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(71) Applicants
Klöckner-Humboldt-Deutz Aktiengesellschaft, Deutz-Mülheimer Strasse. 111, 5000 Köln 80, Federal Republic of Germany.
(72) Inventors
Siegfried Heintges, Werner Strauss, Karl-Heinz Weiffen.
(74) Agents
J.F. Williams & Co., 34 Tavistock Street, London WC2E 7PB.

(54) Controlling jigging machines

(57) In a jigging machine, pulsation chambers, to which compressed air is fed to provide a pulsating motion to liquid contained in the chambers, are located underneath a screen for supporting material to be stratified, and have their compressed air supply controlled in dependence on the magnitude of the stroke of the liquid in the pulsation chambers.

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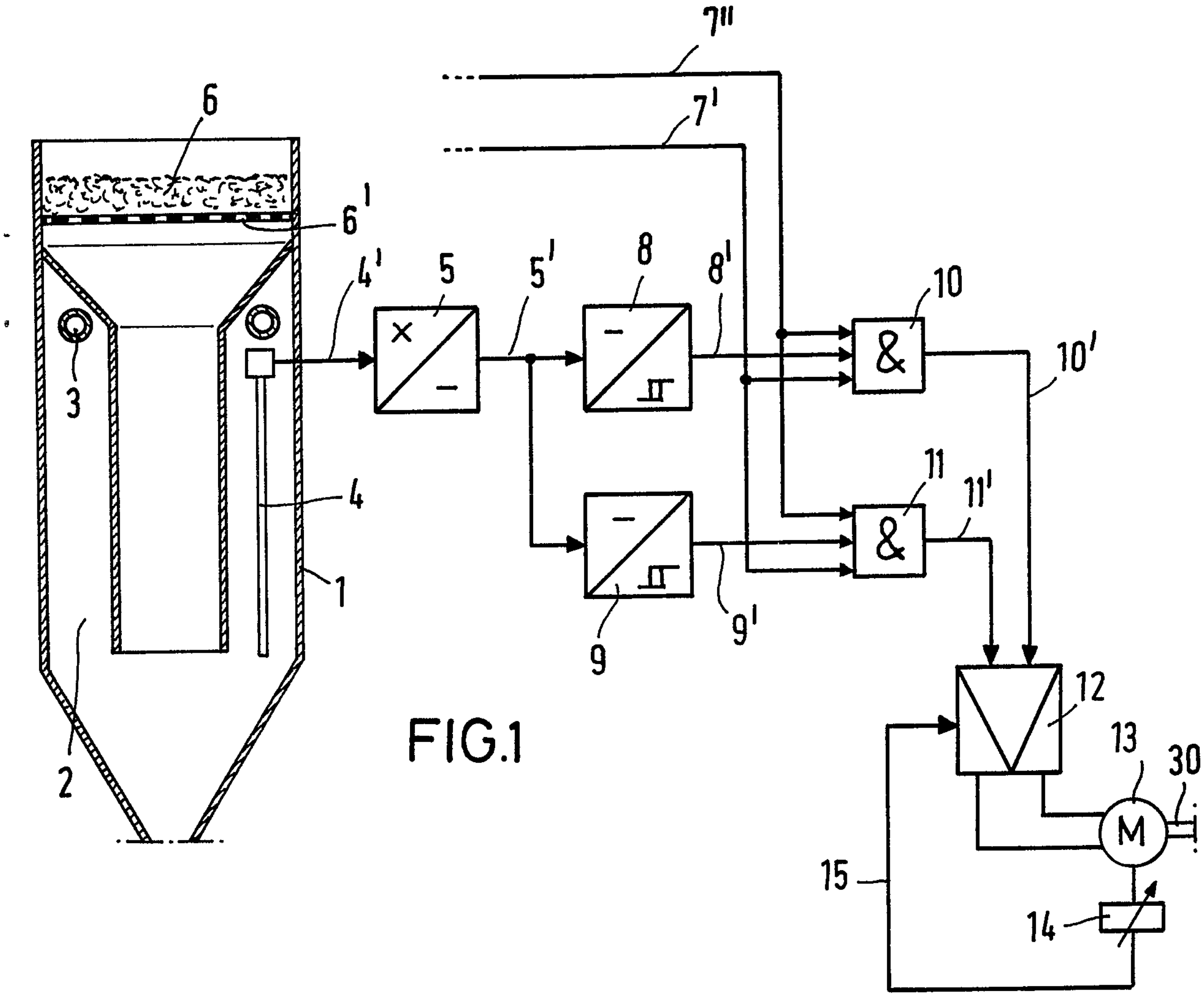

FIG.1

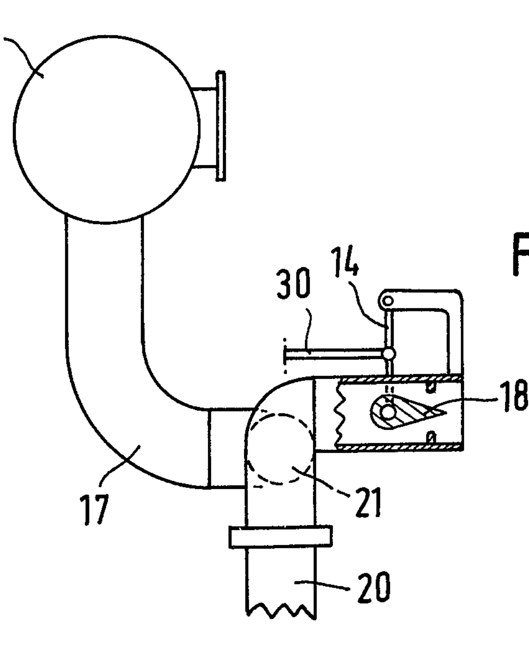

FIG.2

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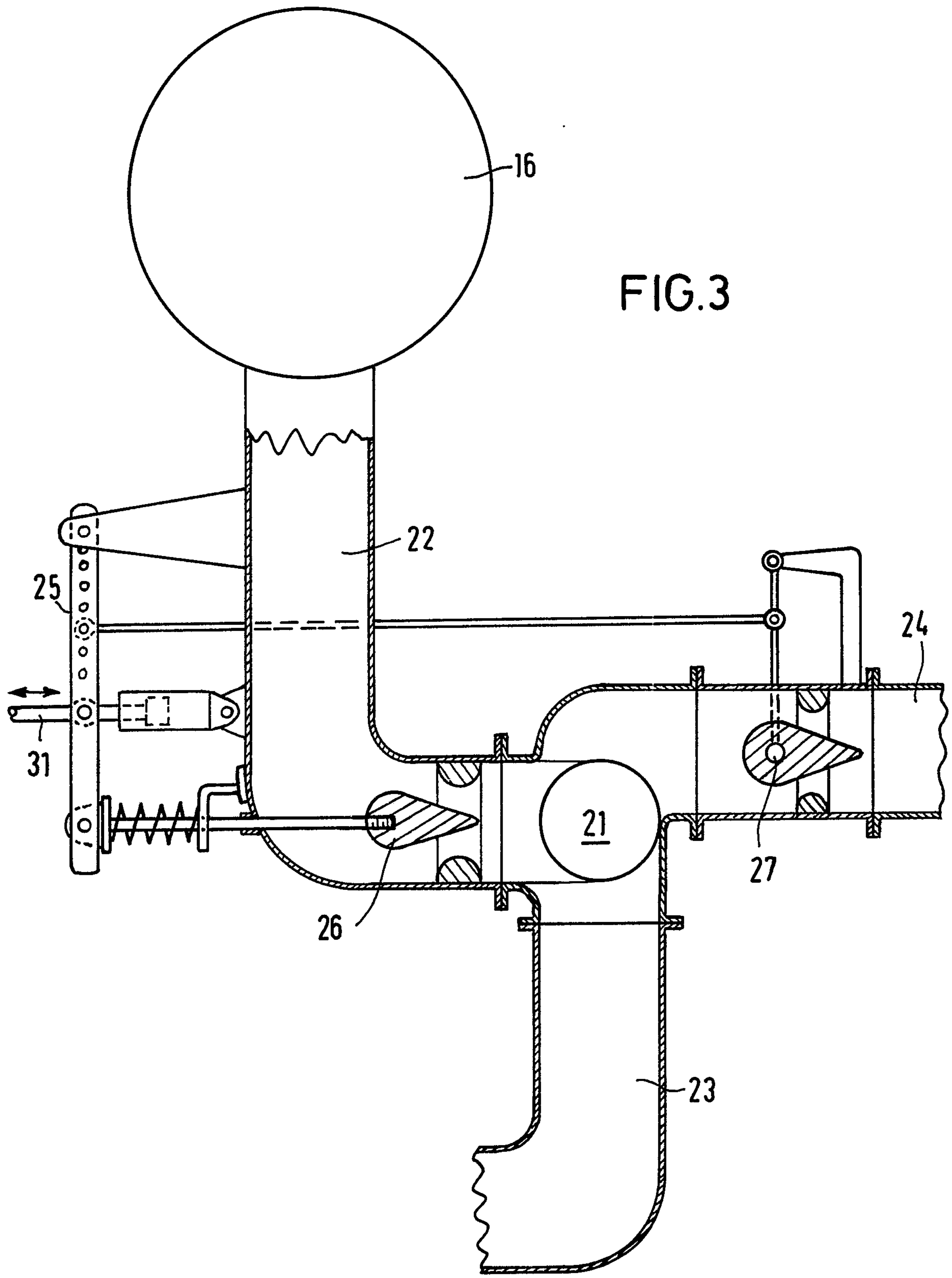

FIG.3

SPECIFICATION

Method of controlling a jigging machine and a jigging machine having suitable control means

The invention relates to a method of controlling a jigging machine, such as a machine controlled by a rotary slide valve, for the purpose of dressing coal or other minerals, one such machine is a throughput jigging machine in which the pulsating chambers acted upon periodically by compressed air in order to produce a pulsating motion, are arranged underneath the jigging screen.

The stroke height in jigging machines for dressing minerals depends, particularly in throughput jigging machines pulsed from below, on the thickness of the layer of material which lies on the jigging screen, if the intensity of energisation is constant. This is because of the damping effect of the minerals.

It is known from German Offenlegungschrift No. 2539374 to measure the layer height of the specifically heavier minerals in a jigging machine by means of a scanning element and to increase the intensity of the pulsating motion of the separating liquid as the layer height increases. This type of control depends heavily on the accuracy of scanning of the layer height of the heavier minerals and therefore is inaccurate. Since for each grain size of the feed material there is an optimum stroke length from which it is inadvisable to deviate if the grain size remains unchanged, there may also be a worsening of the result of dressing in some instances.

The invention seeks to provide a method and device for controlling a jigging machine in which, in contrast, it is possible to maintain the magnitude of the predetermined stroke of the separating liquid with different mineral layer heights on the jigging bed.

According to a first aspect of the invention there is provided a method of controlling a jigging machine in which pulsation chambers, which are acted upon periodically by compressed air in order to produce a pulsating motion, are arranged underneath a jigging screen, wherein the level of operating air pressure in the pulsation chambers is varied independence on changes in the magnitude of the stroke of the separating liquid.

In this way, the stroke length is taken as the control magnitude during the jigging process and it is this magnitude which most effects the result of separation. Moreover, once an optimum operating point has been set it can be safely maintained. The control reacts directly to any changes in the stroke.

The level of the operating air pressure in the pulsating chambers may be varied by controlled throttling of the outflow air. The level of the operating air pressure may be varied particularly simply without the necessity of making other alterations to the jigging machine.

The level of the operating air pressure in the pulsating chambers may be varied by controlled throttling of the inflow and outflow air. An additional throttling of the inflow air may be envisaged if very severe fluctuation in the feed rate of the minerals necessitate large changes in the operating air pressure, in order to maintain the optimum stroke.

The magnitude of the stroke of the separating liquid may be measured continuously preferably electrically by at least one measuring device. By electrical measurement for example, with the aid of a probe, the respective stroke magnitude is determined particularly accurately, which determination is far superior to mechanical scanning in its accuracy. Therefore the magnitude of the stroke of the separating liquid may be held constant within predetermined limit values and the magnitude of the stroke of the separating liquid may be controlled automatically with the aid of an electronic control system. Electronic control systems are very reliable due to the use of MOS components in integrated circuits. At the same time this type of control can be achieved with an accuracy which has not been achieved before and with immediate response.

When seen as a whole, the above method provides for control of a jigging machine which is extremely accurate, responds immediately and has wider range of control.

According to a second aspect of the invention, there is provided jigging machine comprising jigging screen and pulsation chambers arranged underneath the jigging screen and operable by compressed air on liquid therein to produce a pulsating motion wherein sensing means are provided for sensing the magnitude of the stroke of the separating liquid and control means are provided for varying the level of operating air pressure in dependence on the sensed magnitude. Preferably the jigging machine has a throttle valve connected to a control system, in the air outflow air line and/or the air inflow lines. Thus the control method in accordance with the invention may be carried out in an advantageous manner.

The jigging machine may have at least one probe for each pulsation chamber. The probes may measure the pulsating motion in the pulsation chamber at a specially protected region where there is no interference from the sinking material. The pulsation chamber and the jigging chamber may be connected like communicating tubes so that measurement of the pulsating motion in the air chambers, taking account of the respective conversion of the movement of the water due to the different cross sections, gives the pulsating motion on the jigging bed. The accuracy of control may be further increased by arranging the probes in the pulsation chambers, since here the travel of the water is greater than on the jigging bed.

The probes may be connected to an electronic limit value switch system. Thus probe measurement can be used for control without any time delay. A limit value switch system is particularly advantageous since it allows the machine to run within the limits of the optimum pulse range without intervention for the purpose of control and intervention for control would only be necessary in the case of deviations which might affect the result of jigging. Therefore the number of times intervention is necessary is reduced considerably.

The throttle valves may be formed as cone valves, more particularly having a linear curve. As a result, control is made very much simpler. At the same time throttle valves may be used which are particularly insensitive to contamination etc. Furthermore, the throttle valve for the air inflow and the air outflow may be connected together mechanically and so as to be adjustable together. The mechanical valve connection may be so formed that the movement of the air outflow throttle valve comes to a multiple of (that of) the air inflow throttle valve. This simplifies control of the two-valve throttle system considerably.

The invention will now be described in greater detail, by way of example, with reference to the drawings in which:-

Figure 1 is a schematic sectional view through a throughput jigging machine together with a block diagram of an electronic limit value switch system;

Figure 2 shows the arrangement of the cone valve in the outflow air line, and

Figure 3 shows an inflow valve and an outflow valve mechanically coupled together.

In Figure 1 the schematic jigging machine section of a throughput jigging machine is designated 1 and has pulsation chambers 2 and operating air inflow and outflow elements 3. Probes 4, for example capacitively or inductively acting rod type probes, are arranged in the pulsation chambers 2, and their signal 4′ is fed to a transmitter 5.

The jigging screen 6′ is arranged above the pulsation chambers 2 and a layer 6 of feldspar is shown located on the jigging screen 6′, the heavier components of the mineral mixture penetrating downwards through the layer 6 so as to be extracted in a manner (not shown) from the lower part of the jigging section 1. The transmitter 5 produces a signal 5′ which is fed to a limit value switch 8 for providing an upper limit value and to a limit value switch 9 for a lower limit value. The limit value generators 8 and 9 emit signals 8′ and/or 9′ when the present limit value is exceeded by the signal 5′. These signals 8′ and 9′ are fed to the AND elements 10 and 11 together with the signal 7′ which indicates that valve control, for example the rotary slide valve control unit, has started and the signal 7″ which indicates that compressed air is present at the rotary slide valve control unit.

The AND elements 10 and 11 emit a switching signal 10′ and/or 11′ for a motor switch 12, which actuates a servo-motor 13, when the signals 7′, 7″, 8′ are present for the upper limit value and/or the signals 7′, 7″, 9′ are present for the lower limit value. The position of the servo motor 13 with its indicated output shaft 30 is transmitted back to the motor switch 12 via a feed back system 14,15. The output shaft 30 of the motor 13 - an electromagnetic linear servo system may be used just as easily instead of the motor 13 - actuates the outlet throttle valve shown in greater detail in Figure 2. The motor 13 may be replaced by an electromagnetic linear servo system.

In Figure 2, 16 is an expansion chamber storing operating air, 17 is a line from the expansion chamber to a rotary slide valve 21 and 20 is an operating air line from the rotary slide valve 21 to the pulsation chamber (not shown here). In the outlet line of the rotary slide valve 21, an adjustable throttle valve 18 is arranged, preferably a cone valve, which is actuated via a servo device and the adjustable motor shaft 30, which is shown schematically, for example the output shaft of the drive motor 13 shown in Figure 1.

In Figure 3,16 is also the expansion chamber 21, the rotary slide valve. Cone valves 26 and 27 respectively are incorporated into the inflow line 22 and into the outflow line 24. The two valves are preferably connected by means of a mechanical servo system 25 which can be set as regards its transmission of movement and is provided with resonance dampers etc. The servo system 25 is actuated via the servo arm 31. The double-valve embodiment is particularly suitable for jigging machines with large fluctuations in the feed of the jigging material.

The control in accordance with the invention which is described above has been specially developed for fine coal jigging machines; however, without departing from the scope of the invention, it can be used for all throughput (durchsatz) jigging machines and also for output (austrag) jigging machines. The optimum jigging stroke is always maintained even with fluctuating feed quantities. Control is not affected by the kind of mineral which is to be separated or by the type of output.

CLAIMS

1. A method of controlling a jigging machine, in which pulsation chambers which are acted upon periodically by compressed air in order to produce a pulsating motion, are arranged underneath a jigging screen, wherein the level of operating air pressure in the pulsation chambers is varied in dependence on changes in the magnitude of the stroke of the separating liquid.

2. A method according to claim 1, wherein the level of operating air pressure in the pulsating chambers is varied by a controlled throttling of exhaust air.

3. A method according to claim 1 or 2, wherein the level of operating air pressure in the pulsating chambers is varied by controlled throttling of the inflow and outflow air.

4. A method according to claim 1,2 or 3 wherein the magnitude of the stroke of the separating liquid is measured continuously by at least one measuring device.

5. A method according to claim 4, wherein the measurement is carried out electrically.

6. A method according to anyone of claims 1 to 5, wherin the magnitude of the stroke of the separating liquid is held constant within predetermined limit values.

7. A method according to any one of the preceding claims, wherein the magnitude of the stroke of the separating liquid is adjusted and/or held constant automatically with the aid of an electronic control system.

8. A jigging machine comprising a jigging screen and pulsation chambers arranged underneath the jigging screen and operable by compressed air on

liquid therein to produce a pulsating motion wherein sensing means are provided for sensing the magnitude of the stroke of the separating liquid and control means are provided for varying the level of operating air pressure in dependence on the sensed magnitude.

9. A jigging machine according to claim 8, wherein the jigging machine has a throttle valve connected to a control system in the compressed air outflow line and/or compressed air inflow line.

10. A jigging machine according to claim 8 or 9, wherein at least one sensing probe is provided for each pulsation chamber.

11. A jigging machine according to claim 10, wherein the probes are connected to an electronic limit value switch system.

12. A jigging machine according to any one of claim 8 to 11, wherein the throttle valves are constructed as cone valves.

13. A jigging machine according to claim 12, wherein the cone valves have a linear curve.

14. A jigging machine according to any one of claims 8 to 13, wherein the throttle valve for the air inflow and for the air outflow are connected together mechanically and so as to be adjustable together.

15. A method of controlling a jigging machine substantially as described herein with reference to the drawings.

16. A jigging machine substantially as described herein with reference to the drawings.

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