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(12) # EUROPEAN PATENT APPLICATION

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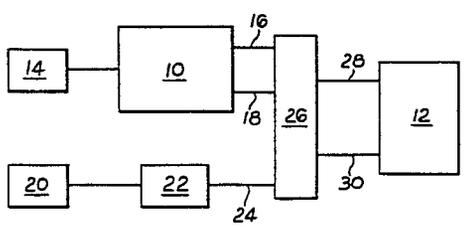
(54) **Mixing apparatus.**

(57) Mixing apparatus as disclosed in published European Patent Application No. 0000827 is provided with means (20) for sensing the electric current drawn by the motor driving the rotary agitator of the apparatus. In response to a fall in the motor current, an override signal (24) is produced to cause the agitator to be lowered automatically back into the mixing vessel irrespective of the agitator positioning control signals (16,18) derived from the noise level sensor (14) of the apparatus.



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DESCRIPTION

MIXING APPARATUS

This invention relates to a development in the mixing apparatus disclosed in our prior published European Patent Application No 0000827, the disclosure of which is incorporated herein by reference.

With the existing apparatus, i.e. as disclosed in our prior application, it has been found that under certain conditions, particularly if a large quantity of powdered solids is added in a relatively short time, the surface of the liquid can become totally blanketed thus causing raising of the mixing rotor. In such circumstances, if the rotor rises above the liquid level and enters the blanketing layer of solids material, the sound level may not change and consequently the rotor may continue to rise until it reaches the uppermost limit of its travel. Such a condition is clearly unsatisfactory as the mixing process is terminated and manual intervention is necessary to restore normal working of the apparatus.

The object of the present invention is to overcome the above mentioned drawback.

According to the invention we provide mixing apparatus comprising a vessel for receiving liquid and other materials to be mixed, a rotary agitator for immersion into the contents of the vessel, means for rotatably driving said agitator and means responsive to the noise level emitted by the contents of the vessel during agitation for automatically adjusting the vertical position of the agitator, characterised by means for monitoring the drive means so as to sense abnormal operating conditions.

Thus, in practice, an abnormal operating condition may correspond to the rotor being raised above the surface of the liquid within the mixing vessel. Another possibility that may be detected by the monitoring means is malfunctioning of the drive system, e.g. failure of an electric drive motor.

In the preferred embodiment of the invention, the drive system comprises an electric motor, as in the apparatus described in our prior Application, and the monitoring means is responsive to the motor current which, it will be appreciated, will decrease significantly when the rotor rises above the liquid surface level because the drag on the rotor exerted by a layer of powder or air is considerably less than that exerted by the liquid. Thus, the monitoring means conveniently, in response to significant reduction in motor current, generates a signal to cause lowering of the rotor automatically and this signal may at least temporarily override the controls which position the rotor according to the noise levels prevailing.

The monitoring means may for example be in the form of a device which senses motor current and converts it into voltage so that when the motor current drops below a predetermined minimum value, the logic state of the output channel of the monitoring

means changes to provide the above mentioned signal.

The control circuitry of the apparatus may be designed to provide, in essence, three output channels corresponding to the raise, lower and motor detector conditions with appropriate gating to derive an output signal consistent with the desired operating conditions. As previously mentioned, the output derived from the monitoring means in response to the presence of an abnormal operating condition will override those signals produced by the apparatus during normal operation.

One example of the invention is illustrated in the accompanying drawing the sole figure of which is a schematic block diagram of circuitry for controlling operation of mixing apparatus as disclosed in our published patent application No. 2002246.

The control circuitry illustrated in the accompanying drawing may for the most part be generally similar to that disclosed in our published Patent Application No. 0000827 and the description herein will therefore be confined to the modifications provided by the present invention. The control circuits depicted by the blocks 10 and 12 respectively correspond to circuitry illustrated in Figures 2a and 2b of Patent Application No. 0000827 and reference should be made to the prior application for detailed description. Essentially the circuits 10, 12 serve to process the output from the microphone 14 in order to produce control signals governing the vertical positioning of the rotary agitator of the mixing apparatus. The circuit 10 provides two outputs 16, 18 such that a signal appears either at output 16 or 18 depending respectively on whether the noise level is below or above a predetermined range. If the

noise level is below the predetermined range, the circuit 12 will produce a control signal to effect raising of the agitator and vice versa.

The modification introduced by the invention involves the use of means for sensing the current drawn by the electric motor for rotatably driving the mixing agitator. Such means may comprise a current transformer 20 connected in circuit with the motor and interface circuitry 22 for providing an output 24 representing the motor current. In this modification the outputs 16,18 are gated with the outputs 24 in gating circuitry 26 in accordance with the following conditions. If the output 24 corresponds to normal motor current levels, the output 16, 18 are coupled by the gating circuitry 26 to inputs 28, 30 respectively of the control circuitry 12. In these circumstances, the apparatus operates in the manner described in Patent Application No. 2002646. If however the output 24 corresponds to a low motor current such as occurs if the agitator is withdrawn from the body of liquid within the mixing vessel then the output 16 is de-coupled from input 28 and the output 24 is coupled to the input 30 so as to cause the circuit 12 to generate an output resulting in lowering of the agitator.

As the agitator is lowered and re-enters the body of liquid, the motor current will return to a normal level with resumption of normal control of the agitator by the outputs 16,18 which will once again be connected to the inputs 28,30 respectively. It will be seen that the output 24 is effective to override normal operation of the apparatus in circumstances where the motor control current falls substantially and will therefore overcome any tendency for the apparatus to continue raising the agitator through failure to detect a change in noise level

due to the presence of a blanketing layer of solids on the liquid surface.

If desired, lowering of the agitator in response to fall in motor current may be sustained for longer than is strictly necessary to re-introduce the agitator back into the liquid. For example, the circuitry 22 may, in response to detection of a substantial fall in motor current, produce a corresponding signal at output 24 for a predetermined time interval sufficient to re-immerse the agitator to a desired depth before allowing resumption of control in accordance with the noise level detected by the microphone.

CLAIMS

1. Mixing apparatus comprising a vessel for receiving liquid and other materials to be mixed, a rotary agitator for immersion into the contents of the vessel, means for rotatably driving said agitator and means responsive to the noise level emitted by the contents of the vessel during agitation for automatically adjusting the vertical position of the agitator, characterised by means for monitoring the drive means so as to sense abnormal operating conditions.

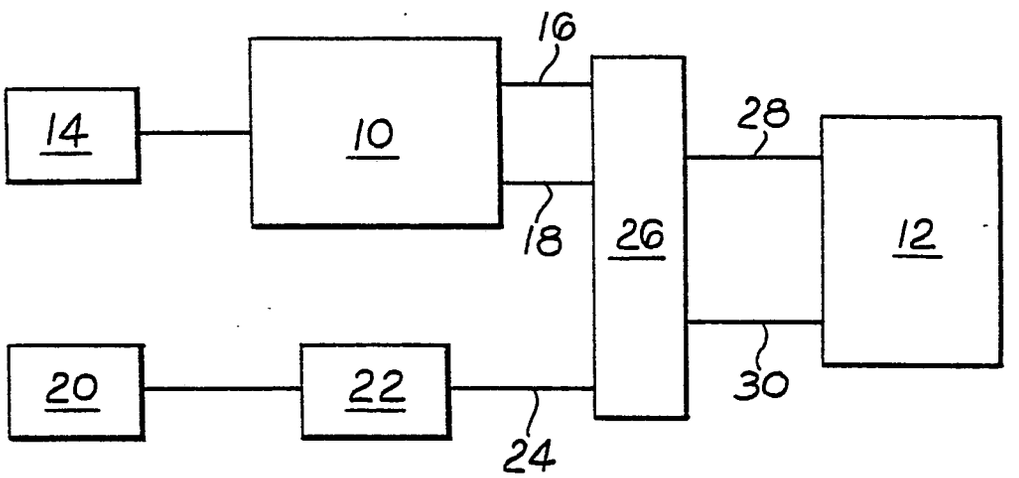
2. Apparatus as claimed in Claim 1 in which said drive means comprises an electric motor and said monitoring means is arranged to sense the electrical power drawn by the motor during rotation of the agitator.

3. Apparatus as claimed in Claim 1 or 2 in which monitoring means is operable, in response to abnormal operating conditions, to cause automatic lowering of the agitator irrespective of the noise level detected.

4. Apparatus as claimed in Claim 2 or Claim 3 when appendent to Claim 2 in which said monitoring means includes a current transformer for sensing

changes in the electrical current drawn by the motor.

5. Mixing apparatus substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.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