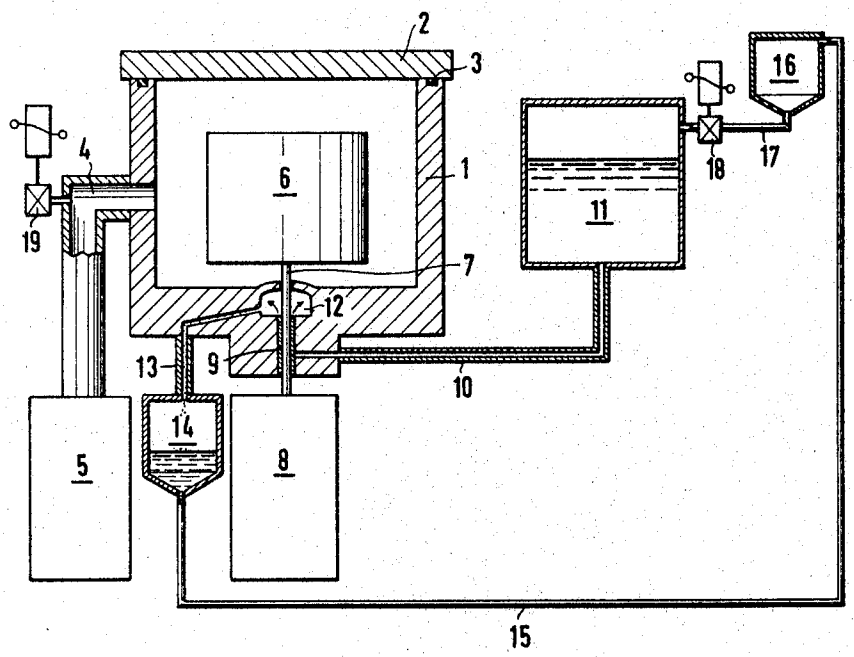
June 27, 1967 H. STALLMANN 3,327,938

VACUUM CENTRIFUGE

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Fig.1



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Fig. 2

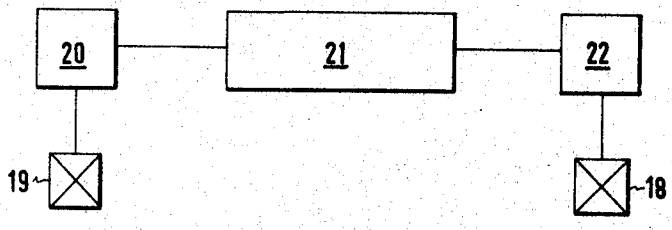
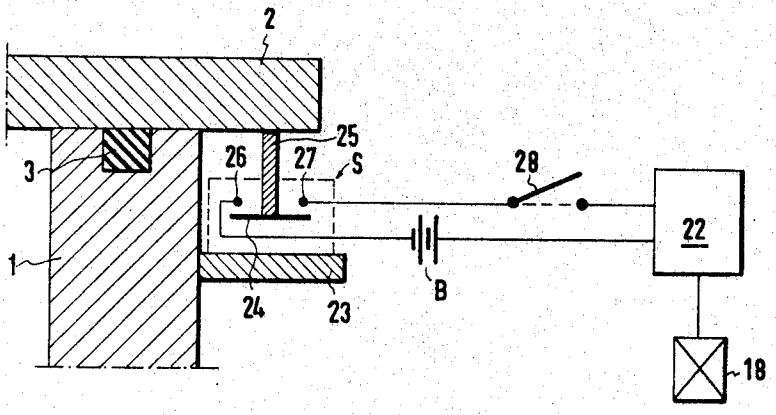


Fig. 3



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United States Patent Office 3,327,938
Patented June 27, 1967

3,327,938

VACUUM CENTRIFUGE

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Filed June 3, 1965, Ser. No. 461,043
Claims priority, application Germany, June 10, 1964, C 33,097
3 Claims. (Cl. 233—1)

The present invention relates to centrifuges and, more in particular, the invention concerns a vacuum centrifuge for very high numbers of revolutions, in particular, an ultra centrifuge. The rotor of such an ultra centrifuge is arranged to operate in a vacuum chamber in order to reduce atmospheric or air friction.

In order that the vacuum in the chamber may be maintained it is necessary to seal the passage for the rotor shaft between the shaft and the wall of the chamber. A vacuum centrifuge is known where the shaft which extends through the housing of the vacuum chamber is journalled in a bearing sleeve which is amply supplied with oil so that the oil between the shaft and the bore acts as a seal. However, the vacuum in the chamber continuously draws oil out of the sealed passage so that a constant loss of oil results.

While care is taken generally that the oil can be replenished from a supply container provided therefor, and that in the event of lack of oil in the container the centrifuge is automatically stopped, there is the awkward disadvantage for the operator that the supply container must be observed continuously and replenished. In addition, a sufficient supply of oil must be held in store, as the oil which leaves the bearing cannot normally be reused due to the impurities it may contain.

In accordance with the invention this problem is solved in that in a centrifuge having a rotor running in a vacuum the leakage oil is automatically returned to the bearing oil container.

Further advantages and details of the invention will become apparent from the following description of an embodiment of a vacuum centrifuge incorporating the invention as illustrated in the drawing, in which

FIG. 1 illustrates an embodiment of the invention,

FIG. 2 is a block diagram of a circuit for delaying the operation of the magnetic control valve, and

FIG. 3 shows a switching arrangement for operating the control valve circuit.

The rotor housing **1** is closed with a cover **2** and sealed with a vacuum seal **3**. The housing is evacuated by the pump unit **5** by way of conduit **4**. The pressure in the housing **1** is reduced to about 10^{-4} mm. Hg in order to reach a velocity of 60,000 r.p.m. A driving means or assembly **8** such as a motor drives the rotor **6** by way of its shaft **7**. The bearing sleeve **9** is supplied with oil through conduit **10** from a supply tank **11**. This tank **11** is disposed at a somewhat higher level than the bearing sleeve **9**, so that the oil may flow to the bearing under gravitational force. An oil passage space in the form of an annular chamber **12** is provided above the bearing sleeve **9** through which the rotor shaft **7** extends. A conduit **13** connects the annular chamber **12** with the sump **14**. A conduit **15** of relatively small cross-section leads from the bottom of sump **14** to a container **16** which, in turn, is disposed somewhat higher than the supply tank **11**.

The bottom of container **16** is connected with tank **11** by way of a tubular conduit **17** which is provided with a magnetic valve **18**. During operation of the centrifuge the magnetic valve **18** is closed so that the conduit **13**, sump **14**, conduit **15** and container **16** are below

normal pressure or in a vacuum. The leakage oil leaving the annular chamber **12** flows into the sump **14** by way of conduit **13** and partly also into the conduit **15**.

When the vacuum pump **5** is shut off at the end of a centrifuging operation and the housing **1** is supplied with air through the valve **19**, the incoming air forces the oil collected in the sump through the conduit **15** into container **16**, which is still in an evacuated condition as a result of the preceding centrifuging operation. The sump **14** is emptied of oil which flows into the container **16** and is thus prepared for receiving further leakage oil during the next operation. The valve **18** provided in the conduit **17** opens after a short time delay and permits the oil accumulated in the container **16** to flow into the supply tank **11**. The delayed opening of the valve **18** can be achieved in a known manner by a delaying element connected after the valve **19** or by a different necessary operation of the apparatus, for example, in response to the opening of the cover **2** of the apparatus. Evidently a centrifuge constructed in accordance with the invention no longer requires the cumbersome operation of manually replenishing the oil.

FIG. 2 is a block circuit diagram of a circuit by means of which the operation of the magnetic valve **18** is delayed after valve **19** has opened. The valve **19** or its electromagnet is actuated by way of a switch **20**. As the valve **19** is actuated a delaying circuit, for example, a time delay relay or the like, is operated which after expiration of a predetermined time period actuates the opening switch **22** for the valve **18** or its electromagnet.

FIG. 3 illustrates the manner in which a switch is provided at the wall of the rotor housing **1** and on the cover **2**. As shown the cover **2** extends outwardly over the upper border of the wall of the rotor housing. A support **23** is provided on the wall of the chamber upon which a switch S is mounted, as indicated in dotted lines. This switch includes two stationary contacts **26** and **27** which are engaged by a yoke **24** when the cover **2** is raised permitting the operating member **25** which is schematically illustrated to raise the yoke **24** under the pressure of a spring (not illustrated). A battery B is connected in series with the contacts **26** and **27** and with the circuit element **22**. This element actuates the electromagnet of the valve **18**. Furthermore, in series with the battery and the two contacts **26** and **27** a single blade switch **28** is connected which is closed as the centrifuge is operative, as indicated in dotted lines, and which is opened when the centrifuge is not in operation, so that when the cover **2** is removed, the battery may be disconnected from the circuit.

The oil return system in accordance with the invention can be incorporated in an analogous manner in centrifuges where the rotor is suspended, i.e., in an arrangement in which the drive assembly such as a motor is disposed above the housing. In that event a centrifuging disk would be mounted on the shaft of the centrifuge which feeds the leakage oil into an annular chamber analogous to chamber **12** and thence to a container that corresponds to container **14** of the illustrated embodiment.

Having now described my invention with reference to the embodiment illustrated in the drawing, I do not wish to be limited thereto, but what I desire to protect by Letters Patent of the United States is set forth in the appended claims.

I claim:

1. A centrifuge comprising a housing including closure means therefor, driving means disposed externally of said housing, a rotor disposed in said housing and having a shaft extending to said driving means, a bearing sleeve disposed around said shaft intermediate said rotor

and said driving means, evacuating means such as a pump connected to said housing for creating a vacuum, an oil supply tank connected to supply lubricant to said bearing sleeve and said shaft, and means associated with said bearing sleeve operative to collect leakage oil and to return the oil automatically to said supply tank, said means including an oil passage space around said shaft, a sump disposed externally of said housing, a conduit connecting said passage space to said sump, a container for oil disposed at a level above said supply tank and a conduit connecting said sump to said container, a tubular conduit connecting said container with said supply tank, and a magnetic valve connected in said tubular conduit operative to control the flow of oil from said container to said supply tank.

2. A centrifuge comprising a housing including closure means therefor, driving means disposed externally of said housing, a rotor disposed in said housing and having a shaft extending to said driving means, a bearing sleeve disposed around said shaft intermediate said rotor and said driving means, evacuating means such as a pump connected to said housing for creating a vacuum, an oil supply tank connected to supply lubricant to said bearing sleeve and said shaft, and means associated with said bearing sleeve operative to collect leakage oil and to return the oil automatically to said supply tank, said means including an oil passage space around said shaft, a sump disposed externally of said housing, a conduit connecting said passage space to said sump, a container for oil disposed at a level above said supply tank and a conduit connecting said sump to said container, a tubular conduit connecting said container with said supply tank, a magnetic valve connected in said tubular conduit operative to control the flow of oil from said container to said supply tank, and valve means associated with said pump and connected to said housing operative to admit air to said housing upon discontinuance of the operation of said pump and means adapted to delay the operation of said magnetic valve until after operation of said valve means.

3. A centrifuge comprising a housing including closure means therefor, driving means disposed externally of said housing, a rotor disposed in said housing and having a shaft extending to said driving means, a bearing sleeve disposed around said shaft intermediate said rotor and said driving means, evacuating means such as a pump connected to said housing for creating a vacuum, an oil supply tank connected to supply lubricant to said bearing sleeve and said shaft, and means associated with said bearing sleeve operative to collect leakage oil and to return the oil automatically to said supply tank, said means including an oil passage space around said shaft, a sump disposed externally of said housing, a conduit connecting said passage space to said sump, a container for oil disposed at a level above said supply tank and a conduit connecting said sump to said container, a tubular conduit connecting said container with said supply tank, a magnetic valve connected in said tubular conduit operative to control the flow of oil from said container to said supply tank, and means including a switch associated with the cover of said housing and connected to said magnetic valve operative to open said magnetic valve upon removal of said cover.

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M. CARY NELSON, *Primary Examiner.*