Aug. 19, 1969 W. E. WAYE 3,462,670

CENTRIFUGE AND MEANS TO PREVENT OVERDRIVING ITS ROTOR

Filed June 6, 1966

Fig. 1.

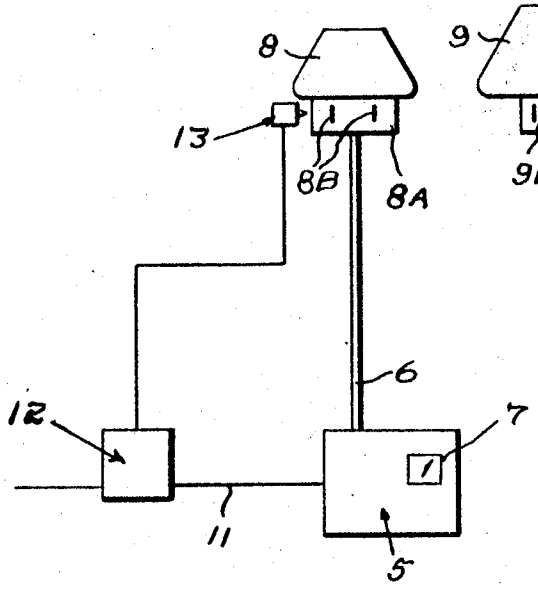


Fig. 2.

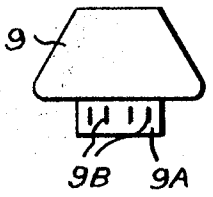
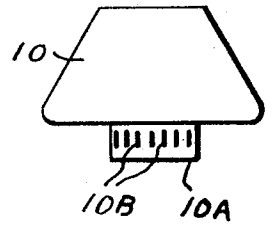


Fig. 3.



Inventor:
William E. Waye,
by Abbott Spear.
Attorney

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CENTRIFUGE AND MEANS TO PREVENT OVERDRIVING ITS ROTOR

William E. Waye, Needham Heights, Mass., assignor to International Equipment Company, Needham Heights, Mass., a corporation of Massachusetts

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ABSTRACT OF THE DISCLOSURE

A centrifuge having a family of rotors that may be used therewith but with each having a predetermined spaced limitation different than the other, the centrifuge having a pulse generator operating a control and the rotor having magnetic portions coacting therewith to effect the generation of pulses, the number of the magnetic portions differing with each rotor of the family and establishing the functioning of the pulse generator to actuate the control whenever the predetermined speed of that rotor is attained.

The present invention relates to centrifuges provided with means to prevent any of the rotors to be used therewith from being rotated at speeds above its rated speed.

Since no rotor may be driven above its rated speed without the danger of bursting, the problem exists, with all high speed centrifuges having speed regulating means, that it is possible to run a rotor above its rated speed as by the wrong setting of the speed regulating means or the malfunctioning thereof.

This problem has been recognized for some time and one approach towards its solution has been to equip each rotor, for use with a particular centrifuge, with a pin that is actuated centrifugally at the rated speed to rupture a control wire in the guard bowl of that centrifuge.

Another approach has been to mount a limit switch within the guard bowl that must be moved into a predetermined position, one for each rotor and corresponding to its size, and preventing the installation of a rotor at a switch position that would result in speed above the rated speed of that rotor.

The general objective of the present invention is to provide an overspeed centrifuge control, an objective that is attained with a centrifuge having an overspeed monitor operable in response to a predetermined frequency which is generated by any one of the different sized rotors for use with that centrifuge at its rated speed.

While the overspeed monitors control of the centrifuge may be that of regulating its speed thereby to automatically limit the speed of its drive to the rated speed of the particular rotor in service, it is preferred that the overspeed monitor be used to discontinue the centrifuge drive should the safe operating speed be exceeded.

In the accompanying drawings, a centrifuge and the series or family of rotors to be used therewith are schematically shown to illustrate the objectives, novel features, and advantages of the invention.

In the drawings:

FIG. 1 is a schematic view of a centrifuge in accordance with the invention with one rotor of the family of rotors that may be used therewith, and

FIGS. 2 and 3 are like views of other rotors of that family.

As illustrative of any high speed centrifuge a drive is generally indicated at **5** and is a drive of the type provided with a control by which the speed of its rotatable support or spindle **6** can be manually regulated as by the appropriate setting of the speed selector **7**. Any one of a series of rotors **8**, **9**, and **10** may be mounted on the spindle **6** in any manner, the rotors are shown as different in size and each has it own rated speed. As the centrifuge and its series of rotors, as thus far described, may be conventional, they are not herein detailed.

In accordance with the invention, the circuit **11** to the motor of the centrifuge drive **5** is under the control of an overspeed monitor generally indicated at **12** and not herein detailed since it may be of any commercially available type such as that manufactured by Airpax Electronics, Inc., Fort Lauderdale, Fla., and as shown in its Bulletin F–11–4 having a frequency-to-D.C. converter.

Pulses are delivered to the overspeed monitor **12** from a generally indicated pulse generator including a pickup **13** mounted adjacent the spindle **6**. Each of the rotors 8, 9, and 10 has a member designated by the suffix addition A to the reference numeral by which that rotor is identified. Each such rotor member has a series of arcuately spaced magnetic portions designated by the suffix addition B to the appropriate rotor-designating reference numeral and the member of each rotor is positioned so that when that rotor is mounted on the centrifuge spindle **6**, the path of the magnetic portions is concentric therewith, the position of the pickup **13** being such that pulses are then generated when the centrifuge drive is in operation. As such pulse generations are conventional, the pulse generator will not be otherwise detailed but it may be of the type manufactured by Electro Products Laboratories.

It will be noted that the number of magnetic portions decreases with the increase in the speed ratings of the rotors and each, in use, results in the same frequency being generated but at a safe speed for that rotor because of the number of magnetic portions which its member is provided and which determine the number of pulses generated per rotation. By way of example, the rotor **8** may be assumed to be capable of being safely driven at 60,000 r.p.m., the rotor **9** at 30,000 r.p.m., and the rotor **10** at 15,000 r.p.m. In order that the pickup will deliver the same predetermined, monitor-operating frequency when each of the rotors **8**, **9**, or **10** is in service at its rated speed, the number of magnetic portions is determined by the formula $NP=60x/M$ wherein NP is the number of pulses per revolution, x is the predetermined frequency to be generated in cycles per second, and M is the rated rotor speed in revolutions per minute. When the predetermined frequency is to be 6,000 cycles per second, it will be seen that the rotor **8** must generate six pulses per revolution; the rotor **9**, twelve pulses per revolution; and the rotor **10**, twenty-four pulses per revolution.

A frequency of 6,000 cycles per second has been selected for purposes of illustration only and any suitable frequency that will protect the family of rated speeds is used in practice.

In the operation of the centrifuge in accordance with the invention with any of the rotors for use therewith, the overspeed monitor **12** becomes operative, if the maximum safe speed of the rotor in use is exceeded, to open the motor circuit **11** until the reason for the overspeed is determined and corrected.

I claim:

1. In a centrifuge, a drive including an electric motor, a rotatable motor support, and a motor circuit, a series of rotors, each adapted to be detachably mounted on said support, each rotor having a predetermined speed at which it can be safely rotated and which is less than the maximum speed of the drive and different from that of the others, and means to limit the speed of the support to the safe maximum speed of the particular rotor on said support, said means comprising an overspeed monitor in control of said drive in response to a predetermined frequency, and means including a pulse generator having a pickup adjacent the rotor suport and members, one for each rotor and concentrically secured thereto and pro-

vided with arcuately spaced, magnetic portions, the position of said pickup relative to the path of said portions of a rotor on said support being such that pulses are generated on each revolution of that rotor, one pulse for each portion, the number of portions of each head member increasing with a decrease in the rated speed of each rotor to effect the generation of the same frequency during the use of each rotor at approximately its maximum rated speed.

2. The centrifuge of claim 1 in which the number of portions of each head member is determined by the formula $NP=60x/M$ wherein NP is the number of pulses per rotor revolution, x is the predetermined frequency in cycles per second, and M is the maximum safe speed for which a rotor is rated in revolutions per minute.

3. The centrifuge of claim 1 in which the motor circuit includes a normally closed switch and the control exercised by the monitor is the opening of that switch in

response to the generations of said predetermined frequency.

4. The centrifuge of claim 1 in which the frequency is that which will protect each of the family of rotors at its rated speed.

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ORIS L. RADER, Primary Examiner

L. L. HEWITT, Assistant Examiner

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