardly along the side wall of the tank at all points about the circumference of the side wall **10***c*. The baffle **62** tends to prevent circumferential flow of the liquid. The level of the liquid indicated at **60** may, for example, at its maximum level be approximately 12" above the bottom wall **10***a* and it is important that the height h of the baffle wall **62** be a substantial proportion of the effective height of the tank. The baffle may have a height substantially greater than that shown and described, but the height of the baffle h cannot be substantially less than that described, namely about 4".

While I have shown and described a commercial embodiment of my novel apparatus, it will be understood that the same is capable of modification, and that modification may be made without departure from the spirit and scope of the invention as defined in the claims.

I claim as my invention:

1. A barium dispensing system for use in colon fluoroscopies comprising

storage means for receiving a level of barium solution,

means for heating and maintaining the solution at approximately human body temperature,

valve means enabling the solution to be dispensed from the storage means,

means for maintaining particles of the barium in a properly dispersed condition within the storage means comprising a baffle spaced at its lower end above a bottom of the storage means and spaced at its upper end below the level of the barium solution and extending laterally to the side walls of the storage means for limiting circumferential flow of the solution within the storage means, and

a motor driven impeller disposed at one side of the baffle with the impeller having rotary driven blades spaced above the bottom at an underside of the baffle to impel the solution downwardly and along the bottom and then vertically along the side wall.

2. A liquid dispensing system comprising

a tank for receiving a level of liquid,

means for heating and maintaining the liquid at a desired temperature,

valve means enabling the liquid to be dispensed from a side wall of the tank adjacent the bottom of the tank,

means for maintaining particles of the liquid in a properly dispersed condition within the tank comprising a baffle spaced at its lower end above the bottom of the tank and spaced at its upper end below the level of the liquid and extending laterally to the side walls of the tank for limiting circumferential flow of the liquid within the tank, and

a motor driven impeller disposed at one side of the baffle with the impeller having rotary driven blades spaced above the bottom at an underside of the baffle to impel the liquid downwardly and along the bottom and then vertically along the side wall of the tank.

3. A solution dispensing system comprising

a tank for receiving a level of a solution,

valve means enabling the solution to be dispensed from the tank,

means for maintaining particles of the solution in a properly dispersed condition within the tank comprising a baffle extended transversely of the tank and joined at opposite ends with the side walls of the tank for limiting circumferential flow of the solution within the tank, said baffle being spaced at its lower end above a bottom of the tank and being spaced at its upper end below the level of the solution, and

a motor driven impeller disposed at one side of the baffle with the impeller having rotary driven blades spaced above the bottom at an underside of the baffle to impel the solution downwardly and along the bottom and then vertically along the side wall of the tank.

4. A solution dispensing system comprising

a tank for receiving a level of a solution,

valve means enabling the solution to be dispensed from the tank,

means for maintaining particles of the solution in a properly dispersed condition within the tank comprising a baffle extended transversely of the tank and joined at opposite ends with the tank for limiting circumferential flow of the solution within the tank, said baffle being spaced at its lower end above a bottom of the tank and being spaced at its upper end below the level of the solution, and

a motor driven impeller disposed at one side of the baffle with the impeller having rotary driven blades spaced above the bottom at an underside of the baffle to impel the solution downwardly and along the bottom and then vertically along the side wall of the tank,

said impeller having its blades tilted approximately 30° relative to a horizontal plane and being rotatable between 1400 and 1900 revolutions per minute.

5. A barium dispensing system for use in colon fluoroscopies comprising

a tank for receiving a level of a barium solution,

means for heating and maintaining the solution at approximately human body temperature,

valve means enabling the solution to be dispensed from the tank,

means for maintaining particles of the barium in a properly dispersed condition within the tank comprising a baffle spaced at its lower end above a bottom of the tank and spaced at its upper end below the level of the solution and extending laterally to

the side walls of the tank for limiting circumferential flow of the solution within the tank, and

a motor mounted on the side wall having a drive shaft extended into the tank and an impeller mounted on its lower end adjacent the bottom of the tank and disposed at one side of the baffle with the impeller having rotary driven blades spaced above the bottom at an underside of the baffle to impel the solution downwardly and along the bottom and then vertically along the side wall of the tank.

6. A barium dispensing system comprising

a tank for receiving a barium solution up to a height of approximately 12 inches above the bottom thereof and having a diameter comparable to said height to provide a capacity of the order of 40 quarts,

valve means enabling the solution to be dispensed from the tank,

means for maintaining particles of the solution in a properly dispersed condition within the tank comprising a baffle extended transversely of the tank and joined at opposite ends with the tank for limiting circumferential flow of the solution within the tank, and with said baffle being spaced above the bottom of the tank, and

a motor driven impeller disposed at one side of the baffle with the impeller having rotary driven blades spaced above the bottom at an underside of the baffle to impel the solution downwardly toward a central region of the bottom and along the bottom and then vertically along the side wall of the tank,

said baffle having a height of not less than approximately 4 inches and the lower edge of the baffle being spaced above the bottom about 2 inches.

7. A barium dispensing system comprising

a tank for receiving a barium solution up to a height of approximately 12 inches above the bottom thereof and having a diameter comparable to said height to provide a capacity of the order of 40 quarts,

valve means enabling the solution to be dispensed from the tank,

means for maintaining particles of the solution in a

properly dispersed condition within the tank comprising a baffle extended transversely of the tank and joined at opposite ends with the tank for limiting circumferential flow of the solution within the tank, and with said baffle being spaced above the bottom of the tank, and

a motor driven impeller disposed at one side of the baffle with the impeller having rotary driven blades spaced above the bottom at an underside of the baffle to impel the solution downwardly toward a central region of the bottom and along the bottom and then vertically along the side wall of the tank,

said baffle having a height of not less than approximately 4 inches, and the lower edge of the baffle being spaced above the bottom wall about 2 inches,

said impeller having its axis disposed in a plane that can be projected within approximately ½ inch of the center of the bottom wall,

said impeller having its blades tilted approximately 30 degrees relative to a horizontal plane and being rotatable between 1400 and 1900 revolutions per minute, said impeller blades having a radial dimension of about ½ inch.

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