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DRIVE ARRANGEMENT FOR DRIVING A ROTATABLE MEMBER IN SHORT INTERVALS AT HIGH AND LOW SPEEDS

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The present invention relates to a driving arrangement for driving a rotatable member at high and low speed. The arrangement according to the present invention may, for instance be applied to centrifugal driers having a basket which is suspended on a vertical shaft and is driven by a motor.

In driers of this type, the carrying out of the working cycle (charging, drying and discharging) in a short period of time imposes conditions as to speeds and driving torques which are difficult to overcome or which are expensive to carry out by electrical means.

In fact, the basket has to be charged and discharged at a reduced rotational speed but with a considerable driving torque, whilst the operations of bringing the basket to operational speed and braking the said basket should be carried out rapidly.

The currently known means for enabling these conditions to be fulfilled more or less completely (multi-pole motors, Ward-Leonard control) are expensive and cannot be adapted to the equipment now actually in service. The present invention has as its object more particularly to overcome these disadvantages and consists in adding to the usual motor a supplementary device whose power can be added to that of the normal motor.

Preferably, this supplementary motor can also be used for braking the basket.

More particularly there will be used a hydraulic device which is adapted to work either as a motor or as a pump, according to the needs of the user.

A coupling device will be provided between the usual motor and the supplementary device.

In the machine which is illustrated diagrammatically in the accompanying drawing by way of example, the basket 1 containing the material to be dried, is suspended on the end of a substantially vertical shaft 2 and is arranged inside a tank 3. A scraper 4 is mounted on the rod 5a of a jack 5 which is movable in a cylinder 5b. A spring 5c tends to lift the jack 5, whilst a hydraulic control arrangement (not shown) is provided for moving the jack downwards. The cylinder 5b is carried by a cross-member 8 which comprises a bearing 8a for the shaft 2 and which is prevented from rotating about the said shaft 2 by a stud 3a carried by the tank 3. This cross-member 8 also carries a control device 9 for lifting the cone 1a when it is desired to empty the basket 1. The cross-member 8, its connections with the cone 1a and the shaft 2 and its retention in position by the stud 3a have been described in detail in the French patent specification filed in the name of the present applicants on January 30, 1957, and entitled "Drier of the Suspended Type."

The material to be dried is stored in a supply container 10, and is brought to a distributor 12 by a volumetric pump 11, for example as described in the French patent application filed on June 5, 1957, in the name of the present applicants and under the title "Method of and Apparatus for Charging Driers of the Suspended Type."

A brake 13 controlled by any appropriate automatic or non-automatic means, makes it possible to slow down

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the rotational movement of the shaft 2 if necessary. The said shaft is fast in a manner known per se with a hemispherical member 15 which bears on a dish member 15a fast with the frame of the machine, thus enabling the said shaft to oscillate about the centre of the said hemispherical member 15.

Fixed on the upper end of the said shaft 2 is a dish member 17a which is driven through the intermediary of a driving member 17b by the shaft 20a of an electric motor 20.

According to the present invention, the rotor of a pump-motor unit 22 is fixed on the shaft 20a. By means of a coupling device 21, the rotor of the pump-motor unit 22 can be coupled or uncoupled from the electric motor 20. The admission and outlet conduits of the pump-motor unit 22 can be connected respectively by means of a distributor of known type 23, either to an accumulator 26 and to a tank 25, in the case where the unit 22 operates as a motor, or to the tank 25 and the accumulator 26 in the case where the unit 22 operates as a pump.

The method of operation is as follows:

Starting.—The accumulator 26 and the tank 25 are connected respectively to the admission conduit and outlet conduit of the unit 22. The latter then operates as a motor. The electric motor 20 is stopped. The unit 22 then actuates the shaft 16 and, through the coupling means 17, drives the shaft 2 at a slow speed. The basket 1 rotates at a slow speed. The basket 1 is then charged by starting up the pump 11.

Normal operation.—At the end of the charging operation, the electric motor 20 is started up. The two motors 20 and 22 simultaneously drive the basket 1 and add their respective power to one another. The basket 1 gradually reaches its operational speed.

When the operational speed is reached, the coupling 21 is disengaged; the unit 22 is then rendered inoperative and the basket 1 continues to be driven at operational speed by the electric motor 20 only.

Discharging.—When it is desired to slow down the rotational movement of the basket 1, for example in order to discharge the said basket, the electric motor 20 is stopped, the coupling 21 is engaged and the admission and outlet conduits of the unit 22 are connected respectively to the tank 25 and the accumulator 26. The unit 22 operates as a pump and slows down the rotation of the basket 1.

When the rotational speed of the basket has slowed down sufficiently, after a short mechanical braking action if necessary, the unit 22 is re-started as a motor at a slow speed, so as to drive the basket 1 in rotational movement at a reduced speed and with a high torque. Discharging is then effected by lifting the cone 1a and starting up the scraper 4. Thus:

(a) The basket 1 is charged and discharged at a reduced speed, but with a considerable torque.

(b) The basket 1 is brought to operational speed and is braked rapidly.

These advantages, on which economic operation of the drier depends, are afforded with apparatus which is much less expensive than that at present used.

In the case of the apparatus described and illustrated, the pump-motor unit 22 is preferably of the volumetric hydraulic type, which permits:

(a) Easy adjustment of the speeds and torques to all rates of working.

(b) The recovery of the braking energy in an accumulator, with an excellent efficiency even at low speeds.

(c) The user has at his disposal an auxiliary energy source under the form of hydraulic means, which is particularly handy for controlling associated installations (operations of charging and discharging, restarting of the

drier up to a speed sufficient to enable the motor 20 to start without any starting resistance).

Moreover, the device according to the present invention can easily be mounted on an already existing apparatus.

We claim:

1. A driving arrangement for rotating a rotatable member at high and at low speed comprising, in combination, driving means for rotating said rotatable member during high speed operation and inoperative during low speed operation; a hydraulic pump-motor unit having an inlet and an outlet, and being connectible to said rotatable member for driving or retarding rotation thereof; a hydraulic accumulator; a hydraulic fluid supply; means for selectively connecting said accumulator to said inlet and said fluid supply to said outlet of said hydraulic pump-motor unit and vice versa, whereby upon discontinuing operation of said driving means said accumulator may be connected to the outlet and said fluid supply to the inlet of said hydraulic pump-motor unit so as to cause charging of said accumulator and consequent retarding of rotation of said rotatable member, and said accumulator when charged may be connected to the inlet and said fluid supply to the outlet of said hydraulic pump-motor unit so as to cause driving of said rotatable member by said hydraulic pump-motor unit while said accumulator is discharged and coupling means for connecting and disconnecting said hydraulic pump-motor unit to and from said rotatable member.

2. A driving arrangement for a rotatable member which has to be started and stopped in short intervals and which has to be operated at high and at low speed comprising, in combination, a shaft on which the rotatable member is mounted to be rotated thereby; driving means operatively connected to said shaft for driving the same during high speed operation and inoperative during low speed operation; a hydraulic pump-motor unit having an inlet and outlet; a hydraulic accumulator; a hydraulic fluid supply; means for selectively connecting said accumulator to said inlet and said fluid supply to said outlet of said hydraulic pump-motor unit and vice versa, whereby said accumulator may be connected to said inlet and said fluid supply to said outlet so that the shaft may be driven at slow speed by said pump-motor unit when operation of said drive means is discontinued or at high speed when said drive means is operated, and upon discontinuing of operation of said drive means said accumulator may be connected to said outlet and said fluid supply to said inlet of said hydraulic pump-motor unit so as to cause charging of said accumulator and retarding of rotation of said shaft while said hydraulic pump-motor unit is driven only by the inertia of the rotating elements of the arrangement; and coupling means for disconnecting said

hydraulic pump-motor unit from said shaft so as to drive the latter only by said driving means and for connecting said hydraulic pump-motor unit to said shaft for driving said shaft by said pump-motor unit when said accumulator means is connected to said inlet of the latter and for driving said pump-motor unit by said shaft when said outlet is connected to said accumulator.

3. A driving arrangement for a rotatable member which has to be started and stopped in short intervals and which has to be operated at high and at low speed comprising, in combination, a vertical shaft on which the rotatable member is suspended to be rotated thereby; an electric motor having a rotor concentrically arranged with and operatively connected to said shaft for driving the same during high speed operation and inoperative during low speed operation; a hydraulic pump-motor unit arranged concentrically with said shaft above said electric motor and having an inlet and outlet; a hydraulic accumulator; a hydraulic fluid supply; means for selectively connecting said accumulator to said inlet and said fluid supply to said outlet of said hydraulic pump-motor unit and vice versa, whereby said accumulator may be connected to said inlet and said fluid supply to said outlet so that the shaft may be driven at slow speed by said pump-motor unit when operation of said electric motor is discontinued or at high speed when said electric motor is operated, and upon discontinuing of operation of said electric motor said accumulator may be connected to said outlet and said fluid supply to said inlet of said hydraulic pump-motor unit so as to cause charging of said accumulator and retarding of rotation of said shaft while said hydraulic pump-motor unit is driven only by the inertia of the rotating elements of the arrangement; and coupling means located between said electric motor and said hydraulic pump-motor unit for disconnecting said hydraulic pump-motor unit from said shaft so as to drive the latter only by said electric motor and for connecting said hydraulic pump-motor unit to said shaft for driving said shaft by said pump-motor unit when said accumulator means is connected to said inlet of the latter and for driving said pump-motor unit by said shaft when said outlet is connected to said accumulator.

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